Conference Program - CASCA 2025
Saint Mary's University, Halifax

Website: www.ap.smu.ca/~casca2025/
For questions or corrections, email casca2025@smu.ca

Thanks to our sponsors

Contents

LOC

- Rob Thacker (chair)
- Margaret Buhariwalla
- Ivana Damjanov
- Nolan Dickson
- Tiffany Fields
- Luigi Gallo
- Vincent Hénault-Brunet
- Shannon Rhode
- Marcin Sawicki
- Ian Short
- Fraser Smith

SOC

- Ivana Damjanov & Vincent Hénault-Brunet (co-chairs; Saint Mary's University
- Emily Deibert (Gemini)
- Marie-Lou Gendron-Marsolais (Université Laval)
- Adrian Liu (McGill University)
- Deborah Lokhorst (NRC-Herzberg)
- Catherine Lovekin (Mount Allison University)
- Greg Sivakoff (University of Alberta)
- Tyrone Woods (University of Manitoba)

Land Acknowledgement

We acknowledge that the land on which Saint Mary's University operates is in Mi'kma'ki, the ancestral and unceded territory of the L'nu'k. This place is still the home to many Indigenous people and we are grateful to have the opportunity to meet and work on this land.

Code of Conduct [EN]

The organizers are committed to making this meeting productive and enjoyable for everyone, regardless of gender, sexual orientation, disability, physical appearance, body size, race, nationality or religion. We will not tolerate harassment of participants in any form. Please follow these guidelines:

- **Behave professionally:** Harassment and sexist, racist, or exclusionary comments or jokes are not appropriate. Harassment includes sustained disruption of talks or other events, inappropriate physical contact, sexual attention or innuendo, deliberate intimidation, stalking, and photography or recording of an individual without consent. It also includes offensive comments related to gender, sexual orientation, disability, physical appearance, body size, race or religion.
- **All communication** should be appropriate for a professional audience including people of many different backgrounds. Sexual language and imagery is not appropriate.
- **Be kind to others.** Do not insult or put down other attendees.

Participants who are asked to stop any inappropriate behaviour are expected to comply immediately. Attendees violating these rules may be asked to leave the event at the sole discretion of the organizers without refund of any fees.
Any participant who wishes to report a violation of this policy is asked to speak, in confidence, to

- LOC Chair Rob Thacker
- A member of the Equity and Inclusivity Committee (EIC)
- A member of the Board

Protocol

- The designated CASCA contact will request a written record of the complaint including time, date, and particulars. The participant reporting the violation of the policy will review and approve the report before it is filed. They will remain anonymous to the invididual(s) indicated to have violated the code in the report.
- The designated CASCA contact will bring the incident to the attention of the LOC and the CASCA Board.
- The designated CASCA contact will inform the individual(s) indicated to have violated the code of conduct of the allegation and ascertain and record their version of events.

Acknowledgement

This code of conduct is based on the "London Code of Conduct", as originally designed for the conference "Accurate Astrophysics. Correct Cosmology", held in London in July 2015. The London Code of Conduct was adapted with permission by Andrew Pontzen and Hiranya Peiris from a document by Software Carpentry](http://software-carpentry.org/conduct.html), which itself derives from original Creative Commons documents by PyCon and Geek Feminism. It is released under a CC-Zero licence for reuse. To help track people's improvements and best practice, please retain this acknowledgement, and log your re-use or modification of this policy at https://github.com/apontzen/london_cc.

Code de Conduite [FR]

Les organisateurs s'engagent à rendre cette réunion productive et agréable pour tous, quel que soit le genre, l'orientation sexuelle, les handicaps, l'apparence physique, la race, la nationalité ou la religion. Nous ne tolérerons aucun harcèlement des participants sous quelque forme que ce soit. Veuillez suivre ces directives:

- **Comportez-vous de manière professionnelle:** Le harcèlement, les commentaires ou blagues sexistes, racistes ou suggérant l'exclusion ne sont pas appropriés. Le harcèlement comprend la perturbation prolongée des discussions ou d'autres événements, les contacts physiques inappropriés, les attentions ou insinuations sexuelles, l'intimidation délibérée, le harcèlement criminel et la photographie ou l'enregistrement d'une personne sans son consentement. Cela inclut également les commentaires offensants liés au genre, à l'orientation sexuelle, au handicap, à l'apparence physique, à la race ou à la religion.
- **Toutes les communications** doivent être adaptées à un public professionnel comprenant des personnes d'horizons variés. Le langage et les images à caractère sexuel ne sont pas appropriés.
- **Soyez gentil avec les autres.** N'insultez pas et ne rabaissez pas les autres participants.

Les participants invités à cesser tout comportement inapproprié sont tenus de s'y conformer immédiatement. Les participants qui enfreignent ces règles peuvent être invités à quitter l'événement, à la seule discrétion des organisateurs, sans remboursement de quelque frais que ce soit. Tout participant qui souhaite signaler une violation de cette politique est prié de s'adresser, en toute confidentialité, à

- LOC Chair Rob Thacker
- A member of the Equity and Inclusivity Committee (EIC)
- A member of the Board

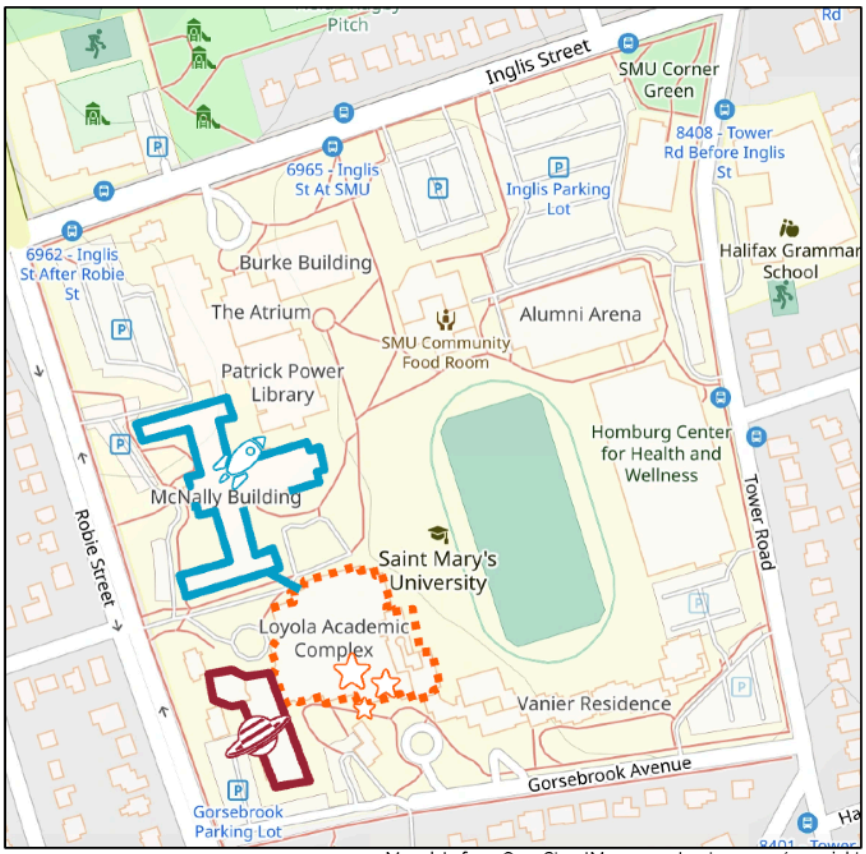
Protocole

- Le contact désigné de la CASCA demandera un compte rendu écrit de la plainte, y compris l'heure, la date et les détails. Le participant qui signale la violation de la politique examinera et approuvera le rapport avant qu'il ne soit déposé. Ils resteront anonyme pour la ou les personnes indiquées comme ayant violé le code dans le rapport
- Le contact désigné de la CASCA portera l'incident à l'attention du LOC et du conseil d'administration de la CASCA.
- The designated CASCA contact will bring the incident to the attention of the LOC and the CASCA Board.
- The designated CASCA contact will inform the individual(s) indicated to have violated the code of conduct of the allegation and ascertain and record their version of events.

Source

Ce code de conduite est basé sur le « Code de conduite de Londres », conçu à l'origine pour la conférence « Accurate Astrophysics. Correct Cosmology », qui s'est tenue à Londres en juillet 2015. Le Code de conduite de Londres a été adapté avec la permission d'Andrew Pontzen et Hiranya Peiris à partir d'un document de Software Carpentry (http://software-carpentry.org/conduct.html), qui lui-même dérive de documents Creative Commons originaux de PyCon et Geek Feminism. Il est publié sous une licence CC-Zero pour réutilisation. Pour aider à suivre les améliorations et les contributions de différentes personnes au fil du temps, veuillez conserver ce paragraphe et enregistrer votre réutilisation ou modification de cette politique à https://github.com/apontzen/london_cc.

Campus Map



Map data from OpenStreetMap: openstreetmap.org/copyright

Grad Student Workshop:
SB 255

Registration, posters, coffee:
Loyola Conference Hall & LA 296

Lunch and prize talks:
McNally Main auditorium

Parallel Session 1:
McNally Main auditorium

Parallel Session 2:
Scotiabank Theatre

Breakout rooms

A few meeting rooms are available (on a first come first served basis) for attendees wanting to organize breakout meetings throughout the conference. These are rooms LA181, LA276, and LA280, is the same building as the Loyola Conference Hall.

WIFI

Network: **smu-guest**
Username: **CASCA**
Password: **CASCA2025**

Attendees can choose wifi network **smu-guest** on their device and a pop-up login window will appear. Use username **CASCA** and password **CASCA2025** to connect. The connection process takes about a minute (it does feel slow while waiting for it, a known issue), but then it will be available for guests to use.

Childcare

Childcare at the conference will be provided by Improv Care and will be hosted on the SMU campus. Further details and registration forms have been sent to CASCA attendees via email. Please contact casca2025@smu.ca for questions. Some information is also copied below:

Improv Care Professionals

- The services will be provided by Improv Care Services for Children who employ licensed childcare professionals and who will comply with the rules and regulations governing the provision of such services under the Ontario Early Learning and Child Care Act.
- All Improv Care professionals hold a university degree or college diploma in a child-related field (Early Childhood Educators, child and youth counselors and teachers)
- Improv Care professionals have been thoroughly screened: this includes a vulnerable person's police check and a professional background check
- All of Improv Care professionals have up-to-date infant/ toddler and standard First Aid and CPR certification
- All Improv Care professionals have extensive experience working in childcare, education, caring for children in individual and group care settings
- Improv Care has Professional Liability Insurance, and a copy will be posted on-site

Services
The fully safety proofed, sanitized and decorated room will have various age-appropriate rotating games, activities and dramatic play stations for the children to enjoy throughout the day, including a quiet space for naptime. Health and safety protocols will be followed.

Meals
Snacks and meals will be provided by Aramark and the childcare professionals.

Dates and hours of operation
Monday, June 2: 7:30 a.m to 6:00 p.m.
Tuesday, June 3: 7:30 a.m to 6:00 p.m.
Wednesday, June 4: 7:30 a.m to 6:00 p.m.
Thursday, June 5: 7:30 a.m to 6:00 p.m.

Age groups
Infants (3 to 18 months)
Toddlers (18 months to 2.5 years)
Preschoolers (2.5 to 5 years)
School age (5 to 12 years)

Invited Speakers

Dr. Simon Blouin
(University of Victoria)

Dr. Simon Blouin is a postdoctoral researcher at the University of Victoria. He was previously a Banting and CITA National Fellow at UVic, and a Director's Postdoc Fellow at Los Alamos National Lab. He obtained his PhD from Université de Montréal in 2019. He is interested in stellar physics and evolution, with a particular emphasis on white dwarf stars.

Dr. Lisa Dang
(University of Waterloo)

Dr. Lisa Dang is a new Assistant Professor in the Department of Physics and Astronomy at the University of Waterloo. Lisa has completed her PhD at McGill University in 2022 and then joined the Trottier Institute for Research on Exoplanets at the Université de Montréal as a Banting and L'Oréal Canada FWIS postdoctoral fellow. She specializes in the characterization of the climate and atmospheric dynamics of exoplanets, with a focus on highly irradiated, tidally locked worlds. By leveraging phase-resolved observations from space-based observatories like JWST and high-resolution spectroscopy from ground-based facilities, she explores how extreme planetary environments challenge our understanding of atmospheric physics. She is a member of the Canadian Ariel

Science Team and coordinates its phase curve working group. Beyond research, Dang is committed to fostering a vibrant exoplanet community, organizing conferences like Exoclimes 2025 and organizing Hackathons to bridge academia and the industry.

Dr. Jason Rowe
(Bishop's University)

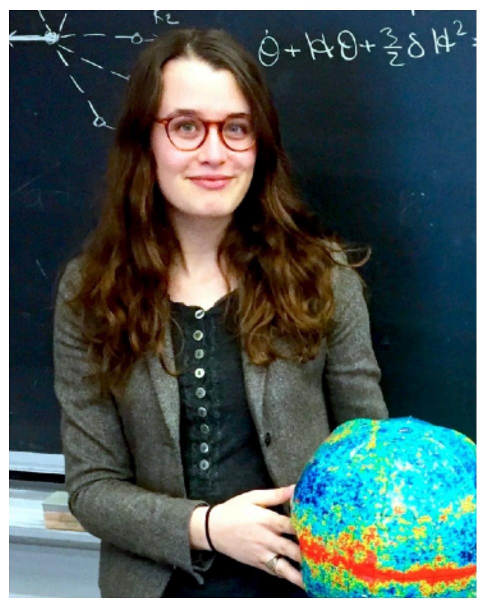
Dr. Jason Rowe received his PhD at the University of British Columbia for his work on measuring the reflectively of extra-solar planets using photometric measurements from the Canadian MOST Satellite. After his PhD Dr. Rowe joined the Kepler team as a NASA Postdoctoral Fellow contributing towards the first Kepler discoveries and was awarded the NASA Exceptional Scientific Achievement medal for his work on measuring fundamental parameters of exoplanets. Dr. Rowe then joined the SETI Institute as a research scientist and member of Kepler Science office and his continued work on exoplanets lead to the discovery of Earth-sized planets in the habitable zone of main-sequence stars and bulk validation of 812 extrasolar planets. During his tenure at SETI he was awarded his second NASA Exceptional Scientific Achievement medal. Dr. Rowe then joined the JWST NIRISS Instrument team at Université de Montréal to develop techniques and tools to measure the atmospheres on extrasolar planets. Dr. Rowe is currently a Canada Research Chair in Extrasolar Planet Astrophysics, his current research goals are to determine what properties make a planet 'Earth-like' and whether there is life beyond Earth.

Dr. Kate Rowlands
(Space Telescope Science Institute)

Dr. Kate Rowlands is an astronomer at the Space Telescope Science Institute in Baltimore, Maryland, where she supports the JWST MIRI instrument, and has previously supported the HST COS UV spectrograph. She is an expert in galaxy evolution, in particular the rapid quenching of galaxies from cosmic noon to the present day Universe. She is interested in what the gas contents, AGN demographics, morphologies and reveal about the processes causing galaxies to transition from star forming to quiescent.

Dr. Katelin Schutz
(McGill University)

Dr. Katelin Schutz is an Assistant Professor at McGill University and is the Canada Research Chair in Astrophysics Beyond the Standard Model. Until 2021, she was a Pappalardo Fellow and NASA Einstein Fellow at MIT. She received her PhD in 2019 from UC Berkeley with the support of fellowships from the Hertz Foundation and the National Science Foundation. Her dissertation, "Searching for the invisible: how dark forces shape our Universe" was supervised by Hitoshi Murayama and won the American Physical Society Sakurai Dissertation Award.



Dr. Alexandra Tetarenko
(University of Lethbridge)

Dr. Alex Tetarenko was born and raised in Calgary, Alberta, Canada. She received her BSc in Astrophysics from the University of Calgary, and she pursued graduate school at the University of Alberta, obtaining her MSc in 2014 and her PhD in 2018. For her PhD work, Alex received the J.S. Plaskett Medal awarded by the Canadian Astronomical Society for the most outstanding PhD thesis in Canada. Following her PhD studies, Alex worked in the Maunakea Observatories in Hawaii and held a NASA Einstein Fellowship at Texas Tech University. Currently, Alex is an Assistant Professor at the University of Lethbridge in Alberta, Canada, where she is focused on studying compact objects like black holes and neutron stars in our Galaxy.

Dr. Chris Willott
(NRC Herzberg / CADC)

Dr. Chris Willott received his Ph.D. in Astrophysics from the University of Oxford in 1998. He moved to Canada in 2002 and is now a multi-wavelength astronomer at the Canadian Astronomy Data Centre in Victoria. His main research interests are the growth of supermassive black holes and galaxies over cosmic time. Chris has worked on the James Webb Space Telescope project since 2006, and since its launch in 2021 has been involved in several prominent JWST science results.

Helen Sawyer Hogg Public Lecture

Tuesday June 3, 19:00 - McNally Main Auditorium

Dr. JJ Kavelaars
(Herzberg Astronomy and Astrophysics Research Centre, NRC Canada)

Cosmic Fossils and the Origins of Planets

How did our solar system come together, and what can its smallest members tell us about how planets are born? In this talk, we'll explore the remarkable clues hidden in asteroids, Kuiper Belt objects, and even rare interstellar visitors—ancient remnants from the dawn of planetary formation. These rocky and icy bodies preserve a record of the early processes that shaped the planets, including Earth. We'll look at how discoveries from space missions and telescopic surveys have transformed our understanding, and how the upcoming Vera C. Rubin Observatory and its Legacy Survey of Space and Time (LSST) will revolutionize the search for these cosmic fossils. With LSST, we expect to uncover hundreds of thousands of new small bodies—and perhaps even more interstellar visitors—opening an unprecedented window into the origins of planetary systems.

CASCA Awards Prize Speakers

Dr. William Thompson (NRC Herzberg)
J.S. Plaskett Medal

From Speckles to Orbits: Coherent Imaging and Joint Exoplanet Modelling

To place our solar system into a wider context, astronomers must study a broad sample of planets around Sun-like stars in detail. This will require a combination of indirect evidence and direct imaging. Directly imaging solar system analogues is a challenging endeavour that is to a large extent, limited by our instruments and analysis techniques. I will present recent work developing improved instruments and techniques for imaging giant planets around nearby stars, predicting where those planets are most likely to occur, and tying direct imaging observations into joint models with radial velocity and proper motion data to extract the maximum scientific information from multi-epoch observations. This and related work provide a path forward to imaging sub-Jovian planets at the occurrence rate peak near 3-10 AU around Sun-like stars, and ultimately connecting our own solar system to the broader population of planets.

Dr. David Charbonneau (Harvard)
R.M. Petrie Prize Lecture

The Terrestrial Worlds of Low-Mass Stars

Examples of rocky worlds have recently been discovered to orbit nearby stars, and attempts to characterize their atmospheres are underway. However, the rocky worlds that are currently observationally accessible orbit only very low-mass stars. These stars offer radiation histories and dynamical environments that differ profoundly from those of the Solar system. While these terrestrial worlds may appear very similar in their bulk characteristics to those of our planetary system, they may stand apart in terms of their formation paths, their ability to retain secondary atmospheres, and, ultimately, their prospects for hosting life.

Dr. Nathalie Nguyen-Quoc Ouellette (Université de Montréal)
Qilak Award

Curiosity, Courage, Kindness, and the Cosmos

Astronomy outreach is often framed as a service to the public, but it can also be a deeply personal and transformative part of a scientist's career. In this talk, I reflect on over 15 years of experience in science communication, sharing a series of lessons that have shaped both my professional journey and my sense of purpose as an astronomer.

Each lesson is drawn from a personal story — moments of uncertainty, joy, challenge, and discovery — and offers a broader reflection on topics such as impostor syndrome, public engagement, self-confidence, and professional growth. Whether it was rediscovering wonder through a campus observatory, building a science exhibit with no prior experience, or making a to-scale JWST Halloween costume, these experiences have informed a philosophy rooted in curiosity, courage, and kindness.

This talk is both a candid retrospective and a hopeful call to action — for scientists at all career stages to embrace the value of outreach, trust in their capacity to grow, and remain connected to the wonder that drew them to astronomy in the first place.

Dr. Julie Hlavacek-Larrondo (Université de Montréal)
Harvey B. Richer Gold Medal

New Frontiers in Black Hole Feedback

At the centers of most galaxies, supermassive black holes release powerful jets and outflows—collectively known as black hole feedback—that shape galaxy evolution over cosmic time. Galaxy clusters, the most massive bound structures in the Universe, offer a unique environment to study these processes. In these systems, AGN-driven jets inject energy into the surrounding medium, driving shocks, sound waves, and turbulence. This regulates the thermal state of cluster cores, triggers molecular outflows, and redistributes metals on large scales—revealing the far-reaching impact of black holes.

In this talk, I will explore how black hole feedback drives the co-evolution of galaxies and their environments, highlighting recent breakthroughs from XRISM, a next-generation X-ray space telescope offering unprecedented insight into hot gas motions in clusters. I will also present new results from the TNG-Cluster suite of cosmological simulations, which deepen our understanding of AGN feedback mechanisms, and discuss how machine learning is revolutionizing our ability to extract physical insights from current and future datasets. Together, these advances are transforming our view of black holes as cosmic engines shaping the Universe.

Dr. Alan McConnachie (NRC Herzberg)
Peter G. Martin Award

Microgalaxies, and the tools we need to understand them

Every year for the past 20 years or so, there have been new additions to the extreme low luminosity end of the galaxy luminosity function, and the record for the lowest luminosity system known has been continually broken: the new record-holding "microgalaxy" may have a total of less than 60 stars above the hydrogen-burning limit. Their discovery requires searches through very large wide field photometric surveys, in combination with follow-up spectroscopy and Gaia astrometry where available. In many respects, the smallest dwarfs are an excellent stress test for cosmology given that the modern cosmological paradigm was developed with most consideration given to the largest, not smallest, scales. Their existence raises some very basic questions, including how such a low luminosity system (and how low mass a dark matter halo) can form and survive? I will discuss some of the surveys that are critical for this work, and some of the latest scientific discoveries. This will include results using new instrumentation developed here in Canada. Finally, I will attempt to predict the future, and discuss what I see as some challenges ahead, both scientifically and instrumentally.

Tours of the Burke-Gaffney Observatory

CASCA 2025 attendees are welcome to join tours of the Burke-Gaffney Observatory (and stargazing evenings; weather permitting) at the following times:

Monday June 2 @ 9pm
Tuesday June 3 @ 9:30pm
Thursday June 5 @ 6:30pm (daytime, no telescope use)

Sign-up forms are available at the registration desk.

Each session will last about one hour with a capacity of up to 20 people, and it will go ahead regardless of clear/cloudy skies. If we cannot observe, you will still get a chance to visit the facility and learn about the automated telescope that is accessible through social media. Participants will meet just outside the Loyola Conference Hall (LA 290).

Conference Schedule

Monday, June 2
(Graduate Student Workshop)

Room: Sobey 255

9:30 - 10:00: Introduction & Welcome

10:00 - 10:45: Science Communication Workshop

10:45 - 11:00: Short Break

11:00 - 12:00: Career Prospects Panel

12:00 - 1:30: Lunch

1:30 - 2:15: Guest Speaker: Leslie Sage

2:15 - 3:00: CASCA Board Panel

3:00 - 3:15: Short Break

3:15 - 4:15: GSC Business Meeting

Find more information about the Graduate Student Workshop in the **detailed workshop program posted here**.

Monday, June 2 (Main Conference)

18:30 - 20:30: Opening Reception (Loyola Conference Hall)

Tuesday, June 3

8:30 - 9:00: Coffee, Registration & Poster Setup (Loyola Conference Hall & Loyola 296)

9:00 - 9:30: Welcome (McNally Main Auditorium)

- Welcome on behalf of LOC by Rob Thacker
- Institutional welcome and Land Acknowledgement, by the Vice President Academic & Research (Interim) Dr Madine VanderPlaat
- Indigenous welcome by Melissa Labrador, Wasoqopa'q First Nation, Knowledge Keeper.

9:30 - 10:15: Plaskett Medal prize talk (McNally Main Auditorium)
Dr. William Thompson (NRC-Herzberg)

10:15 - 11:00: Coffee Break & Poster Viewing (Loyola Conference Hall & Loyola 296)

Parallel Session I (Instrumentation; Star & Cluster Formation): 11:00 - 12:30

Instrumentation (McNally Main Auditorium)

Chair: Locke Spencer

11:00 - 11:30: **Invited talk - Jason Rowe** (Bishop's University) [faculty/staff]
Building a Space Telescope: The Pandora and POET Missions

11:30 - 11:45: **Deborah Lokhorst** (NRC-Herzberg) [faculty/staff]
Mapping extended low surface brightness gas with the Dragonfly Spectral Line Mapper

11:45 - 12:00: **René Doyon** (Université de Montréal) [faculty/staff]
ANDES and the Extremely Large Telescope : A Canadian Opportunity

12:00 - 12:15: **Christopher Mann** (NRC - Herzberg) [postdoc]
Colour-blindness: Chromaticity problems and solutions for Coherent Differential Imaging of exoplanets

12:15 - 12:30: **"Instrumentation" poster presentations,** 1-min flash talks

1. Gladys A. Harvey: Canada's First Woman Radio Astronomer **(Robishaw)** [faculty/staff]
2. Supporting Transformative Science with NIRISS, the Canadian Instrument Onboard JWST **(Noirot)** [faculty/staff]
3. Thirty Meter Telescope Program Update (Andersen) [faculty/staff]
4. Instrumentation at the Observatoire du Mont-Mégantic **(Baron)** [faculty/staff]
5. Time-Resolved Point Spread Function Measurements of an Adaptive Optics System with a Single-Photon Avalanche Diode Array **(Grosson)** [grad]
6. The Colibri Telescope Array: A High-Cadence Robotic Facility for Time-Domain Astronomy **(Cordeiro de Almeida)** [grad]
7. Canadian Gemini News **(Steinbring)** [faculty/staff]

Star & cluster formation (Scotiabank Theatre)

Chair: Gilles Joncas

11:00 - 11:15: **Claude Cournoyer-Cloutier** (McMaster University) [grad]
The impact of feedback from massive interacting binaries on the interstellar medium

11:15 - 11:30: **Jeremy Karam** (McMaster University) [grad]
The Role of Gas in Star Cluster Formation

11:30 - 11:45: **Alison Sills** (McMaster University) [faculty/staff]
Spatial and Kinematic Substructure as Tracers of Star Cluster Assembly

11:45 - 12:00: **Simon Coudé** (Worcester State University) [postdoc]
FIELDMAPS: A Survey of Magnetic Support in the Bones of the Milky Way

12:00 - 12:15: **Breanna Crompvoets** (University of Victoria) [grad]
What is that? Multi-object Identification in Galactic Regions with JWST Data and Machine Learning

12:15 - 12:30: **"Star & cluster formation" poster presentations,** 1-min flash talks

1. A multi-line analysis of dense gas tracers across the Antennae **(Bemis)** [postdoc]
2. The Role of Galaxy Environment in Pressure-Regulated Star Formation and Gas Content in Galaxies **(Jindel)** [grad]
3. A multi-scale ALMA view of starless and protostellar dense cores in Aquila **(Fielder)** [grad]
4. Insights into the physics encoded in star cluster dating techniques **(Armstrong)** [grad]
5. Studying Protoplanetary Disks Around Herbig Stars with Subaru/SCExAO **(Mullin)** [grad]
6. The Impact of Galaxy Mergers on Molecular Cloud Properties and Star Formation **(Maeve)** [grad]
7. The Formation of Star Clusters in High-resolution Galaxy Simulations **(Koletic)** [grad]

12:45 - 14:15: CFHT + Gemini lunch, including CADC update
(McNally Main Auditorium)

14:15 - 15:00: Petrie prize lecture (McNally Main Auditorium)
Dr. David Charbonneau (Harvard)

15:00 - 15:30: Coffee Break & Poster Viewing (Loyola Conference Hall & Loyola 296)

Parallel session II (Exoplanets; Stars/Solar System): 15:30 - 17:30

Exoplanets (McNally Main Auditorium)

Chair: David Lafrenière

15:30 - 16:00: **Invited talk - Lisa Dang** (University of Waterloo) [faculty/staff]
Mapping Infernal Worlds by Revealing their Multidimensional Nature

16:00 - 16:15: **Michael Radica** (University of Chicago) [postdoc]
The Surprising Composition and Climate of WASP-96b Revealed by Panchromatic JWST and Ground-Based Transit Spectroscopy

16:15 - 16:30: **Jess Speedie** (University of Victoria) [grad]
Gravitational instability in the planet-forming disk around AB Aurigae

16:30 - 16:45: **Emily Pass** (Massachusetts Institute of Technology) [postdoc]
The Cosmic Shoreline of Mid-to-Late M Dwarfs

16:45 - 17:00: **Erik Gillis** (McMaster University) [grad]
Characterizing the Exoplanet Population around Mid-to-Late M Dwarfs

17:00 - 17:15: **Audrey Burggraf** (Queen's University) [grad]
Another One Bites the Dust: Using Polarized Light to Probe Dust Grain Sizes in Protoplanetary Disks

17:15 - 17:30: **"Exoplanets" poster presentations,** 1-min flash talks

1. Roman and the search for one hundred thousand new transiting exoplanets **(Hoffman)** [faculty/staff]
2. Synthetic modelling of exoplanet transit light curve using state-of-the-art model stellar atmosphere limb darkening **(Kaushal)** [grad]
3. Disk Wind-Driven Formation of the First Planetary Cores **(Goksu)** [grad]
4. MAROON-X Reveals Two Aligned Stellar Obliquities for the Hot Jupiter Hosting M Dwarfs TOI-3714 and TOI-5293 A **(Cloutier)** [faculty/staff]
5. Resolving the Mystery of H_2O in the Atmosphere of τ Boötis b using Doppler Tomography **(Young)** [postdoc]

Stars/Solar System (Scotiabank Theatre)

Chair: Catherine Lovekin

15:30 - 16:00: **Invited talk - Simon Blouin** (University of Victoria) [postdoc]
High-fidelity 3D Hydrodynamics Simulations of Red Giant Branch Stars

16:00 - 16:15: **Anna O'Grady** (Carnegie Mellon University) [postdoc]
Identifying the first population of Yellow Supergiant Binary Candidates in the Magellanic Clouds

16:15 - 16:30: **Aryanna Schiebelbein-Zwack** (University of Toronto/CITA) [grad]
The Tell Tail Mass Distribution: How Gaia Neutron Stars Challenge Assumptions

16:30 - 16:45: **David Miller** (University of British Columbia) [grad]
Expanding and Refining the Open Cluster White Dwarf Initial-Final Mass Relation with Gaia DR3

16:45 - 17:00: **Wesley Fraser** (NRC-Herzberg) [faculty/staff]
The Classical and Large-a Solar System

17:00 - 17:15: **Martin Connors** (Athabasca University) [faculty/staff]

A Terminator Asteroid that Will Be Back

17:15 - 17:30: **“Stars/Solar System” poster presentations,** 1-min flash talks

1. Rotation Periods of Candidate Single M6-M8 Dwarfs in TESS **(Lambier)** [grad]
2. The White Dwarf Opportunity: Constraining Winds from the Galaxy's Smallest Stars using a Well-Behaved Neighbour **(Westlake)** [grad]
3. Replication and Identification of g-mode and Tidal Pulsation in HgMn Stars Using MESA and GYRE **(Allison)** [grad]
4. Decoding M Dwarf Chemistry: A New Framework to Derive Stellar Elemental Abundances **(Gromek)** [grad]
5. Investigating the Influence of Metallicity and Mass Ratio on Orbital Eccentricity in Main-Sequence Binary Stars **(Denney)** [grad]
6. Spectropolarimetric observation of chemically peculiar stars ESPaDOnS **(Khalack)** [faculty/staff]
7. Long Secondary Periods in Red Giants: AAVSO Observations and the Eclipse Hypothesis **(Szpigiel)** [undergrad]
8. Research Announcements for the Outer Solar System **(Buchanan)** [postdoc]
9. Binary Stars as Sources of Chemical Anomalies in Stellar Clusters **(Khadour)** [grad]

17:30 - 18:15: Afternoon poster session (Loyola Conference Hall & Loyola 296)

19:00 - 21:00: Public Hogg lecture (McNally Main Auditorium)
Dr. JJ Kavelaars (NRC Herzberg/CADC)

Wednesday, June 4

8:30 - 9:00: Coffee, Registration & Poster Setup (Loyola Conference Hall & Loyola 296)

9:00 - 9:45: Qilak Award prize talk (McNally Main Auditorium)
Dr. Nathalie Nguyen-Quoc Ouellette (Université de Montréal)

9:45 - 10:45: EIC and Indigenous Engagement Committee (McNally Main Auditorium)

10:45 - 11:30: Coffee Break & Poster Viewing (Loyola Conference Hall & Loyola 296)

Parallel Session III (Galaxies I; Education & Public Outreach): 11:30 - 12:30

Galaxies I (McNally Main Auditorium)

Chair: Ivana Damjanov

11:30 - 11:45: **Anan Lu** (University of British Columbia) [postdoc]
Calibrating star formation rate in nearby nuclear rings at unprecedented spatial resolution

11:45 - 12:00: **Rosa Maria Merida** (Saint Mary's University) [postdoc]
Probing the Star Formation Main Sequence in low-mass galaxies at cosmic noon

12:00 - 12:15: **Nathan Deg** (Queen's University) [faculty/staff]
Gas, Galaxies, and Rotation: The Resolved Disks of WALLABY

12:15 - 12:30: **Kiyoaki Christopher Omori** (Saint Mary's University) [postdoc]
Investigating Clumpy Galaxies at $z > 5$ and their Physical Properties Using JWST

Education and Public Outreach (Scotiabank Theatre)

Chair: Nathalie Nguyen-Quoc Ouellette

11:30 - 11:45: **Ian Short** (Saint Mary's University) [faculty/staff]
The Burke-Gaffney Observatory: A social media controlled robotic telescope for students everywhere

11:45 - 12:00: **Megan Tannock** (Cosmographic Software)
SpaceEngine: The Universe Simulator

12:00 - 12:15: **Theodore Grosson** (University of Victoria) [grad]
TIPs for Astronomers: A Collaborative Guide for Young Researchers

12:15 - 12:30: **Pierre Chastenay** (UQAM) [faculty/staff]
The Reasons for Seasons Concept Inventory: A New Instrument to Assess Students Learning in Astro-101 Courses

+ 1-min flash poster talk: Concerning the Invisibility of our Solar System **(Connors)** [faculty/staff]

12:45 - 14:15: ACURA (SKA + CASTOR) lunch (McNally Main Auditorium)

Parallel Session IV (Galaxies II; Compact Objects/High-Energy): 14:30 - 16:15

Galaxies II (McNally Main Auditorium)

Chair: Marcin Sawicki

14:30 - 15:00: **Invited talk - Kate Rowlands** (STScI) [faculty/staff]
Post-starburst galaxies: a tool to track quenching throughout cosmic time

15:00 - 15:15: **Scott Wilkinson** (University of Victoria) [grad]

Leveraging CANFAR and the ALMA archive to create SALVAGE: The SDSS-ALMA Legacy Value Archival Gas Exploration (Wilkinson)

15:15 - 15:30: **Ian Roberts** (University of Waterloo) [postdoc]
Ram Pressure Candidates at Cosmic Noon

15:30 - 15:45: **Tobias Géron** (University of Toronto) [postdoc]
Bar fractions up to z = 4

15:45 - 16:00: **Gaia Gaspar** (Saint Mary's University) [postdoc]
Possible environmental quenching in an interacting LRD pair at z ~ 7

16:00 - 16:15: **"Galaxies" poster presentations,** 1-min flash talks

1. Galaxy Stellar Halo Growth: Probing Merger-Driven Mass Assembly **(Williams)** [grad]
2. Automated Detection of Dwarf Galaxies in NGC5128 Using Image Processing and Deep Learning **(Leahy)** [grad]
3. Surveying Atomic Gas in Nearby Low-Mass Galaxies with CHORD **(Bij)** [grad]
4. Exploring Star Formation with Made to Order Galaxies: A Tailored High-Resolution Simulation of NGC 5055 **(Rock)** [grad]
5. Effect of Ram Pressure on Star Formation in Satellite Galaxies **(Foster)** [grad]
6. Probing the Faintest Galaxies Below the Confusion Limit **(Wang)** [grad]
7. The Intrinsic Flattening of Galaxy Disks **(Favaro)** [grad]
8. Comparing the SIMBA Cosmological Simulation with WALLABY Observations **(Perron-Cormier)** [grad]
9. Measuring Physical Properties of Globular Cluster Populations at Intermediate Redshift with SED Fitting **(Kim)** [grad]

Compact Objects/High-Energy (Scotiabank Theatre)

Chair: Tyrone Woods

14:30 - 15:00: **Invited talk - Alexandra Tetarenko** (University of Lethbridge) [faculty/staff]

Unravelling the mysteries of black holes and neutron stars with flashes, bursts and eruptions

15:00 - 15:15: **Labani Mallick** (University of Manitoba & CITA) [postdoc]

Constraining Disk-to-Corona Power Transfer Fraction, Soft X-ray Excess Origin, and Black Hole Spin Population of AGN

15:15 - 15:30: **James Leung** (University of Toronto) [postdoc]

Breaking the radio frontier for gamma-ray burst afterglow studies in the SKA/ngVLA era

15:30 - 15:45: **Pau Bosch-Cabot** (University of Lethbridge) [grad]

Estimating black hole jet power through astrochemistry: New ALMA observations of MAXI J1348-630

15:45 - 16:00: **Margaret Buhariwalla** (Saint Mary's University) [grad]

A Hot Mess: MRK 1239

16:00 - 16:15: **"Compact Objects/High-Energy" poster presentations,** 1-min flash talks

1. RS CVn variables: Potential X-ray Binary Imposters? **(Rao)** [grad]
2. Investigating the AGN variability timescale - black hole mass relationship with Gaia, SDSS and ZTF **(Hélias)** [grad]
3. The role of millisecond pulsars in constraining black hole populations in globular clusters **(Hoque)** [undergrad]
4. Applying the Superlet Transform to AGN Timing Analysis **(Hodd)** [grad]
5. The High-Resolution Spectrum of Dual AGN Candidate MCG-03-34-64 **(Semenchuk)** [grad]
6. Modelling AGN wind properties using 3rd-order Chandra MEG Absorption Spectra (**Adamski)** [grad]

16:15 - 16:45: Coffee Break & Poster Viewing (Loyola Conference Hall & Loyola 296)

16:45 - 17:45: Midterm Review Presentation/Discussion (McNally Main Auditorium)

17:45 - 18:15: President's address (McNally Main Auditorium)

19:00 - 22:00: Banquet (Atlantica Hotel)

Thursday, June 5

8:30 - 9:00: Coffee, Registration & Poster Setup (Loyola Conference Hall & Loyola 296)

9:00 - 9:45: Richer Award prize talk (McNally Main Auditorium)
Dr. Julie Hlavacek-Larrondo (Université de Montréal)

9:45 - 10:30: Martin Award prize talk (McNally Main Auditorium)
Dr. Alan McConnachie (NRC-Herzberg)

10:30 - 11:00: Coffee Break & Poster Viewing (Loyola Conference Hall & Loyola 296)

Parallel Session V (Supermassive Black Holes; Cosmology & Early Universe): 11:00 - 12:45

Supermassive Black Holes (McNally Main Auditorium)

Chair: Luigi Gallo

11:00 - 11:30: **Invited talk - Chris Willott** (NRC Herzberg) [faculty/staff]
Pushing the Study of Active Galactic Nuclei to Early Cosmic Times

11:30 - 11:45: **Matías Bravo** (McMaster University) [postdoc]
The galaxy-SMBH mass scaling relations over 13 billion years in SHARK v2.0

11:45 - 12:00: **Marie-Joëlle Gingras** (University of Waterloo) [grad]
Complex Dynamics of Stars and Nebular Gas in Active Galaxies Centred in Cooling X-ray Atmospheres

12:00 - 12:15: **Matthew Taylor** (University of Calgary) [faculty/staff]
Detour Ahead: The Supermassive Black Hole That Took the Wrong Exit in a Compact Elliptical Galaxy

12:15 - 12:30: **Adam Gonzalez** (Saint Mary's University) [postdoc]
A spectrotemporal analysis of X-ray reverberation in the Seyfert 1.5 galaxy 4U 1344-60

12:30 - 12:45: **"Supermassive Black Holes"+"Local Group/Near-Field Cosmology" poster presentations,** 1-min flash talks

1. Dude, Where's My Stars? Probing Compact Stellar System Evolutionary Connections via Central Black Holes **(Thompson)** [grad]
2. Globular cluster SED fitting: a new method for tracing local universe galaxy evolution **(Hartman)** [grad]
3. Searching for Globular Clusters in NGC 7332 and NGC 7339 **(Lenz)** [undergrad]
4. High-velocity stars ejected from globular clusters: NGC 3201 candidates from Gaia DR3 **(Battson)** [grad]
5. Exploring Nearby Galaxies with Optical and Ultraviolet Machine Learning Analysis **(Bellamy)** [grad]
6. All The Single Ladies: The First High-Resolution Spectra of Previously Unobserved UFD Members **(Dovgal)** [grad]
7. Characterizing the Metal-Poor C-19 Stellar Stream in DESI **(Mohammed)** [grad]
8. Human machine understanding of astrophysical data **(Ortega Cruz Prieto)** [undergrad]

Cosmology & Early Universe (Scotiabank Theatre)

Chair: Pauline Barmby

11:00 - 11:30: **Invited talk - Katelin Schutz** (McGill University) [faculty/staff]
A minimalist approach to modelling reionization

11:30 - 11:45: **Simran Nerval** (University of Toronto) [grad]
Constraining the Primordial Power Spectrum with the Atacama Cosmology Telescope

11:45 - 12:00: **Marcin Sawicki** (Saint Mary's University) [faculty/staff]
Witnessing the First Stages of Galaxy Assembly in the Cosmic Dawn with JWST Imaging and Spectroscopy

12:00 - 12:15: **Vasilii Pustovoit** (CITA/University of Toronto) [grad]
Beyond the First Light: Novel Simulations of Pop III Stars with PeakPatch-GIZMO Pipeline

12:15 - 12:30: **Connor Stone** (Université de Montréal) [postdoc]
Making scientific simulators and pipelines easy with caskade

12:30 - 12:45: **"Cosmology & Early Universe"+"Galaxies"+"Galaxy Clusters" poster presentations,** 1-min flash talks

1. A nascent intra-cluster medium at z=4.3: detection of the Sunaev-Zeldovich effect in the SPT2349 protocluster **(Chapman)** [faculty/staff]
2. The role of gas stripping in the quenching of satellite galaxies **(Oxland)** [grad]
3. The Evolution of Galaxy Star Formation and Morphology in Groups and Clusters with IllustrisTNG **(Yeung)** [grad]
4. The impacts of AGN feedback on galaxy clusters and their surroundings **(Rosenberg)** [undergrad]
5. Searching for the Extreme: SpARCS1049 Analogues in TNG-Cluster **(Manojh)** [undergrad]
6. Identifying backsplash galaxies with machine learning **(Haggar)** [postdoc]
7. Structural evolution of galaxies: from disks to disks?? **(Sazonova)** [postdoc]

13:00 - 14:30: JWST lunch (McNally Main Auditorium)

14:30 - 15:15: NSERC udpate (McNally Main Auditorium)

15:15 - 15:45: Coffee break and poster viewing (Loyola Conference Hall & Loyola 296)

Parallel Session VI (Galaxy Clusters; Local Group and Near-Field Cosmology): 15:45 - 17:15

Galaxy Clusters (McNally Main Auditorium)

Chair: Laura Parker

15:45 - 16:00: **Cameron Morgan** (University of Waterloo) [grad]
Decoding quenching in the Virgo cluster with spatially resolved star formation

16:00 - 16:15: **Angelo George** (Saint Mary's University) [grad]
From UV to optical: cosmic environment and the size evolution of quiescent galaxies

16:15 - 16:30: **Syeda Lammim Ahad** (Waterloo Centre for Astrophysics [postdoc]
The impact of the dynamical states of galaxy clusters on the properties of clusters and cluster galaxies across $0 < z < 1$

16:30 - 16:45: **Marie-Lou Gendron-Marsolais** (Université Laval) [faculty/staff]
Tracers of galaxy cluster environments

16:45 - 17:00: **Lucas Kuhn** (University of British Columbia) [grad]
Exploring Star Formation and Multi-Phase Gas in a Brightest Cluster Galaxy with JWST, MUSE, and ALMA

17:00 - 17:15: **Jade Yeung** (University of Manitoba) [grad]
The Virgo Astrosat UVIT Long-Term (VAULT) Survey: The Far-UV Luminosity Function of the Virgo Galaxy Cluster

Local Group and Near-Field Cosmology (Scotiabank Theatre)

Chair: Alan McConnachie

15:45 - 16:00: **Simon Smith** (University of Victoria) [grad]
Census of dwarf galaxies within the Local Group in UNIONS and implications for galaxy formation on the smallest scales

16:00 - 16:15: **Dasha Zaremba** (University of Victoria) [grad]
GHOST commissioning science results - IV: Chemodynamical analyses of Milky Way satellites Sagittarius II and Aquarius II

16:15 - 16:30: **Nolan Dickson** (Saint Mary's University) [grad]
Fast dynamical modelling of globular clusters; constraints on initial conditions and black hole physics

16:30 - 16:45: **Akshara Viswanathan** (University of Victoria) [postdoc]
Decoding the Galactic memory: The slow rotational build-up of the high-redshift Milky Way

16:45 - 17:00: **Ana Ines Ennis** (Waterloo Centre for Astrophysics/Perimeter Institute) [postdoc]
Planetary nebulae as tracers of stellar population properties with MUSE

17:00 - 17:15: **Veronika Dornan** (McMaster University) [grad]
From Dwarfs to Giants: Studying Galaxy Evolution Using Globular Cluster Systems

17:30 - 17:45: Poster/talk awards and closing remarks (McNally Main Auditorium)

Full list of posters

The poster # also refers to the order/location in the poster viewing area.

Long-Range Plan

1. **FIRSA – The Future of Canadian Far-Infrared Space Astronomy**
   Spencer Locke (Institute for Space Imaging Science, Dept. of Physics & Astronomy, University of Lethbridge) [faculty/staff]

2. **An overview of the space astronomy program at the Canadian Space Agency**
   Jean Dupuis (Canadian Space Agency / Agence spatiale canadienne) [faculty/staff]

Education and Public Outreach

3. **Progress on the Westar Program**
   Daniella Morrone (CASCA / University of Toronto) [faculty/staff]

4. **Concerning the Invisibility of our Solar System**
   Martin Connors (Athabasca University) [faculty/staff]

Exoplanets / planet formation

5. **Synthetic modelling of exoplanet transit light curve using state-of-the-art model stellar atmosphere limb darkening**
   Ishan Kaushal (Memorial University of Newfoundland) [grad]

6. **Disk Wind-Driven Formation of the First Planetary Cores**
   Olcay Ates Goksu (McMaster University) [grad]

7. **Roman and the search for one hundred thousand new transiting exoplanets**
   Kelsey Hoffman (Bishop's University) [faculty/staff]

8. **Comparing Uniform & Observable Priors in Octofitter: Testing Predictivity of Orbital Parameters in Multi-Object Systems**
   Kaitlyn Hessel (University of Victoria / NRC-HAA) [grad]

9. **MAROON-X Reveals Two Aligned Stellar Obliquities for the Hot Jupiter Hosting M Dwarfs TOI-3714 and TOI-5293 A**
   Ryan Cloutier (McMaster University) [faculty/staff]

10. **Resolving the Mystery of H_2O in the Atmosphere of τ Boötis b using Doppler Tomography**
    Mitch Young (Queen's University Belfast) [postdoc]

Star & Cluster Formation

11. **Studying Protoplanetary Disks Around Herbig Stars with Subaru/SCExAO**
Camryn Mullin (University of Victoria) [grad]

12. **Insights into the physics encoded in star cluster dating techniques**
Isabella Armstrong (McMaster University) [grad]

13. **A multi-scale ALMA view of starless and protostellar dense cores in Aquila**
Samuel Fielder (University of Victoria) [grad]

14. **Mining the ALMA Archive: Building a Catalog of Structured Young Protostellar Disks**
Lance Schonberg (Queen's University) [grad]

15. **The Formation of Star Clusters in High-resolution Galaxy Simulations**
Tamara Koletic (McMaster University) [grad]

16. **Investigating the Influence of Magnetic Fields on Bubble Morphology in Star-Forming Regions**
Raina Irons (Queen's University) [grad]

17. **Filamentary hierarchies and fragmentation from kpc to sub-pc scales**
Rachel Pillsworth (McMaster University) [grad]

18. **Dynamics of Dense Gas Filaments in the Serpens South Star-Forming Region**
Julian Caza (Queen's University) [grad]

19. **Making the Next Generation of 3D Interstellar Medium Dust Temperature Maps**
Oluwasemoore Tijani (University of Toronto) [undergrad]

Stars/Solar System

20. **Spectropolarimetric observation of chemically peculiar stars ESPaDOnS**
Viktor Khalack (Université de Moncton) [faculty/staff]

21. **Research Announcements for the Outer Solar System**
Laura Buchanan (University of Victoria) [postdoc]

22. **Binary Stars as Sources of Chemical Anomalies in Stellar Clusters**
Zena Khadour (McMaster University) [grad]

Co-author(s): Sills, Alison

23. **Replication and Identification of g-mode and Tidal Pulsation in HgMn Stars Using MESA and GYRE**
Jay Allison (Université de Moncton) [grad]

24. **Rotation Periods of Candidate Single M6-M8 Dwarfs in TESS**
Samantha Lambier (Western University) [grad]

25. **The White Dwarf Opportunity: Constraining Winds from the Galaxy's Smallest Stars using a Well-Behaved Neighbour**
Raven Westlake (McMaster University) [grad]

26. **Long Secondary Periods in Red Giants: AAVSO Observations and the Eclipse Hypothesis**
Melanie Szpigiel (University of Toronto Department of Astronomy & Astrophysics, and Dunlap Institute) [undergrad]

27. **Angular momentum in aging brown dwarfs: spinning up or spinning down?**
Ethen Sun (University of Toronto) [grad]

28. **Investigating the Influence of Metallicity and Mass Ratio on Orbital Eccentricity in Main-Sequence Binary Stars**
Abigail Denney (University of Toronto) [grad]

29. **A Systematic Search for Radio Stars in the Northern Hemisphere**
Ryan Johnston (University of Alberta) [grad]

30. **The Wind of the Red Supergiant 31 Cygni**
Philip Bennett (Dalhousie University) [faculty/staff]

31. **Stellar Atmosphere Modeling with SATLAS: A Case Study of 55 Cancri**
Tahere Parto (Memorial University of Newfoundland) [grad]

32. **Decoding M Dwarf Chemistry: A New Framework to Derive Stellar Elemental Abundances**
Nicole Gromek (McMaster University) [grad]

Local Group & Near-Field Cosmology

33. **High-velocity stars ejected from globular clusters: NGC 3201 candidates from Gaia DR3**
Abigail Battson (Saint Mary's University) [grad]

34. **Characterizing the Metal-Poor C-19 Stellar Stream in DESI**
Nasser Mohammed (University of Toronto) [grad]

35. **Exploring Nearby Galaxies with Optical and Ultraviolet Machine Learning Analysis**
Monica Bellamy (University of Calgary) [grad]
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36. **All The Single Ladies: The First High-Resolution Spectra of Previously Unobserved UFD Members**
Anya Dovgal (University of Victoria) [grad]

37. **More CHANG-ES in the Works**
Judith Irwin (Queen's University) [faculty/staff]

38. **Human machine understanding of astrophysical data**
Alejandro Ortega Cruz Prieto (University of Toronto) [undergrad]

Instrumentation

39. **Gladys A. Harvey: Canada's First Woman Radio Astronomer**
Timothy Robishaw (Dominion Radio Astrophysical Observatory) [faculty/staff]

40. **Validating a SWIR Camera for Exoplanet Detection: The POET-STRATOS High-Altitude Balloon Mission**
Noel Wajnblum (Western University) [undergrad]

41. **Canadian Gemini News**
Eric Steinbring (NRC/HAA) [faculty/staff]

42. **Time-Resolved Point Spread Function Measurements of an Adaptive Optics System with a Single-Photon Avalanche Diode Array**
Theodore Grosson (University of Victoria) [grad]

43. **Supporting Transformative Science with NIRISS, the Canadian Instrument Onboard JWST**
Gaël Noirot (Space Telescope Science Institute, Canadian Space Agency) [faculty/staff]

44. **Initial Polarization Observations with TolTEC Millimeter Camera on the LMT**
Brandon Shane (Queens University) [grad]

45. **Thirty Meter Telescope Program Update**
David Andersen (TMT International Observatory) [faculty/staff]

46. **The Colibri Telescope Array: A High-Cadence Robotic Facility for Time-Domain Astronomy**
Toni Cordeiro de Almeida (Western University) [grad]

47. **The Balloon-borne Very Long Baseline Interferometry Experiment (BVEX)**
Maggie Oxford (Queen's University) [grad]

48. **Simulating a UV Multi-object Spectrograph for the CASTOR Mission**
Charles Lee (University of Manitoba) [grad]
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49. **Remote Telescopes in the High Arctic - Affordable Optical Satellite Communications**
Ryan Wierckx (University of Manitoba) [grad]

50. **The Radio Revolution: A Primer for Non Radio Astronomers**
Gregory Sivakoff (University of Alberta) [faculty/staff]

51. **Toward reflected light exoplanet imaging with SPIDERS and CAL2: Project update of NRC focal plane wavefront sensors**
Christian Marois (National Research Council of Canada) [faculty/staff]

52. **Instrumentation at the Observatoire du Mont-Mégantic**
Frédérique Baron (Université de Montréal) [faculty/staff]

53. **News and highlights from CFHT**
Nadine Manset (CFHT) [faculty/staff]

54. **Deep in the Lows: A Machine Learning Based Wavefront Reconstructor for the Lyot-based Low Order Wavefront Sensor**
Andre Fogal (University of Victoria, NRC-HAA) [grad]

Galaxies

55. **Comparing the SIMBA Cosmological Simulation with WALLABY Observations**
Mathieu Perron-Cormier (Queen's University) [grad]

56. **Searching for Globular Clusters in NGC 7332 and NGC 7339**
Heather Lenz (University of Calgary) [undergrad]

57. **The Impact of Galaxy Mergers on Molecular Cloud Properties and Star Formation**
Barbara Maeve (McMaster University) [grad]

58. **The role of gas stripping in the quenching of satellite galaxies**
Megan Oxland (McMaster University) [grad]

59. **Ergodicity of FIRE: Star Formation Variations within and between Simulated Galaxies**
Fraser Smith (Saint Mary's University) [grad]

60. **Effect of Ram Pressure on Star Formation in Satellite Galaxies**
Lauren Foster (McMaster University) [grad]

61. **Measuring Physical Properties of Globular Cluster Populations at Intermediate Redshift with SED Fitting**
Jinoo Kim (McMaster University) [grad]

62. **The Intrinsic Flattening of Galaxy Disks**
Jeremy Favaro (Saint Mary's University) [grad]

63. **Globular cluster SED fitting: a new method for tracing local universe galaxy evolution**
Kate Hartman (McMaster University) [grad]

64. **Observations of globular cluster populations at cosmological lookback times of 3-4 Gyr**
Kaitlyn Keatley (McMaster University) [grad]

65. **A multi-line analysis of dense gas tracers across the Antennae**
Ashley Bemis (Waterloo Centre for Astrophysics, University of Waterloo) [postdoc]

66. **Surveying Atomic Gas in Nearby Low-Mass Galaxies with CHORD**
Akanksha Bij (Queen's University) [grad]

67. **Disentangling SFR Timescales: An Updated Identification Method for Rejuvenating Galaxies**
Dylan Lazarus (McMaster University) [grad]

68. **The Role of Galaxy Environment in Pressure-Regulated Star Formation and Gas Content in Galaxies**
Taavishi Jindel (McMaster University) [grad]

69. **Galaxy Stellar Halo Growth: Probing Merger-Driven Mass Assembly**
Devin Williams (Saint Mary's University) [grad]

70. **Structural evolution of galaxies: from disks to disks??**
Elizaveta Sazonova (University of Waterloo) [postdoc]

71. **Identifying backsplash galaxies with machine learning**
Roan Haggar (University of Waterloo) [postdoc]

72. **Stellar Populations of Ultra-Compact Dwarf Galaxies**
Ryan Primdahl (University of Calgary) [grad]

73. **Exploring Star Formation with Made to Order Galaxies: A Tailored High-Resolution Simulation of NGC 5055**
Emily Rock (Mcmaster University) [grad]

74. **Probing the Faintest Galaxies Below the Confusion Limit**
Yunting Wang (University of British Columbia) [grad]

75. **Automated Detection of Dwarf Galaxies in NGC5128 Using Image Processing and Deep Learning**
Cameron Leahy (University of Calgary) [grad]

Galaxy Clusters

76. **The impacts of AGN feedback on galaxy clusters and their surroundings**
Isaac Rosenberg (University of Toronto, Canadian Institute for Theoretical Astrophysics) [undergrad]

77. **Searching for the Extreme: SpARCS1049 Analogues in TNG-Cluster**
Bhuvan Manojh (McGill University) [undergrad]

78. **The Evolution of Galaxy Star Formation and Morphology in Groups and Clusters with IllustrisTNG**
Jing Yeung (McMaster University) [grad]

79. **A nascent intra-cluster medium at z=4.3: detection of the Sunaev-Zeldovich effect in the SPT2349 protocluster**
Scott Chapman (NRC/UBC/Dalhousie) [faculty/staff]

Compact Objects / High-Energy / Supermassive Black holes

80. **Applying the Superlet Transform to AGN Timing Analysis**
Thomas Hodd (Saint Mary's University) [grad]

81. **A Spectral Energy Distribution Variability Study of the Eclipsing AGN NGC 6814**
Lucy Pothier-Bogoslowski (Saint Mary's University) [undergrad]

82. **Multiwavelength Cross-Correlation Using Millimeter AGN Light Curves from the Atacama Cosmology Telescope**
Erika Hornecker (University of Toronto) [grad]

83. **Modelling AGN wind properties using 3rd-order Chandra MEG Absorption Spectra**
Jordan Adamski (Saint Mary's University) [grad]

84. **The High-Resolution Spectrum of Dual AGN Candidate MCG-03-34-64**
Cameron Semenchuck (Saint Mary's University) [grad]

85. **Suppressed Star Formation in Diffuse Disks**
Jason Young (SETI Institute, Williams College)

86. **Modelling Neutron Star Observables in the Schwarzschild Metric With Oblate Rotationally Deformed Surfaces**
John Ngo (University of Alberta) [grad]

87. **How initial magnetic field topology impacts accretion disk geometry**
Gibwa Musoke (Canadian Institute for Theoretical Astrophysics) [postdoc]

88. **RS CVn variables: Potential X-ray Binary Imposters?**
Suhasini Rao (University of Alberta) [grad]

89. **The role of millisecond pulsars in constraining black hole populations in globular clusters**
Noha Hoque (Saint Mary's University) [undergrad]

90. **Radiation and Hydrodynamics in Luminous Red Novae: An Enhanced FLED Framework**
Devotosh Ganguly (University of Alberta) [grad]

91. **Active Galactic Nuclei Survey Simulator: The Use Case of CASTOR**
Viraja Khatu (Canada-France-Hawaii Telescope Corporation) [faculty/staff]

92. **Investigating the AGN variability timescale - black hole mass relationship with Gaia, SDSS and ZTF**
Adrien Hélias (Western University) [grad]

93. **Verification of Cas A neutron star cooling rate using Chandra HRC-S observations**
Jiaqi Zhao (University of Alberta) [grad]

94. **Dude, Where's My Stars? Probing Compact Stellar System Evolutionary Connections via Central Black Holes**
Solveig Thompson (University of Calgary) [grad]

List of abstracts (invited speakers)

Simon Blouin

Title: High-fidelity 3D Hydrodynamics Simulations of Red Giant Branch Stars

Abstract: Stars are dynamic, three-dimensional fluid systems, yet we rarely get to see their inner workings in action. In this talk, I will present results from our 20-billion-cell 3D hydrodynamical simulations that reveal the interiors of red giant stars. These simulations, representing the state-of-the-art in terms of modeling fidelity, combine extreme spatial resolution with realistic microphysics and a full 4π geometry. They resolve in exquisite detail how the turbulent convective envelope continuously impacts the stable radiative interior, exciting internal gravity waves that ripple through the stellar interior. Our key discovery is how rotation transforms wave dynamics, enhancing wave-induced mixing between the stellar core and envelope by over 100 times compared to non-rotating models. This mechanism can solve long-standing observational puzzles regarding surface abundance anomalies in red giants.

Lisa Dang

Title: Mapping Infernal Worlds by Revealing their Multidimensional Nature

Abstract: Although we will never get the same level of details for exoplanets as we do for Solar System bodies, the large diversity of exoplanets revealed by exoplanet hunting missions, e.g. Kepler and TESS, provide thousands of study cases to refine formation and evolution pathways as well as theories of how their climate is shaped by their environment. Particularly amenable for atmospheric characterization, short-period exoplanets with dayside blasted with stellar radiation are some of the best-characterized exoplanets to this day. Due to their synchronous rotation, they exhibit large day-to-night differences and their observation can be difficult to interpret without a full understanding of their "3D-ness". Fortunately, phase-resolved observations can reveal the inhomogeneous nature of these exoplanets and provide a more comprehensive view into their atmosphere. In this talk, I will present what we have learned from observations of a variety of close-in planets from large hot Jupiters to small lava planets. More excitingly, I will also discuss the continuation of Spitzer's legacy in the era of JWST and ground-based high-resolution spectroscopy.

Jason Rowe

Title: Building a Space Telescope: The Pandora and POET Missions

Abstract: Developing a space telescope presents unique opportunities for Canada to drive scientific discovery and technological innovation, enabling researchers to explore the universe in unprecedented detail and push the boundaries of human knowledge. This talk

will outline the process of building a space-based instrument, highlighting key technical milestones from conceptual design to launch and operation. We will draw on the experience of two small-sat missions - the Pioneers Pandora Mission and the Canadian POET mission - to illustrate the development lifecycle and strategies for overcoming challenges faced by Canadian teams.

Through case studies of these missions, we will discuss the importance of interdisciplinary collaboration, innovative engineering solutions, and effective project management in overcoming the technical and logistical hurdles associated with space telescope development. We will also explore how these missions have driven advancements in areas such as optics, detector technology, and spacecraft operations, and how they will pave the way for future Canadian contributions to international astronomical research.

By sharing lessons learned and best practices from these missions, this talk aims to provide valuable insights and inspiration for researchers, engineers, and students involved in the development of future space telescopes. The development of space telescopes can drive scientific progress, foster technological innovation, and inspire new generations of scientists and engineers to pursue careers in astronomy and aerospace engineering.

Kate Rowlands

Title: Post-starburst galaxies: a tool to track quenching throughout cosmic time

Abstract: One key problem in astrophysics is understanding how and why galaxies stop forming stars. The exact mechanisms that lead to the disruption of the gas supply, the relative importance of different quenching mechanisms, and the timescales involved are still poorly understood. Post-starburst galaxies are an ideal laboratory to study the galaxy transition process as they have undergone a recent, rapid shutdown in star formation. Recent work has showed that post-starburst galaxies are not completely devoid of gas, which challenges the rapid quenching mode thought to form the quiescent population. I will describe what the number densities, AGN demographics, environments and gas contents of post-starburst galaxies reveal about the processes causing galaxies to transition from star forming to quiescent, from cosmic noon to the present day. I will review how deep observations from JWST and ALMA are providing insights into mechanisms of AGN feedback, star-formation suppression and gas cycling in galaxies at a crucial point in their evolution.

Katelin Schutz

Title: A minimalist approach to modelling reionization

Abstract: I will discuss recent progress in perturbative approaches to model the epoch of reionization — despite all of the complex galactic astrophysics responsible for ionizing the intergalactic medium — using techniques inspired by particle physics. Specifically, I will discuss how effective field theory, a principled order-by-order expansion, can accurately reproduce (and even predict!) hydrodynamical simulations of reionization at the sub-10% level with only a few free parameters on scales that are observable by HERA and other high-redshift observatories.

Alexandra Tetarenko

Title: Unravelling the mysteries of black holes and neutron stars with flashes, bursts and eruptions

Abstract: The most powerful cosmic engines in our universe are fueled by compact objects such as black holes and neutron stars. These cosmic engines consume large amounts of material and expel matter in the form of jets travelling at near the speed of light. Recent groundbreaking discoveries of gravitational waves from systems harbouring compact objects and the direct imaging of the black hole shadows with the Event Horizon Telescope, represent major steps forward in our understanding of such systems. However, there exists a huge population of compact objects in our own Galaxy which provides much more ideal laboratories, offering a real-time view of the behaviour of these compact objects and their dynamic environments. In this talk, I will discuss new experiments leveraging the capabilities of today's state-of-the-art telescopes to observe repetitive, (somewhat) predictable, energetic surges of radiation that allow us to track the path of material from inflow to outflow in these Galactic systems.

Chris Willott

Title: Pushing the Study of Active Galactic Nuclei to Early Cosmic Times

Abstract: Quasars and active galactic nuclei are powered by accreting supermassive black holes at the cores of galaxies. I will discuss recent results in the field, with particular emphasis on pushing to redshifts higher than 7 with Euclid and JWST to attempt to answer a question posed almost half a century ago: What are the initial seeds of billion solar mass black holes?

List of abstracts (contributed talks)

Instrumentation

1. **Mapping extended low surface brightness gas with the Dragonfly Spectral Line Mapper**
Deborah Lokhorst (NRC-Herzberg)
Co-author(s): Seery Chen, Imad Pasha, Roberto Abraham, Pieter van Dokkum

We present the first results from the latest evolution of the Dragonfly Telephoto Array, which combines ultranarrow bandpass filters with commercial Canon telephoto lenses to achieve unprecedented sensitivity to visible-wavelength line emission. This unique telescope, the Dragonfly Spectral Line Mapper (DSLM), was designed to map the circumgalactic medium (CGM) of local galaxies in H-alpha, [OIII], and [NII] line emission. A pathfinder version of DSLM detected low surface brightness gas around the M81 group of galaxies, reaching a surface brightness limit of ~ 5 x 10^-19 erg/s/cm^2/arcsec^2. This data has been expanded with DSLM to a sample set of galaxies. We present the first results from DSLM, which include narrowband imaging of NGC 6946, NGC 891, and NGC 7479, revealing a surplus of gas in the field of the galaxies. The gas is suspected to be of both Milky Way and extragalactic origin. We confirm that DSLM's instrumentation is not limited by systematic errors and is on track to surpass surface brightness limits of ~10^-20 erg/s/cm^2/arcsec^2, which is the theoretical limit required to detect the CGM in H-alpha emission. DSLM just scratches the surface as we are currently expanding to a 1000-lens version of the telescope which will conduct a dedicated observational campaign to unveil the CGM of local galaxies.

2. **ANDES and the Extremely Large Telescope : A Canadian Opportunity**
René Doyon (Université de Montréal)
Co-author(s): Allison Man, Frédérique Baron, the Canadian ANDES Science Team

The ArmazoNes high Dispersion Echelle Spectrograph (ANDES) is a second-generation instrument for the Extremely Large Telescope (ELT) in Chile. ANDES is a high-resolution (R~100k), fiber-fed, cross-dispersed echelle spectrograph covering visible to infrared wavelengths (0.35 to 2.4 µm) simultaneously. Designed as a versatile and robust instrument, it supports seeing-limited and adaptive optics observations. The broad range of scientific programmes enabled by ANDES requires the instrument to be divided into 3 modular spectrographs: a blue (BV), a red (RIZ), and an infrared (YJH) spectrograph, with an additional U-band to the B spectrograph and a standalone K spectrograph if funding allows. ANDES will enable transformative scientific discoveries: detecting biosignatures in the atmospheres of nearby habitable exoplanets, identifying the fingerprints of the universe's first stars, and directly measuring the universe's accelerating expansion, each a Nobel-worthy breakthrough. The instrument is scheduled for First light in the early 2030.

In June 2024, ESO and the ANDES consortium signed a construction agreement, underscoring ESO's commitment to equipping the ELT with this crucial instrument. Canada is an active partner in ANDES, contributing to its design through the Laboratoire d'Astrophysique Expérimentale (co-hosted at Université de Montréal and Université

Laval) and the Herzberg Astronomy and Astrophysics Research Centre, with support from a Canadian ANDES Science Team.

This talk will provide an update on the ELT, an overview of ANDES and its scientific capabilities, and outline how the Canadian astronomical community can actively participate in ANDES and use other first-light ELT instruments. With ELT's first light scheduled for 2028, now is the time for Canada to actively engage in a very large optical telescope, and the ELT is the only near-term opportunity.

3. **Colour-blindness: Chromaticity problems and solutions for Coherent Differential Imaging of exoplanets**
   Christopher Mann (NRC - Herzberg)
   Co-author(s): William Thompson, Christian Marois, Olivier Lardière, Jean-Pierre Véran

   Coherent Differential Imaging (CDI) is a powerful tool in the exoplanet direct-imaging arsenal, allowing us to adeptly remove the speckle noise that plagues the technique. CDI can achieve theoretically infinite contrast in monochromatic simulations; however, it suffers from real-world effects that limit its contrast—finite bandpass chromaticity being a major one. Via simulation work and on-bench lab tests, we are developing techniques to mitigate the effects of chromatic fringe-blurring and push the CDI contrast potential ever-deeper. Our efforts are being validated on the Subaru Pathfinder Instrument for Discovering Exoplanets and Retrieving Spectra (SPIDERS) instrument and are laying the groundwork for achieving the contrast needed for Earth-analogue observations by next-generation missions like the Habitable World Observatory.

4. **CADC services for the next generation**
   Stephen Gwyn (Canadian Astronomy Data Centre, National Research Council)

   The Canadian Astronomy Data Centre (CADC) continues to expand its capabilities to support the evolving needs of the Canadian astronomical community. This talk will highlight recent developments, including our plans to provide services to the community to exploit the upcoming influx of data from next-generation observatories such as Euclid, LSST and SKA. For Euclid, we already host the first Q1 data release and will host the upcoming DR1 later this year. We support Canadian LSST participation by providing storage and computing resources for LSST data access, processing, and analysis. Our plans include hosting an Independent Data Access Centre for Canadian researchers, integrating LSST data with our existing holdings. CADC is building a SKA Regional Centre (SRC) node to enable Canadian astronomers to access and process SKA data. We are working with our SKA partners to enable interoperability across the global network of SRCs. To support these new datasets, we are significantly upgrading CANFAR, our cloud computing environment. To meet the needs of SKA/SRC and LSST, we will expand by a factor of 20 in terms of both CPUs and storage by the end of the decade. To support machine learning, the expansion will include a crop of the latest generation of GPUs, available mid-2025. The hardware increase is accompanied by corresponding operations and software developments, building new interfaces and improving reliability, interoperability and scalability to ensure a smooth and uniform user experience across all of our data holdings, both old and new.

Star & Cluster Formation

5. **The impact of feedback from massive interacting binaries on the interstellar medium**
   Claude Cournoyer-Cloutier (McMaster University)
   Co-author(s): Alison, Sills, Eric. P. Andersson, Sabrina M. Appel, Brooke Polak, William E. Harris, Mordecai-Mark Mac Low, Simon Portegies Zwart

   Massive stars, which dominate the feedback budget in cluster-forming regions, are almost always in close binaries. Two thirds of O stars are in binaries close enough to undergo mass transfer before the end of their lives. This has profound consequences on their evolution, as well as on their feedback: mass transfer in binaries increases the UV luminosity and the amount of pre-SN ejecta from a stellar population, and extends the timeframe over which SNe occur. Despite being studied extensively in population synthesis studies, the effects of mass transfer in binaries have not been included in previous models of star and cluster formation: simulations rely on single star prescriptions for mechanical and radiative feedback from massive stars. I present the first suite of simulations of feedback from massive binaries in star-forming regions that accounts for the effects of mass transfer and binary stellar evolution. I compare the properties of the ISM near the stars for simulations using feedback based on binary stellar evolution and on single star stellar evolution. I explore simulations of isolated binaries displaying stable and unstable mass transfer, and simulations of clusters of massive binaries. I also discuss how the changes to the feedback budget due to binary evolution affect our understanding of star formation and galaxy evolution.

6. **The Role of Gas in Star Cluster Formation**
   Jeremy Karam (McMaster University)
   Co-author(s): Alison Sills, Michiko Fujii

   The formation of star clusters takes place embedded inside giant clouds of molecular gas (GMCs) where mergers of smaller sub-clusters into larger clusters is expected. The embedded nature of this process makes observing star cluster assembly inside a GMC challenging. Similarly, computational constraints makes resolving individual stars in a cluster alongside the surrounding gas medium challenging if the initial GMC is very massive and expected to form a massive star cluster. We perform zoom-in simulations of sub-cluster mergers inside a gas-rich GMC to model the evolution of individual stars and the gas environment simultaneously. We analyze the dynamics of clusters as they undergo mergers with other clusters. We show that the surrounding gas environment is extremely important in promoting sub-cluster mergers, and in producing dynamical signatures that we see in Gaia observations (i.e. asymmetric expansion, and rotation). We perform simulations with and without star formation and feedback and find that star formation increases the magnitude of the detected asymmetric expansion and rotation. As well, we study the kinematics of the cluster after it removes its background gas to predict the long term evolution of the cluster.

7. **Spatial and Kinematic Substructure as Tracers of Star Cluster Assembly**
   Alison Sills (McMaster University)

   Simulations of star cluster and assembly are now sufficiently complex that we can simultaneously follow the evolution of the star-forming gas, the stellar populations, and the effect of feedback on the early cluster environment. These simulations tell us that the process of assembling a star cluster is a stochastic combination of sub-cluster formation, mergers, and accretion of gas onto the proto-clusters. These complex processes imprint both spatial and kinematic substructure onto the forming systems. Simultaneously, the exquisite astrometry of the Gaia mission has revealed substructure in local young star clusters and cluster complexes. In this presentation, I will describe some of the statistical measures used to quantify and characterize different kinds of substructure in observed clusters. We apply those same measures to models of cluster formation which include detailed stellar dynamics and a realistic treatment of primordial binaries. Our simulations allow us to follow the evolution of the substructure with time and over different initial conditions for the star-forming cloud. We use these results to provide some context and words of caution for the interpretation of the observational results.

8. **FIELDMAPS: A Survey of Magnetic Support in the Bones of the Milky Way**
Simon Coudé (Worcester State University)
Co-author(s): Ian Stephens, Philip Myers, Jessy Marin, Nicole Karnath, Andres Guzman, Howard Smith, Catherine Zucker

We present results from the Filaments Extremely Long and Dark: A Magnetic Polarization Survey (FIELDMAPS) of far-infrared polarization in ten of the largest known filaments in the Milky Way, observed at 214 μm with the HAWC+ camera on the Stratospheric Observatory for Infrared Astronomy (SOFIA). These observations provide the highest resolution measurements to date of the magnetic field in these dense filamentary structures, also described as the “bones” of our Galaxy. Following our previous study of the G47 cloud (Stephens et al. 2022), we use the Davis-Chandrasekhar-Fermi (DCF) technique, combined with ancillary spectroscopic data of dense gas tracers (e.g., NH3) in each bone, to quantify the magnetic field amplitude across these filaments. Specifically, we experiment with modified DCF techniques such as fitting the Angular Dispersion Function (ADF) along the spine of the filament and with independent methods such as the Spheroidal Flux-Freezing (SFF) technique in selected high-density regions. We present the first description of the polarization structure of all ten bones, their angular relation of the polarization direction to the bone axis, their typical mass to flux ratios (MFRs), and the relation of the MFR to their column density and level of star formation. We compare these results to those published for G47, where we found evidence that the filament is magnetically subcritical (i.e., the magnetic field is sufficient to support the cloud against gravitational collapse) except in regions of active star formation.

9. **What is that? Multi-object Identification in Galactic Regions with JWST Data and Machine Learning**
Breanna Crompvoets (University of Victoria)
Co-author(s): Helen Kirk

Since its first data release in 2022, JWST has been revolutionizing astronomy from the scale of exoplanets to that of the Universe. In Galactic astronomy, JWST’s capabilities present a new problem: how can we accurately categorize the thousands of point sources we see as protostars (YSOs), field stars, dwarfs, or distant galaxies? In this work, we use machine learning to analyze synthetic photometry of brown dwarfs, white dwarfs, field stars (from main sequence through AGB), YSOs, and galaxies, to determine how well these can be separated in a Galactic field. We focus primarily on the identification of YSOs, though this method can be applied to any region of JWST data to separate out the desired class of objects from all others. Our approach allows us to flexibly apply any combination of JWST's 39 filters across NIRCam and MIRI, allowing application to any given set of observations. Even for regions with significant extinction and PAH contamination, our method has excellent recovery (>90% using only 6-8 bands) across all classes of objects. Future work will explore the application of this method to archival JWST data of star-forming regions.

Exoplanets

10. **The Surprising Composition and Climate of WASP-96b Revealed by Panchromatic JWST and Ground-Based Transit Spectroscopy**
Michael Radica (University of Chicago)
Co-author(s): Jake Taylor, Luis Welbanks, Ryan MacDonald, Adina Feinstein, Eva-Maria Ahrer, Maria Zamyatina

WASP-96b is an inflated hot-Saturn exoplanet, which thanks to its very puffy atmosphere and supposed "clear skies", is one of the most observable exoplanets known. However, atmosphere observations with JWST NIRISS in 2023 revealed some surprising inferences into WASP-96b's atmosphere composition, which were seemingly at odds with previous studies of this planet from the ground and with HST, and cast doubt on previous claims of its "cloud-free" skies. In this talk, I will present the first results from a new JWST NIRSpec observing campaign of this planet. With the longer, infrared, wavelengths accessible to NIRSpec, we are able to confirm the highly-elevated abundance of CO_2 inferred by NIRISS, which was missed by HST, and indicates an atmosphere in severe chemical disequilibrium -- contrary to predictions of many previous models. Moreover, we perform the first-ever combined analysis of JWST and ground-based low-resolution transit observations to break degeneracies between the presence of hazes and alkali absorption, and definitively confirm the nature of clouds and hazes in WASP-96b's atmosphere. Finally, I will discuss the implications of asymmetries in the composition of WASP-96b's morning and evening limbs on the 3D structure and climate of this keystone target.

11. **Gravitational instability in the planet-forming disk around AB Aurigae**
Jess Speedie (University of Victoria)
Co-author(s): Ruobing Dong, Cassandra Hall, Cristiano Longarini, Teresa Paneque-Carreño, Bennedetta Veronesi, Giuseppe Lodato, Ya-Wen Wang, Richard Teague, Jun Hashimoto

Although gravitational instability has been long-considered as a promising pathway to planet formation, observational identification of gravitational instability is still very limited. In this talk, I present a clear and convincing case of gravitational instability in the planet-forming disk around AB Aur, a nearby Class II YSO. High quality ALMA observations of CO isotopologue emission reveal global spiral arms in the gas density and kinematics at scales of 100-1000 au. The data show detailed agreement with numerical and analytical models. In particular, we detect the telltale kinematic signature of self-gravitating spiral arms —the "GI wiggle"— in 13CO and C18O simultaneously. Through quantitative comparisons to models, we are able to constrain the AB Aur disk mass. With multiple protoplanet candidates identified amongst the spiral arms in previous observations, the AB Aur system represents a direct observational connection between gravitational instability and planet formation.

12. **The Cosmic Shoreline of Mid-to-Late M Dwarfs**
Emily Pass (Massachusetts Institute of Technology)
Co-author(s): David Charbonneau, Andrew Vanderburg

Detecting and characterizing the atmosphere of a habitable exoplanet is a key goal of exoplanetary astronomy, one that may now be within reach given the James Webb Space Telescope and its upcoming campaign to conduct a large-scale survey of rocky M-dwarf worlds. To select the optimal targets for such a survey, it is imperative that we understand where known planets sit relative to the cosmic shoreline, the boundary between planets that can retain atmospheres and those that cannot. However, many works model the XUV history received by mid-to-late M-dwarf planets using a scaling relation calibrated using more massive stars, despite the fact that fully convective M dwarfs display unique rotation/activity histories that differ from Sun-like stars and early M dwarfs. Here, we synthesize recent developments in the stellar astrophysics literature surrounding mid-to-late M dwarfs, providing an updated model of their historic XUV fluence and refining our picture of where known rocky planets are located relative to the cosmic shoreline. For many mid-to-late M dwarf planets, we calculate a historic XUV fluence that is greater than the canonical XUV scaling relation by more than a factor of 3.5. As a result, we find that only the largest known terrestrial planets are capable of retaining atmospheres within the cosmic shoreline paradigm. Our calculations thus provide important and timely context for the James Webb Space Telescope and its efforts to search for atmospheres of rocky M-dwarf worlds.

13. **Characterizing the Exoplanet Population Around Mid-to-Late M Dwarfs**
Erik Gillis (McMaster University)
Co-author(s): Ryan Cloutier

Around both Sun-like stars and early M dwarfs, super-Earths and sub-Neptunes form a bimodal distribution with a dearth of planets from 1.6-1.9 Earth Radii, known as the Radius Valley. Models of the Radius Valley have informed our understanding of how these planets likely form and evolve, but a full understanding of the planet formation process requires a complete picture of the planet population over all stellar masses. Thus far, transiting exoplanet surveys have been largely insensitive to planets around mid-to-late M dwarfs. Fortunately, NASA's Transiting Exoplanet Survey Satellite (TESS) has opened a window into the exoplanet population around these stars. I have completed a systematic search for small transiting planets around 9,131 mid-to-late M dwarfs observed by TESS to characterize occurrence rate of planets around the smallest stars. My search employed a custom pipeline to process TESS light curves to detect and vet signals from transiting planets. I recover 74 vetted transiting planets with radii smaller than 6.5 Earth Radii. Using injection-recovery tests, I characterize the sensitivity of my pipeline to planets as a function of planet period, instellation and radius. After correcting for survey completeness, I measure an occurrence rate of 1.326 planets

per star, with orbital periods < 30 days. My results reveal that the planet population around mid-to-late M dwarfs is largely dominated by sub- and super-Earths, which outnumber sub-Neptunes by more than 9:1. This suggests that the Radius Valley disappears around the lowest mass stars. This finding is consistent with theoretical predictions from water-rich formation models, which predict a fading Radius Valley with decreasing stellar mass, supporting the emerging idea that the sub-Neptune population is composed of water-rich worlds around M stars.

14. **Another One Bites the Dust: Using Polarized Light to Probe Dust Grain Sizes in Protoplanetary Disks**
Audrey Burggraf (Queen's University)

To understand how planets form, we must study how dust grains in protoplanetary disks stick together and grow in size. One of the biggest challenges in understanding this process is determining the sizes of dust grains themselves. Fortunately, polarized light from self-scattering in disks provides us with an opportunity to constrain dust grain sizes. Self-scattering occurs when thermally emitted light from dust is scattered by other grains in the disk, with the resulting polarization pattern depending on dust size, disk geometry, and optical depth. This project analyzes multi-wavelength ALMA observations (0.87 mm, 1.3 mm, 1.7, mm, and 2.0 mm) to study polarization in four disks. By analyzing total brightness, polarization intensity, and polarization patterns across the wavelengths, we aim to constrain dust self-scattering in these disks and disentangle this process from other polarization mechanisms. We will then use the scattering models to improve measurements of the disk properties, including dust grain size. In this presentation, I will share preliminary results using simple geometric models to characterize the dust polarization seen in these disks and outline the next steps for modelling self-scattered polarization.

Stars/Solar System

15. **Identifying the first population of Yellow Supergiant Binary Candidates in the Magellanic Clouds**
Anna O'Grady (Carnegie Mellon University)
Co-author(s): Maria Drout, Katie Breivik, Kathryn Neugent, Bethany Ludwig, Ylva Gotberg, Bryan Gaensler

Binary evolution theory predicts that the Hertzsprung Gap — the area of the Hertzsprung-Russell diagram occupied primarily by intermediate temperature evolved stars — is home to multiple populations of binary systems with varied evolutionary histories. Recent works have constrained the binary fraction of evolved populations of massive stars in local galaxies such as red supergiants and Wolf-Rayet stars, but the binary fraction of yellow supergiants (YSGs) in the Hertzsprung Gap remains unconstrained. We have developed a method to distinguish single YSGs from binary

YSGs using optical and ultraviolet photometry, and have applied this method to identify the first population of candidate YSG binaries in the Magellanic Clouds, finding a preliminary binary fraction of 30-60%. In this talk I'll explain how we developed this method, present the results of our initial search for YSG binaries, show preliminary spectroscopic results, and discuss plans to characterize the properties of these systems, constrain the binary fraction of YSGs in the Clouds, and identify what fraction of the binary population have partially stripped envelopes.

16. **The Tell Tail Mass Distribution: How Gaia Neutron Stars Challenge Assumptions**
Aryanna Schiebelbein-Zwack (University of Toronto/CITA)
Co-author(s): Lieke van Son, Will Farr, Maya Fishbach

The mass distribution of neutron stars remains an active subject of study and the recent discovery of neutron stars in binaries with main sequence stars from Gaia (El-Badry, et al., 2024) provides more information and introduces new questions to this discussion. The Gaia neutron stars are on wide orbits (~100s-1000s of days) and therefore are assumed to have never interacted with their companions or accreted additional mass. As such, it is expected that their mass distribution would differ significantly from the mass distribution of recycled neutron stars in galactic double pulsar systems – which are believed to have accreted mass. However, our work reveals that the mass distribution of Gaia neutron stars is statistically consistent with the mass distribution of recycled neutron stars in galactic double pulsar systems. Surprisingly, the Gaia neutron star population is inconsistent with the young, slow galactic neutron stars which are conventionally assumed to not have gained mass. We discuss the observational biases and evolutionary mechanisms that could explain these results, and assess whether other neutron star populations show similar consistency or not. Ultimately, the presence of a high-mass tail in the Gaia neutron star mass distribution — despite their lack of accretion history — raises fundamental questions about the evolutionary pathways of both Gaia neutron stars and galactic double neutron star systems. This also offers possible hints at the birth mass distribution of neutron stars and the processes which shape observed mass.

17. **Expanding and Refining the Open Cluster White Dwarf Initial-Final Mass Relation with Gaia DR3**
David Miller (University of British Columbia)
Co-author(s): Ilaria Caiazzo, Jeremy Heyl, Harvey Richer

The initial-final mass relation (IFMR) relates the final mass of a white dwarf (WD) to the initial mass of its progenitor star, making it a key tool for understanding stellar evolution. Determining the maximum mass for WD progenitors sets core-collapse supernova and compact object formation rates and plays a crucial role in shaping galactic star formation histories and chemical enrichment. Open clusters provide an ideal environment to study the IFMR, as their coeval populations allow for direct progenitor mass estimates. Using Gaia DR3 cluster and WD catalogues, we present a major update to the cluster-based IFMR, restricting our sample to spectroscopically confirmed hydrogen-atmosphere (DA) WDs to minimize systematics. We identify a substantial number of candidate cluster member WDs lacking previous spectroscopic follow-up, observing 22 with Gemini GMOS and Keck LRIS and confirming 20 as DA WDs. Combining these new identifications with an extensive literature compilation, we

construct a Gaia-based IFMR consisting of 70 spectroscopically confirmed WDs. We supplement this sample with 55 literature WDs strongly associated with clusters but lacking reliable Gaia astrometric confirmation. This dataset more than doubles the number of spectroscopically confirmed WDs in previous Gaia-based IFMRs and expands the total sample size by over 50% compared to earlier works. We rederive WD cooling parameters across our full dataset using a methodology that ensures a self-consistent IFMR. We model both the Gaia-based and full-sample IFMRs separately with piecewise linear functions, employing MCMC analysis to determine optimal breakpoint positions and confidence regions. We provide functional forms for both fits and compare our results to recent literature. Finally, we discuss observed discrepancies between our best-fit IFMR and recent Gaia-based, volume-limited field WD samples, as well as potential evidence for a non-monotonic trend at low masses.

18. **The Classical and Large-a Solar System**

Wesley Fraser (Herzberg Astronomy and Astrophysics)
Co-author(s): Samantha Lawler, Rosemary Pike, JJ Kavelaars, Edward Ashton, Stephen Gwyn, Ying-Tung Chen, Yukun Huang, Brett Gladman, Jean-Marc Petit, Justine Obidowski, Lowell Peltier, Mike Alexandersen, Benoit Noyelles, Chang-Kao Chang, Andy Connolly, Shiang-Yu Wang, Mario Juric, Christa Van Laerhoven, Michele Bannister,;] Preeti Cowan, Kat Volk, Jack Pattersen

Here we present results of CLASSY: the Classical and Large-A Solar SYstem survey. Running into its third year, this 2-year CFHT Large Program was allotted 75 nights from 2022B through 2024A inclusive, with a 16 night extension in 2024B and 2025A to accommodate time lost due to equipment failure. Using shift'n'stack techniques, CLASSY has been surveying 5 independent pointings (10.1 square degrees total) of the cold classical belt's forced midplane, with as uniform spread in ecliptic as possible, achieving depths of r~26.8 in search of Kuiper Belt Objects and extreme trans-Neptunian objects (eTNOs). Field opposition locations are chosen to be spaced as evenly as possible and span a two-month window (AS: Aug-Sept, ON, JF, MJ, JA). By design each field is visited in 5 visits across the first year (discovery), and are tracked to a second opposition one year later for some fields, and 2 years later for others (tracking). All discovery fields have been acquired, and all fields have received a complete year 2 or year 3 follow. This presentation will provide an overview of the survey design, and what we have learned during the execution of this surprisingly challenging project. In particular we will highlight just how vital the queue-based observations that are offered by the CFHT and her staff have been for our program. We will finish with some science highlights. One of the main science goals is to complete a census of extreme TNOs with minimal bias in ecliptic longitude. While full statistical testing of the nodal clustering of the most distant TNOs will require the completed survey analysis, we have some very interesting initial discoveries to highlight. One block includes a distant object distribution that agrees with that discovered by the New Horizons survey, which revealed an enhancement of objects at heliocentric distances >~80au than otherwise expected. One of the CLASSY distant discoveries is possibly the lowest eccentricity 5:2 resonator yet discovered, pushing into some weird and wild orbital dynamics phase space.

19. **A Terminator Asteroid that Will Be Back**

Martin Connors (Athabasca University)
Co-author(s): William Newman, Amy Mainzer

Discovered on Christmas Day 2024, asteroid 2024 YR4 captured attention due to having a small but very finite chance of impacting Earth in 2032. Previously unnoticed, it has made close visits to Earth in the modern epoch every fourth year since 1948, indicating a 3:1 mean motion resonance with Jupiter. By chance, the asteroid 887 Alinda also passed by Earth in early 2025, but at present cannot impact. Its orbit had its parameters vastly improved through radar detection, which also revealed a peculiar shape. 4179 Toutatis, similarly resonant, has a double nature revealed by radar and space mission. Alinda, discovered in 1918, gave its name to this class of resonant asteroids in the Kirkwood gap at 2.5 AU. All three asteroids have low inclination, which to some degree enhances the impact hazard, although the most important determinant is the location of the orbital nodes with respect to Earth. Although nominally the eccentric orbits of these asteroids are "pumped up" due to the 3:1 MMR with Jupiter, the mechanisms for doing so are not necessarily easily described, nor obtained with toy models. There is a weak 4:1 resonance with Earth that has limited dynamical effects apart from on close encounters. Nevertheless, these are frequent enough that Alinda orbits become chaotic once their eccentricity allows them to cross the orbits of the inner planets. We will discuss general aspects of the 3:1 MMR, and present results from integrations of Alinda's improved orbit and the latest available for 2024 YR4. The latter indicate most likely missing Earth in 2032 but possibly hitting our Moon. Uncertainty in orbits are investigated using "clone studies" in which multiple sets of orbits close to the nominal orbit are integrated to give a range of future behaviours. That of 2024 YR4 will remain uncertain due to the close encounter with the Earth-Moon system in 2032 (after a more distant pass in 2028 which will likely allow a radar orbit to be determined). The most likely outcome is scattering into a non-resonant orbit, which, since the scattering occurs at Earth, will still intersect our orbit. This means that this asteroid "will be back" at some time in the future.

Galaxies I & II

20. **Calibrating star formation rate in nearby nuclear rings at unprecedented spatial resolution**

Anan Lu (University of British Columbia)
Co-author(s): Woorak Choi, Allison Man, Daryl Haggard, Martin Bureau

The accurate measurement of star formation rate (SFR) is essential in inferring any star formation regulation and galaxy evolution theory. This has become an urgent problem, as our observational techniques have advanced to the point that we can now spatially resolve individual star forming units in nearby galaxies. Local SFR can be affected by many complexities, including the evolution and mixing of stellar populations, the ability of stellar continuum light and ionizing photons to leak out of star-forming regions, and dust attenuation. It is thus important to observe different SFR tracers in star forming regions to best calibrate these tracers and accurately measure SFR. Here, we present a case study of nearby nuclear rings, which host the brightest stars and most intense star formation at the centres of barred galaxies. We compare H-alpha emission (observed with VLT/MUSE) and free-free radio emission at 33 GHz (observed with VLA) at unprecedented spatial resolution — below 30 pc, resolving individual HII regions. The integrated SFR from different tracers in the entire nuclear rings agree with each other, but significant discrepancies exist locally. We look for explanations of these

discrepancies in archival HST and JWST images as well as ALMA observations, by associating the discrepancies with different stellar populations, dust emission, warm ionized gas (inferred from PAH abundances) and molecular gas distribution. Our multi-wavelength study of these star forming nuclear rings demonstrates that there is no “gold standard” tracer of SFR in spatially resolved star forming regions. It is essential to observe and quantitatively analyze each components in the complete star forming cycle to actually understand the physics behind star formation regulation mechanisms.

21. **Probing the Star Formation Main Sequence in low-mass galaxies at cosmic noon**
Rosa Maria Merida (Saint Mary's University)
Co-author(s): Marcin Sawicki

The Star Formation Main Sequence (SFMS) is a fundamental scaling relation that links the star formation rate of galaxies with their stellar mass. The normalization, scatter, and slope of this relation provide important constraints on the evolution and mass assembly of galaxies over cosmic time. Over the past decades, numerous studies have investigated the evolution of the SFMS from the times of the local Universe to the Epoch of Reionization. However, most efforts so far have focused on the study of bright, massive galaxies (>10^9-10 Msun) due to typical mass-completeness limits. The general picture connecting the low- and high-mass galaxy regimes is not yet fully elucidated and extrapolations from our understanding of high-mass galaxies may not apply. The star formation histories of low-mass objects have been found to be more stochastic and burstier compared to the steady, smooth trajectories followed by more massive galaxies. In my work, I combine data from the JWST/CANUCS, UNCOVER, and CEERS surveys, together with GTC/SHARDS and HST/GOODS-CANDELS data, to explore the evolution of the SFMS properties down to 10^7.5 Msun at $1 < z < 4$. In this talk, I will present my latest results, which suggest possible changes in the slope and scatter of the relation, pointing to an increasing burstiness as we move to lower stellar masses.

22. **Gas, Galaxies, and Rotation: The Resolved Disks of WALLABY**
Nathan Deg (Queen's University)

WALLABY is an untargetted, large area HI survey on the ASKAP telescope. It will observe an the HI content of order of magnitude more galaxies than ever before, and many of these will be large enough to kinematically model. At ~2% complete, the total number of kinematic models is already comparable to the largest collections of HI derived models available to date. In this talk I will present the current set of WALLABY models and their derivation. I will also present some of the early WALLABY results from these models. These range from the measurement of the most robust HI derived scaling relations to date, to investigations of low mass/low velocity galaxies, to detailed kinematic and mass modelling of ultra diffuse galaxies.

23. **Investigating Clumpy Galaxies at z > 5 and their Physical Properties Using JWST**
Kiyoaki Christopher Omori (Saint Mary’s University)
Co-author(s): Guillaume Desprez, Marcin Sawicki

In the currently accepted cosmological framework, the primary pathway for structure growth is through hierarchical merging. In the context of galaxies, this is the process of galaxy interactions and mergers, where multiple galaxies collide and merge to form one

larger galaxy. In addition to being a fundamental building block process for galaxy evolution, galaxy interactions and mergers are also considered to be connected to various processes related to galaxy evolution. One such process is the enhancement of star formation. During a galaxy merger, gas is torqued towards the center of the galaxies, resulting in the formation of star-forming clumps and star formation activity. As such, while it is suggested that clumpy galaxies are a product of merging activity, the exact origin of these clumps is unclear, particularly at high redshifts. Recent JWST observations have enabled us to identify clumps in high redshift galaxies and investigate their origins. In this work, we identify multi-component, clumpy galaxies in JWST observations at redshift z>5 and investigate their star formation activity and stellar population properties. We discuss our findings and results.

24. **Leveraging CANFAR and the ALMA archive to create SALVAGE: The SDSS-ALMA Legacy Value Archival Gas Exploration**
Scott Wilkinson (University of Victoria)
Co-author(s): Sara Ellison, Toby Brown

Understanding the processes that shutdown star-formation in galaxies requires an assessment of both the stellar and gaseous components of a large statistical sampling of galaxies. For Canadian astronomers, large optical surveys have provided a substantial sampling of the resolved stellar distributions, but large samples of resolved molecular gas observations are challenging to compile due to the oversubscription of key facilities such as the Atacama Large (sub)Millimeter Array (ALMA). After 12+ years of operations, the ALMA Science Archive has accumulated an untapped wealth of molecular gas observations waiting to be analyzed as an ensemble. Enabled by the CANFAR Science Platform computing resources, The SDSS-ALMA Legacy Value Archival Gas Exploration (SALVAGE) includes ~300 galaxies with optical data from the Sloan Digital Sky Survey (SDSS) and CO(1-0) observations with ALMA (at comparable resolutions to SDSS). SDSS provides central measurements of stellar mass and star-formation from central fibre spectroscopy and equivalent global measurements from the optical photometry. The accompanying ALMA CO(1-0) observations allow for a molecular gas mass estimate in the central and outer apertures. Therefore, SALVAGE provides a “semi-resolved” perspective of the exchange between gas and stars for a large and diverse sample of galaxies, the largest of its kind. With this sample, we investigate the state of molecular gas in moderately star-forming green valley galaxies and how active galactic nuclei effect central gas reservoirs, leveraging the ALMA archive and Canadian resources to provide new insights into galaxy quenching.

25. **Ram Pressure Candidates at Cosmic Noon**
Ian Roberts (University of Waterloo)

We present a sample of ~100 candidates for galaxies undergoing ram pressure stripping at z~1-3. These galaxies are selected from a blind search through JWST imaging of the COSMOS field on the basis of extended, one-sided features that potentially trace a ram pressure stripped tail. These galaxies are preferentially associated with groups and (proto)-clusters at high-z, are preferentially found above the star-forming main sequence, and show evidence for extremely young stellar populations in the proposed ‘tails’. All of these are characteristics seen in populations of galaxies at the early stages of ram pressure stripping in the local Universe. We will also present preliminary results from a Gemini GMOS-IFU program targeting a particularly compelling galaxy at z=1.155. This resolved spectroscopy will either confirm, or place strict limits, on the presence of a one-sided ionized gas tail associated with the observed extra-planar stellar emission. While it is unlikely that all of these candidate galaxies will prove to be examples of ram pressure stripping at high-z, we argue that it is also unlikely that none will. The current highest redshift for a confirmed case of ram pressure stripping is z=0.7, thus any of the candidates from this sample that are eventually confirmed will be probing uncharted territory and will be invaluable test-pieces for strong environmental galaxy evolution at Cosmic Noon.

26. **Bar fractions up to z = 4**

Tobias Géron (University of Toronto)
Co-author(s): Galaxy Zoo Team

We study the evolution of the bar fraction in disc galaxies over redshift (0 < z < 4) using images from the Cosmic Evolution Early Release Science Survey (CEERS). We presented multi-band coloured images to citizen scientists for classification in a new Galaxy Zoo (GZ) project called GZ:CEERS. The citizen scientists were asked a number of morphological questions, including whether a strong or weak bar is present. After considering multiple corrections for observational biases, we find that the bar fraction decreases with redshift in our volume-limited sample (n = 398); from 25+6-4% at 0.5 < z < 1.0 to 3+6-1% at 3.0 < z < 4.0. However, we argue it is appropriate to interpret these fractions as lower limits. Disentangling real changes in the bar fraction from detection biases remains challenging. Nevertheless, we find a significant number of bars up to z = 2.5. This implies that discs are dynamically cool or baryon-dominated, enabling them to host bars. This also suggests that bar-driven secular evolution likely plays an important role at higher redshifts. When we distinguish between strong and weak bars, we find that the weak bar fraction decreases with increasing redshift. In contrast, the strong bar fraction is constant between 0.5 < z < 2.5. This implies that the strong bars found in this work are robust long-lived structures, unless the rate of bar destruction is similar to the rate of bar formation. Finally, our results are consistent with disc instabilities being the dominant mode of bar formation at lower redshifts, while bar formation through interactions and mergers is more common at higher redshifts.

27. **Possible environmental quenching in an interacting LRD pair at z ~ 7**

Gaia Gaspar (Saint Mary's University)
Co-author(s): Rosa Maria Merida, Marcin Sawicki

Little Red Dots (LRDs) are a recent discovery by the James Webb Telescope (JWST) that had posed challenges to current galaxy models. These objects exhibit a peculiar V-shaped Spectral Energy Distribution (SED) in the UV-optical, along with broad emission lines (FWHM > 1500 km/s), leading to interpretations in the literature as Active Galactic Nuclei (AGNs) or composite AGN/galaxy objects. The proposed host galaxies of these systems span a wide range—from low-mass star-forming galaxies dominating in the UV to massive, dusty, and quenched galaxies in the optical. Similarly, proposed AGN models for LRDs include both absorbed and unabsorbed emission, and in some cases, these models challenge previously constrained dust properties and accretion limits. In this talk, I will report the discovery of a z ~ 7 galaxy group from the Canadian NIRISS Unbiased Cluster Survey (CANUCS) that contains two LRDs separated by only 3.3 kpc,

along with three potential satellite galaxies. For the LRDs, the NIRCam/JWST SED is best fitted with an obscured, massive, and post-starburst host galaxy displaying a clear Balmer Break, and an unobscured AGN component dominating in the UV. The star formation histories derived from the SED fitting present evidence of synchronized bursting and quenching that could have occurred during the close interaction of the two LRDs, strongly suggesting a case of environmental quenching in two massive galaxies as early as z ~ 7.

Education and Public Outreach

28. **The Burke-Gaffney Observatory: A social media controlled robotic telescope for students everywhere**
    Ian Short (Saint Mary's University)
    Co-author(s): David Lane; Tiffany Fields

    The Burke-Gaffney Observatory (BGO) on the Saint Mary's University Campus (lat. +44, long. −63) is equipped with a CCD imaging camera and photometric filter wheel and accepts remote imaging requests in queued-mode. Students anywhere can acquire a BGO account and submit requests via SMS text, Facebook Messenger, Mastodon, email, or our own BGO Communicator app for Windows, MacOS, and Android, and will receive their images the same way. At Saint Mary's we have used the capability for projects ranging from simple white-light direct imaging in our first-year elective astronomy course to time series photometry and cluster colour-magnitude diagram projects in senior research courses. https://observatory.smu.ca/bgo-useme

29. **SpaceEngine: The Universe Simulator**
    Megan Tannock (Cosmographic Software)
    Co-author(s): Vladimir Romanyuk, Alex Long, Brendan Touesnard, Madison Schwartz

    SpaceEngine is a virtual Universe users can explore on their computer. It uses realistic physics and effects to create an accurate, high-definition, full-scale, interactive representation of objects in space with seamless transitions and beautiful visuals. In this presentation, we introduce the software, highlight its features and built-in tools for exploring and learning about space, and describe the process of turning complex astrophysical phenomena into code that can run on a typical gaming computer. Using the example of SpaceEngine's planetary climate model, we will describe the process of implementing a physics model within a large simulation consisting of many sub-systems. We will discuss how to make reasonable scientific approximations to build a product that balances accuracy and interest while being developed on a reasonable timeline. The general public typically receives their space-related news one object or region at a time in the press. In SpaceEngine's 3D, 1:1 scale universe, we put those discoveries into context with the rest of the Universe, demonstrating the full physical scale of space. The program contains hundreds of thousands of real astrophysical objects, with up-to-date physical parameters and orbits. Unknown regions of space are filled in with procedural generation based on real scientific knowledge to ensure SpaceEngine depicts the Universe in the way it is thought to be by modern science. SpaceEngine is frequently used by science communicators and educators, as well as by professional astronomy organizations like ESO, to generate beautiful and accurate visual representations of space.

30. **TIPs for Astronomers: A Collaborative Guide for Young Researchers**
Theodore Grosson (University of Victoria)
Co-author(s): Jaclyn Jensen

Astronomers are fortunate to have a wide variety of telescopes to choose from to conduct research. However, for early career astronomers without extensive knowledge of available facilities, it can be overwhelming to determine which instruments are best suited for desired observations. In an effort to provide a useful tool that aids in the comparison of instruments, we have created Telescopes, Instruments, and Purposes (TIPs), a website containing information about facilities that are available to astronomers. TIPs hosts a filterable list of basic properties for different instruments, as well as examples of scientific research which have made use of the instruments. In order to draw from the diverse expertise of the astronomy community, additions to TIPs can be made through a public Github interface. We invite the CASCA community to contribute to this website as a resource especially for young astronomers in the early stages of their careers. TIPs can be accessed online at https://pagsa.github.io/tips/.

31. **The Reasons for Seasons Concept Inventory: A New Instrument to Assess Students Learning in Astro-101 Courses**
Pierre Chastenay (Université du Québec à Montréal (UQAM))
Co-author(s): Michael Reid, Magdalen Normandeau, Alexandre David-Uraz

Based on the most common misconceptions about the seasons (distance and distance+tilt), as well as the content of the concept domain of seasonal changes, we have built the Reason for Seasons Concept Inventory (RSCI). This new 18-item instrument is based in part on questions excerpted from various validated astronomy concept inventories found in the scientific literature, as well as new questions added to cover the entire concept domain of the seasons. Face validity and construct validity of the instrument were assessed by expert astronomers at Université de Montréal, University of Toronto and several other institutions across Canada and the US. The instrument was field-tested in Astro-101 classes at UQAM, the University of Toronto, and the University of New Brunswick between January 2024 and February 2025. Cronbach's Alpha of the RSCI is .702, indicating strong internal consistency of the instrument. Difficulty index for the items is in the interval 0.30 and 0.90, as suggested (Haladyna et al., 2002), except for two items that were rewritten after the first iteration of the RSCI. Finally, Point-biserial correlation (Pearson' correlation coefficient) is the correlation between the answer to a single item given by one student and the total score obtained by the same student to all questions in the instrument (i.e. discrimination index). In the RSCI, most items have a satisfactorily Point-biserial correlation coefficient (i.e. larger than .30) except for one item (same as above), which is a poor discriminant between students, and was rewritten. Used in a pretest+post-test research design with instruction (Astro-101 course), the RSCI showed excellent capacity to measure learning among undergraduate students. The RSCI also contains sociodemographic questions (age, sex, schooling, previous astronomy courses, etc.) to be used as covariables, as well as two Likert-scale questions about the level of confidence of respondents in their answers to the RSCI and their capacity to explain the reasons for seasons to others. As expected,

answers to these two questions were positively correlated to the total score of respondents on the RSCI. The instrument will be presented and future developments will be outlined.

Compact Objects / High-Energy

32. **Constraining Disk-to-Corona Power Transfer Fraction, Soft X-ray Excess Origin, and Black Hole Spin Population of AGN**
Labani Mallick (University of Manitoba & CITA, University of Toronto)

Unveiling the nature of the accretion disk, its interplay with the X-ray corona, and assessing black hole spin demographics are some open challenges in astrophysics. To address these issues, we systematically modeled broadband XMM-Newton+NuSTAR spectra of a sample of Type-1 active galactic nuclei (AGN) across mass scales. In this talk, I will present the key results derived from our spectral modeling, discuss the implications of the relativistic disk reflection and warm Comptonization for the origin of soft X-ray excess, predictions of the standard alpha-disk model, and how we can compute the disk-to-corona power transfer fraction in accreting objects. I will also discuss how detailed measurements of the reflected X-rays from the accretion disk can be used to probe the innermost regions of accretion flow just outside the event horizon and determine one of the fundamental parameters, the spin of the central black hole across mass scales in AGN.

33. **Breaking the radio frontier for gamma-ray burst afterglow studies in the SKA/ngVLA era**
James Leung (University of Toronto)

The development of the next-generation radio astronomy facilities will break past many current limitations in the study of gamma-ray burst afterglows at radio frequencies, particularly with respect to sensitivity and angular resolution. In this talk, I will talk about the redshift distribution of afterglows that would be able to be probed with next-generation radio telescopes compared to today, and also discuss the science enabled by SKA/ngVLA from wide field surveys down to high angular resolution VLBI observations. I will start by discussing the role of these facilities in confirming and characterising the population of much fainter orphan afterglows, i.e. those identified without a high-energy counterpart. Sensitive radio observations remain the only way to probe highly off-axis jetted events and understand the true underlying GRB rate and population-wide jet geometry/structure, which is still not very well understood despite almost 30 years passing since the discovery of the first afterglow. I will highlight the key results from our pathfinder program on ASKAP, which has found one promising candidate, and discuss the key challenges that successful SKA and ngVLA programs must overcome for maximising orphan afterglow science. I will also discuss the importance of sensitive sub-milliarcsecond VLBI observations enabled by the SKA/ngVLA for breaking parameter degeneracies in the modelling of GRBs, including the understanding of GRB jet properties, as well as in more novel but important applications, such as probing for a population of lensed GRBs that would provide a new, competitive method for constraining cosmological parameters. Only a handful of GRBs have been successfully studied with VLBI and no lensed GRBs have conclusively been confirmed before; both because they are partially limited by sensitivity of current arrays. I will discuss outcomes of recent results from pathfinder programs on the EVN and VLBA targeting these science cases and the capabilities that VLBI on the next-generation facilities should have to be fruitful for high-resolution time-domain astronomy.

34. **Estimating black hole jet power through astrochemistry: New ALMA observations of MAXI J1348-630**

Pau Bosch-Cabot (University of Lethbridge)
Co-author(s): Alexandra Tetarenko, Erik Rosolowsky, Stéphane Corbel, Franceso Carotenuto, James Miller-Jones, David; Russell, Thomas Russell, Gregory Sivakoff

MAXI J1348-630 is a BHXB that was recently discovered in outburst. This source was shown to exhibit strong radio jets with a distinct deceleration pattern of motion, indicative of the presence of a jet-blown cavity in the interstellar medium (ISM). To investigate this further, we observed MAXI J1348-630 with ALMA to map the molecular line emission and search for evidence of a jet-ISM interaction in this region. In this talk, I will discuss the compelling evidence we found in favour of a jet-ISM interaction consistent with the previously proposed cavity structure surrounding this BHXB. These findings allow us to estimate the jet power and provide new insights into how BHXB jets inject energy into their environment, with broader implications for feedback mechanisms in galactic ecosystems.

35. **A Hot Mess: MRK 1239**

Margaret Buhariwalla (Saint Mary's University)
Co-author(s): L. Gallo, J. Mao, J. Jiang, L. K. Pothier-Bogoslowski, E. Järvelä, S. Komossa, D. Grupe

Mrk 1239 is one of the strangest active galaxies you've never heard of. The Active Galactic Nucleus (AGN) at the center of Mrk 1239 was originally classified as a Narrow Line Seyfert 1 (NLS1). This indicated a clear line of sight to the broad line region of this source, and a relatively low-mass supermassive black hole (SMBH). However, later polarized optical measurements of this source showed a high level of polarization, indicating dusty gas in our line of sight. X-ray observations of this source revealed its complex nature. Detailed timing analysis shows that the soft band of Mrk 1239 is completely absorbed, meaning we receive no flux directly from the AGN below 2 keV (6.2 AA). This is very challenging to the Seyfert 1 classification of Mrk 1239, and begs the question: Where is the soft emission we see coming from? To probe this, we explore deep observations of this source using XMM-Newton and NuSTAR. We find evidence of collisionally ionized and photoionized material in the soft X-ray band, making Mrk 1239 one of only a hand full of AGN that show emission from both. The harder, high energy X-ray band shows strong evidence for emission originating in the innermost regions of the accretion disc. To explain the many X-ray properties of Mrk 1239 we propose that this is a young AGN whose flaring central engine is pushing material away from the supermassive black hole. This material is crashing into the ISM, creating the collisionally ionized emission. This process clears material from our line of sight, as the AGN is 'digging' its way out from a cloud of material. Mrk 1239 could be undergoing a short-lived, but important step in the AGN duty cycle. The data demand the intricate scenario

and highlights the complexity of the environment that is normally invisible when overwhelmed by the AGN continuum.

Supermassive Black Holes

36. **The galaxy-SMBH mass scaling relations over 13 billion years in SHARK v2.0**
Matías Bravo (McMaster University)
Co-author(s): Claudia Lagos, Chris Power, Katy Proctor, Ángel Chandro-Gómez

The presence of strong correlations between super-massive black hole (SMBH) masses and key galaxy properties like stellar mass in the local Universe have been well-established, but how these scaling relations evolve with cosmic time and the drivers of the observed scatter remains unclear. Recent studies have emphasized the influence of third parameters, such as galaxy morphology, on the scatter of SMBH-galaxy mass scaling relations. However, the impact of other galaxy properties, particularly the role of environment, remains poorly explored. In this work, we use the state-of-the-art SHARK v2.0 semi-analytic model to explore the evolution of these galaxy-SMBH scaling relations to expand the available predictions from theoretical models to contrast with existing and upcoming observations. We find the relations between SMBH masses and both total and bulge stellar mass predicted by SHARK v2.0 to be in good overall agreement with observational measurements across a wide range of redshift and stellar masses. These scaling relations show a significant evolution as a function of cosmic time in SHARK v2.0, with SMBH masses ~1 dex lower at z=0 compared to z=9 at fixed stellar mass and the scatter increasing by a factor of ~2-5 towards low redshift. The scatter in both relations is correlated with multiple galaxy properties, though we find that galaxy morphology alone explains most of the scatter, with environment playing an indirect role in the SMBH scaling relations through its impact on morphology.

37. **Complex Dynamics of Stars and Nebular Gas in Active Galaxies Centred in Cooling X-ray Atmospheres**
Marie-Joëlle Gingras (Waterloo Centre for Astrophysics, University of Waterloo)
Co-author(s): Alison Coil, Brian McNamara, Serena Perrotta, Fabrizio Brighenti, Helen Russell, Muzi Li, Peng Oh, Wenmeng Ning

Active Galactic Nuclei (AGN) feedback is known to play a key role in galaxy evolution and in regulating star formation. Studying the interplay between the central AGN and the different gas phases permeating galaxies is crucial to further our understanding of this powerful mechanism. We have observed the central regions of four brightest cluster galaxies at optical wavelengths using the Keck Cosmic Web Imager. With the high-resolution Integral Field Unit data obtained from these observations, we map the fluxes and velocities of both emission lines and stellar absorption lines. This allows for a detailed tracing of gas cooling in galaxy centres. These galaxies have extensive X-ray and radio observations, allowing us to compare the dynamics of different gas phases and to study their interactions. Nebular emission extends up to tens of kiloparsecs from the central cluster galaxies of Abell 1835, PKS 0745-191, Abell 262, and RXJ0820.9+0752. With the stellar continua, we map the kinematics and ages of the stars, learning about the systems' star formation histories. Our findings highlight the complex stellar and gas

dynamics which can be induced by radio-mechanical feedback. Surprisingly, three of the four systems have substantial (~ 150 km/s) velocity differences between the central galaxy and its associated nebular gas. This shows that, contrary to popular assumptions, the central galaxy is not at rest with respect to its surrounding nebula. In PKS 0745-191 and Abell 1835, nebular gas is churned to higher velocity dispersions by the buoyantly rising bubbles and jets. The churned gas is also surrounded by larger scale, lower velocity dispersion nebular emission. These complex motions will affect thermally unstable cooling, the interactions between the AGN and its atmosphere and how jet energy dissipates in its surroundings. These novel results highlight the deeply complex dynamics of AGN and the multiphase gas in the centre of massive galaxies.

38. **Detour Ahead: The Supermassive Black Hole That Took the Wrong Exit in a Compact Elliptical Galaxy**
Matthew Taylor (University of Calgary)
Co-author(s): Behzad Tahmasebzadeh, Solveig Thompson, Monica Valluri, Eugen Vasiliev, Michael Drinkwater, Laura Ferrarese, Patrick Cote

Compact elliptical galaxies (cE's) are a rare form of compact stellar system with ~10^{8-10} solar masses packed into very compact configurations as small as a few dozens of pc. These stellar mass densities offset them from typical galaxy scaling relations, which combined with their rarity – M32 being the only example in the Local Group, and only four identified in the entire Virgo galaxy cluster – make them unique targets in which to study galaxy evolution. One famous example is NGC4486B, a cE in the Virgo cluster that harbours a double nucleus like that discovered in the core of M31. A ~10^8 solar mass supermassive black hole (SMBH) has been claimed to reside in the centre of NGC4486B, but definitive evidence has been lacking despite the original claim dating back to the late 90's. In this talk I will present new results based on an analysis of high-quality, spatially-resolved spectral data taken with the integral-field unit on JWST's Near Infrared Spectrograph. A 2D kinematic analysis reveals a sharp peak in the velocity dispersion map. Based on Schwarzschild modeling of the 2D kinematic map, we confirm the existence of a ~10^8 solar mass SMBH in NGC4486B's core region. Most interestingly, we find that the kinematic peak and associated SMBH is not co-located with the central bright nucleus of the galaxy. Rather, it shows an offset of ~12pc, which corresponds closely to the location of the fainter secondary nucleus. We interpret these findings as the double nucleus of NGC4486B arising from an ellipsoidal, apsidal disk of stars, where the fainter offset nucleus is formed by the retinue of stars located directly nearby to the SMBH, while the brighter central nucleus corresponds to stars gathered near the apocentre of their elliptical orbits. Further modeling may reveal the presumed presence of another SMBH located in the brighter nucleus, which would make NGC4486B a prime target for studies of binary SMBH systems in the nearby universe.

39. **A spectrotemporal analysis of X-ray reverberation in the Seyfert 1.5 galaxy 4U 1344-60**
Adam Gonzalez (Saint Mary's University)
Co-author(s): Luigi Gallo

The highly variable X-ray emission of active galactic nuclei (AGNs) is produced by the so-called X-ray corona near the central supermassive black hole (SMBH). Reprocessing of coronal X-rays in the various structures of the AGN central engine (i.e. the accretion

disc, dusty torus, etc.) reveals their chemical composition, dynamics, and structure via their characteristic emission spectra. Correlated variations between direct and reprocessed X-ray emission offer another lens through which the properties of the SMBH, corona, and reprocessing matter may be probed. 4U 1344-60 is a nearby, X-ray bright AGN that has previously exhibited significant changes in the nature of its X-ray reprocessor. Between 2001 and 2011, the reprocessor was found to have changed from the innermost region of the accretion disc to the dusty torus on much larger size scales. A more recent 2016 observation cannot statistically distinguish one scenario from the other based on spectral fits alone. By performing a joint spectrotemporal analysis of the 2011 and 2016 data sets, we find that the reprocessor has changed again, back to an inner disc scenario. Our results describe an evolving AGN central engine, and provide the first-ever X-ray-based SMBH mass estimate of this system.

Cosmology & Early Universe

40. **Constraining the Primordial Power Spectrum with the Atacama Cosmology Telescope**
Simran Nerval (University of Toronto and The Dunlap Institute for Astronomy & Astrophysics)
Co-author(s): Renee Hlozek, The ACT Collaboration

Measurements of the microwave sky provide a window into the earliest moments of the cosmos. The Atacama Cosmology Telescope (ACT) operated from 2007 to 2022 and offers the tightest constraints on the cosmic microwave background (CMB) to date. I will present constraints on the primordial power spectrum using new data from the ACT Data Release 6 (DR6) as well as Planck legacy data, baryon acoustic oscillation data from DESI Year-1, and CMB lensing data from both ACT and Planck. While the concordance cosmology Lambda Cold Dark Matter (LCDM) model is a good fit to our data, the ACT data allow us to study models beyond this standard picture. In order to explore a broader range of deviations from the simple power-law primordial adiabatic power spectrum than those captured solely by the running of the scalar spectral index, we consider a more model-independent approach. We reconstruct the primordial power spectrum of curvature scalar perturbations for 30 k bins from $k = 10^{-4} - 0.43 ~\mathrm{Mpc^{-1}}$, and constrain the amplitude per bin. Given the degeneracy between the primordial power and the optical depth (often described in terms of the ${A_s-\tau}$ degeneracy), we sample the value of $e^{-2\tau}P_{\mathcal{R}}(k_{i})$ for each $i^{\rm th}$ bin. We find that the constraints from our combined analysis with all listed data sets are improved over the Planck-alone measurements wherever ACT data are included (for $\ell \gtrsim 850$). I will show a mapping of this measurement onto the linear matter power spectrum and compare with other measurements from the Dark Energy Survey (DES), the Sloan Digital Sky Survey (SDSS), the extended Baryon Oscillation Spectroscopic Survey (eBOSS), and the Hubble Space Telescope (HST) measurements of the UV galaxy luminosity function (UV LF).

41. **Witnessing the First Stages of Galaxy Assembly in the Cosmic Dawn with JWST Imaging and Spectroscopy**
Marcin Sawicki (Saint Mary's University)

Co-author(s): Yoshihisa Asada, Guillaume Desprez, Roberto Abraham, Maruša Bradač, Gabriel Brammer, Anishya Harshan, Kartheik Iyer, Nicholas S. Martis, Lamiya Mowla, Adam Muzzin, Gaël Noirot, Swara Ravindranath, Ghassan T. E. Sarrouh, Victoria Strait, Chris J. Willott, Johannes Zabl

The hierarchical model of galaxy formation has long predicted that galaxies like the Milky Way gradually assemble through hierarchical merging over cosmic time, starting soon after the Big Bang and continuing to the present day. While evidence of this mechanism is well established for recent cosmic epochs ($z<2$), studying its earliest stages directly has been challenging until the advent of JWST.

I will present observations of systems of a sample of low-mass (~10^7 solar masses) galaxy building blocks undergoing hierarchical assembly when the Universe was just one gigayear old ($z\sim5$). I will then focus on an archetypical example, where gravitational lens magnification allows us to study this early assembly process on sub-kpc scales. Our JWST/NIRCam imaging and NIRSpec spectroscopy let us measure directly the system's recent star formation history (very bursty) and constrain its chemical enrichment (very low), pointing to the key role of gravitational interactions and merging in fuelling star formation in these early stages of galaxy assembly. Abundance-matching arguments indicate that this low-mass system is likely to grow into a 10^{11} Msun galaxy over the subsequent 12.7 billion years, and thus these observations provide us with a direct look at what the early stages of the hierarchical assembly of a Milky-Way galaxy may have been like.

42. **Beyond the First Light: Novel Simulations of Pop III Stars with PeakPatch-GIZMO Pipeline**

Vasilii Pustovoit (CITA/University of Toronto)
Co-author(s): J. Richard Bond, Norman Murray, Christopher Thompson

Recent observations with JWST have successfully identified galaxies at high redshifts ($z \gtrsim 13$), yet the Initial Mass Function (IMF) of the Universe's first stars, known as Population III (Pop III) stars, remains poorly constrained. Addressing this gap, our work employs a novel numerical strategy utilizing the Meshless Finite Mass (MFM) method within the GIZMO simulation framework to study Pop III star formation with an unprecedented level of detail. This method surpasses previous methods used in such studies by offering improved accuracy in modeling accretion disks and high-density regions, crucial for understanding the early universe's star formation processes. Incorporating the STARFORGE module enables a prediction of the IMF, a critical advancement for studying Pop III stars. Furthermore, the implementation of particle splitting and zoom-in techniques facilitates the resolution of individual stars from initial conditions (ICs) derived from the Cosmic Microwave Background (CMB) on megaparsec scales. The goal of our initial efforts is to improve our understanding of the physics of high-redshift star formation, revealing new insights into the formation mechanisms and structural properties of Pop III stars.

43. **Making scientific simulators and pipelines easy with caskade**

Connor Stone (Université de Montréal)
Co-author(s): Alexandre Adam

A near universal task in modern astronomy is the construction of scientific simulators and pipelines. These may represent mock observations, models to fit to data, or data processing workflows. A common challenge in the development of such codes is the maintainability while priorities and techniques change over time. Hard coded passing of parameters through growing simulators and pipelines is fragile and can lead to lost time or hidden errors. Caskade is a development workflow for such simulators and pipelines that scales effortlessly to allow for faster and more stable progress. In this talk I will demonstrate how caskade can improve almost any analysis workflow and I will demonstrate the ecosystem that is building up around it. Since caskade modules can interface seamlessly, this finally realizes the dream of a growing "Lego of code" system for users to design their own workflows.

Galaxy Clusters

44. **Decoding quenching in the Virgo cluster with spatially resolved star formation**
Cameron Morgan (University of Waterloo)
Co-author(s): Elizaveta Sazonova, Ian Roberts, Michael Balogh, Alessandro Boselli, Matteo Fossati, Laura Ferrarese, Patrick Côté

The Virgo cluster presents a unique opportunity to disentangle the roles of environmental quenching mechanisms such as ram-pressure stripping and starvation given its proximity and ongoing formation. Leveraging deep, spatially resolved optical and H-alpha data from Virgo cluster surveys, we are probing the effects of the environment on both integrated and spatially-resolved scales for galaxies spanning from dwarfs to massive spirals. We have measured stellar mass functions across the cluster, splitting the population according to star formation rate. Although Virgo is a low-mass, dynamically young cluster, we find it is dominated by low-mass galaxies with negligible star formation, throughout the cluster and beyond the virial radius. We have quantified the edges of star-forming disks and shown that in the cluster, these disks are truncated with respect to normal star-forming galaxies. The ubiquity of this feature across the cluster, including in areas where ram-pressure stripping cannot be dominant, suggests that more passive mechanisms such as starvation consume gas and kickstart quenching well before the galaxy approaches first pericenter. While the effect of the cluster halo itself may begin earlier than expected, smaller group structures and filaments around the cluster likely also play a role in pre-processing galaxies. Using multiwavelength photometry including the ultraviolet and H-alpha, we compute spatially-resolved star formation histories in Virgo galaxies with different environmental quenching signatures, to understand how recent star formation across the disks of galaxies is affected by various quenching mechanisms. These results demonstrate that low-density environments can have a dramatic effect on galaxy evolution long before they are accreted by massive clusters.

45. **From UV to optical: cosmic environment and the size evolution of quiescent galaxies**
Angelo George (Saint Mary's University)
Co-author(s): Ivana Damjanov, Marcin Sawicki

Understanding how dense environments shape galaxies is crucial for unravelling galaxy evolution. The deep CFHT and Subaru imaging in six filters over 18 sq. deg. provides an ideal dataset to study galaxy morphology across environments and redshifts. Using this dataset, we analyze the size–mass relation of 85,000 massive quiescent galaxies in the field and cluster cores over the past 6 billion years (George et al., submitted to ApJ). For the first time, we perform this analysis in two rest-frame wavelengths – UV (tracing young stars) and optical (older stars) – leveraging a statistically large sample. We find that the quiescent galaxies in clusters are systematically smaller than their field counterparts, with the most pronounced differences observed in the rest-UV. Additionally, Milky Way-mass quiescent galaxies grow rapidly in both environments. In the field, mergers and accretion drive this growth (George et al. 2024, MNRAS, 528, 4797), whereas cluster cores suppress mergers, suggesting alternative mechanisms. The differences we observe between cluster and field galaxies point to distinct evolutionary pathways, shaped by their surrounding environments.

46. **The impact of the dynamical states of galaxy clusters on the properties of clusters and cluster galaxies across 0 < z <1**
Syeda Lammim Ahad (Waterloo Centre for Astrophysics)
Co-author(s): James Taylor, RashaadReid, Charlie Mpetha

According to the hierarchical structure formation model, larger structures in the Universe, such as galaxy clusters, grow through the merging and interactions of smaller systems like galaxies and galaxy groups. A relaxed and evolved galaxy cluster has had enough time to virialize, unlike clusters that are still dynamically active. Therefore, the dynamical state of clusters is strongly tied to the cluster formation timescale, and the mass and light distribution in relaxed and unrelaxed clusters are expected to be different. However, the impact of the dynamical states of clusters on the properties of these systems and their member galaxies has not been explored in detail. One reason for this has been the lack of a large sample of clusters with reliable measures of their dynamical classification. In this work, we study a sample of ~6000 relaxed and ~6000 unrelaxed galaxy clusters from the UNIONSxDESI Legacy surveys, which is improving the sample size of such analysis by at least two orders of magnitude. We quantify the impact of the dynamical states on the mass and light distributions in clusters with a halo mass range between 10^13.8 and 10^15 Msun across redshift 0 to 1. We find significant differences in the stellar mass function, mass density profiles, and weak lensing mass measurements between the stacked relaxed and unrelaxed clusters. These findings highlight the need to carefully consider the cluster dynamical states in any stacking analysis, such as the weak lensing mass measurements of stacked clusters. In this talk, I will show our findings from this work and demonstrate the potential bias introduced in the stacked measurements by not considering the dynamical states.

47. **Tracers of galaxy cluster environments**
Marie-Lou Gendron-Marsolais (Université Laval)
Co-author(s): Camille Poitras, Mélissa St-Pierre

Galaxy clusters are found at the intersections of the filaments of the Cosmic Web and formed stormy, interacting environments, involving physics beyond the reach of a terrestrial laboratory. They gather several hundreds of galaxies, large amounts of dark matter, and a hot, diffuse, X-ray emitting plasma within a constantly evolving

gravitational potential permeated by magnetic fields. Recent technologies now offer the potential to capture and characterize the light from these constituents at an unprecedented level. In this talk, I will present how optical integral field units spectrographs and multi-frequencies radio arrays can serve as complementary diagnostic tools to probe the physical properties of galaxy cluster environments. I will focus on one particular case: the notorious Perseus cluster. As the brightest cluster in the X-ray sky, it is a well-studied object and has been the center of numerous discoveries. Due to its proximity, it is an ideal laboratory to study all processes taking place in a typical cluster as it is internally perturbed by the nuclear outburst of its central dominant galaxy, NGC 1275, as well as externally affected by its interaction with its surrounding environment. I will show how cutting-edge multiwavelength observations of this cluster and novel analysis techniques have revealed a multitude of unexpected structures and challenged our understanding of cluster's physics. Such studies are essential for dynamical comparison with X-ray observations (from e.g. XRISM), and pave the way for the future generation of radio observatories, such as the world's next most sensitive radio telescope, the SKAO.

48. **Exploring Star Formation and Multi-Phase Gas in a Brightest Cluster Galaxy with JWST, MUSE, and ALMA**
Lucas Kuhn (The University of British Columbia)
Co-author(s): Allison Man, Laya Ghodsi, Paola Andreani, Carlos De Breuck

We provide a comprehensive multi-phase study of the interstellar and circumgalactic medium (ISM and CGM) of the brightest cluster galaxy (BCG) in MACS1931-26, a cool-core cluster at z~0.35. This galaxy hosts a radio-loud active galactic nucleus (AGN) and a massive molecular gas reservoir, extending over 30 kpc in a tail-like structure, likely responsible for the galaxy's enhanced star formation. We present new JWST MIRI observations revealing the spatially resolved distribution and kinematics of warm molecular gas—traced by rotational H2 lines—along with ionized gas, and dust tracing polycyclic aromatic hydrocarbons (PAHs). By combining these warm (100–1000 K) H2 observations with cold (10–50 K) H2 traced by ALMA CO measurements, we probe an extensive temperature range of the molecular phase. Our analysis reveals a comparable warm-to-cold gas mass ratio across the ISM core (1.0%+/-0.3%) and CGM tail (1.3% +/-0.8%), suggesting active coupling between molecular gas components despite varying heating mechanisms. We investigate these mechanisms in the ionized phase, where detections of the AGN-tracing [S IV]10.54 um line, combined with radio continuum data, suggest the jet's potential role in heating and shocking gas. Additionally, we use PAH features and Halpha emission from MUSE data to search for signatures of shock-induced star formation. Ultraviolet radiation from these regions and several localized star-forming clumps may also influence gas excitation. Finally, we compare observed optical/infrared diagnostic ratios to predictions from photoionization and shock modeling to quantify the relative contributions of different heating mechanisms. With an approved JWST Cycle 4 program targeting the same source, we will soon test these models and predict new line ratios using NIRSpec and the full MRS spectrum. Our preliminary findings indicate that it is necessary to consider multiple mechanisms to fully explain the heating of both gas phases. By analyzing the CGM across a range of temperatures, ionization states, and wavelengths, we provide new insights into feedback, the baryon cycle, and the roles of shocks and turbulence in the heating and cooling of the multiphase CGM.

49. **The Virgo Astrosat UVIT Long-Term (VAULT) Survey: The Far-UV Luminosity Function of the Virgo Galaxy Cluster**

Jade Yeung (University of Manitoba)
Co-author(s): Tyrone Woods, Charles Lee, Chelsea Spengler, Pat Cote

We surveyed the Virgo galaxy cluster in the far UV using the UVIT instrument onboard the Indian space telescope Astrosat. UVIT has a wide field of view with a diameter of 28' and a relatively high angular resolution of 1.8". Images were taken using the BaF2 (F154W) filter of 48 distinct pointings covering a total area of ~8 deg2. After estimating and subtracting the backgrounds, we recovered 70-100% of galaxies in the Next Generation Virgo cluster Survey (NGVS) catalog that fall within the survey footprint. Compared to previous studies with GALEX, this significantly increases the number of faint galaxies in the cluster with available FUV photometry and at much greater spatial resolution. We find the FUV luminosity function to be well described by a Schecter function with best-fit parameters M^{*}=-18.89+/-0.97 and =-1.26+/-0.03. The slope is consistent with deep optical (g-band) measurements in the cluster core, however, it is somewhat steeper than what was measured with GALEX. Looking ahead, this survey data will enable detailed analysis of recent star formation, perturbation-induced peculiarities in ionized gas emission, and dwarf galaxies that are recent post-merger systems, providing an invaluable probe of cluster evolution and a benchmark for higher redshift studies.

Local Group & Near-Field Cosmology

50. **Census of dwarf galaxies within the Local Group in UNIONS and implications for galaxy formation on the smallest scales**

Simon Smith (University of Victoria)
Co-author(s): Alan McConnachie, Jaclyn Jensen, Stephen Gwyn, Julio Navarro, Will Cerny, Christian Hayes

At the very extreme end of the galaxy luminosity function lie the ultra-faint dwarf galaxies which are critical small-scale probes of both baryonic physics, (e.g., chemical evolution & the earliest nucleosynthesis events), as well as dark matter physics, (e.g., distinguishing between cosmological models & the particle nature of dark matter). In this work, I will present on the results from a multi-year search for faint dwarf galaxies of the Local Group conducted in the deep, wide-field Ultraviolet Near Infrared Northern Optical Survey (UNIONS). This Canadian-led sky survey has proven to be a rich resource, where my work has produced the discovery of seven previously unknown Local Group galaxies. I will present the overall results from this search and highlight Ursa Major III/UNIONS 1, the least massive, least luminous coherent satellite system ever identified. This particular satellite consists of only 16 solar masses of stellar material, but it exhibits a large stellar velocity dispersion, which we tentatively interpret as the presence of several thousand times more dark matter than normal matter. I will provide updates from active work on Ursa Major III/UNIONS 1, summarize studies of other faint satellites in UNIONS, and discuss their implications for low-mass galaxy formation and small-scale dark matter structure. The exquisite quality and wide breadth of UNIONS has enabled the discovery of one of the most extreme stellar systems known and the contributions of this Canadian-led survey turn a lens toward the future with what will be

possible using the combined might of UNIONS, the LSST program at Rubin Observatory, and the Euclid space mission.

51. **GHOST commissioning science results - IV: Chemodynamical analyses of Milky Way satellites Sagittarius II and Aquarius II**
Dasha Zaremba (University of Victoria)
Co-author(s): Kim Venn, Christian R. Hayes, Raphaël Errani, Triana Cornejo, Jennifer Glover, Jaclyn Jensen, Alan W. McConnachie, Julio F. Navarro, John Pazder, Federico Sestito, André Anthony, Gabriella Baker, Timothy Chin, Vladimir Churilov, Ruben Diaz, Tony Farrell, Veronica Firpo, Manuel Gomez-Jimenez, David Henderson, Venu M. Kalari, Jon Lawrence, Steve Margheim, Bryan Miller, J. Gordon Robertson, Roque Ruiz-Carmona, Katherine Silversides, Karleyne Silva, Peter J. Young, and Ross Zhelem

We present Gemini/GHOST high-resolution spectra of five stars observed in two low surface bright- ness Milky Way satellites, Sagittarius II (Sgr2) and Aquarius II (Aqu2). For Aqu2, the velocities and metallicities of the two stars are consistent with membership in a dark matter-dominated ultra faint dwarf galaxy (UFD). The chemical abundance ratios suggest inefficient star formation from only one or a few supernovae (e.g., low Na, Sr, Ba), and enriched potassium (K) from super-AGB stars. For Sgr2, the velocity and metallicity dispersions of its members are not clearly resolved and our detailed chemical abundances show typical ratios for metal-poor stars, with low dispersions. There is only one exception - we report the discovery of an r-process enhanced star (Sgr2584, [Eu/Fe]= +0.7 ± 0.2; thus, an r-I star). As r-I stars are found in both UFDs (Tuc III, Tuc IV, Grus II) and globular clusters (M15 and M92), then this does not help to further classify the nature of Sgr2. Our exploration of Sgr2 demonstrates the difficulty in classifying some of the faintest (ambiguous) satellites. We advocate for additional diagnostics in analysing the ambiguous systems, such as exploring radial segregation (by mass and/or chemistry), N-body simulations, and the need for dark matter to survive Galactic tidal effects. The spectra analysed were taken as part of the GHOST commissioning observations, testing faint observation limits (G< 18.8) and the single and double IFU observing modes.

52. **Fast dynamical modelling of globular clusters; constraints on initial conditions and black hole physics**
Nolan Dickson (Saint Mary's University)
Co-author(s): Vincent Hénault-Brunet, Mark Gieles, Fotios Fronimos Pouliasis, Peter Smith, Holger Baumgardt

Populations of stellar-mass black holes (BHs) in globular clusters (GCs) strongly influence their dynamical evolution and lifetimes. Recently, we used multimass equilibrium models of Milky Way GCs to explore the present-day BH populations of a large sample of clusters, based on several observables, including velocity dispersions, density profiles and stellar mass functions. We have now combined these equilibrium models with the new rapid cluster evolution model ""clusterBH"", which simulates the bulk properties of tidally-limited GCs and their BH subsystems over time. These coupled models allow us to hierarchically place constraints on the initial conditions of real GCs, based only on their observable present-day conditions. These models also provide a framework for probing the highly uncertain physics surrounding the formation of BHs, such as their natal kicks, by experimenting with flexible prescriptions and common assumptions and analyzing the impacts on the formation, evolution and present-day structure of Milky Way GCs. In this presentation, will describe these new coupled models, and present the results of their application to both mock observations of N-body models and a large sample of real Milky Way GCs.

53. **Decoding the Galactic memory: The slow rotational build-up of the high-redshift Milky Way**
Akshara Viswanathan (University of Victoria)
Co-author(s): Danny Horta, Adrian M. Price-Whelan, Else Starkenburg

Observational studies and cosmological simulations are identifying in situ stars thought to be remnants from the earliest stages of the Milky Way's hierarchical mass assembly, referred to as the proto-Galaxy, since the third data release of the ESA Gaia survey. The transition from a turbulent proto-Galaxy to a rotationally supported disc is a fundamental stage in the formation of the Galaxy. In this work, we use red giant stars with kinematics from Gaia DR3 RVS and elemental abundances from Gaia DR3 XP spectra to examine the azimuthal velocity and orbital circularity evolution of high- and low-α stars across metallicity space (down to the very metal-poor stars). By modelling the conditional probability distribution, P(v_ϕ | [M/H]), using a two-component Gaussian Mixture Model (GMM) with both fixed and evolving velocity parameters, we provide new constraints on the timeline of the proto-Galaxy's spin-up into the high-α disc. Our results demonstrate that the metal-poor high-α population exhibits a slow, monotonic increase in azimuthal velocity and rotational support from v_ϕ ≃ 50 km/s at [M/H] ≃ -1.7 to a more ordered disc by [M/H] ≃ -1.0. In contrast, the low-α population shows a much sharper transition at [M/H] ≃ -1, driven by the dominance of Gaia-Enceladus-Sausage (last major merger) debris at lower metallicities. The orbital circularity evolution further supports a gradual kinematic transition for high-α stars, reinforcing the scenario in which the proto-Galactic debris slowly gained rotation rather than experiencing a rapid spin-up over a narrow range in metallicity. Comparisons with previous literature highlight the critical role of α-selection in disentangling in situ disc evolution from accreted halo structures. Our findings challenge prior interpretations that suggested a rapid disc formation phase, instead favouring a more extended and continuous kinematic transition. These results have broad implications for models of Galaxy formation, emphasising the need for detailed chemo-kinematic analyses and robust statistical methods to trace the evolution of the high-redshift Milky Way. Our approach provides a framework for future studies utilizing next-generation spectroscopic surveys to refine the timeline of disc formation and the interplay between accreted and in situ stellar populations.

54. **Planetary nebulae as tracers of stellar population properties with MUSE**
Ana Ines Ennis (Waterloo Centre for Astrophysics / Perimeter Institute)
Co-author(s): Johanna Hartke, Fuyan Bian, Magda Arnaboldi, Chiara Spiniello, Claudia Pulsoni

Planetary nebulae (PNe) are essential tracers of the kinematics of the diffuse halo and intracluster light due to their strong emission lines, but that is not all they can reveal about the underlying stellar population. In recent years, it has also been found that PNe in the metal-poor halos of galaxies have different properties (specific frequency, luminosity function), than PNe in the more metal-rich galaxy centers. A more quantitative understanding of the role of age and metallicity in these relations would turn PNe into valuable stellar-population tracers. In order to do that, a full characterisation of PNe in regions where the stellar light can also be analysed in detail is necessary. In this talk, I will present the results from our work using integral-field spectroscopic data, which allows us to detect PN populations in the bright centres of galaxies where traditional detection methods are blind. We analyze MUSE archival data of ten early-type galaxies that also have deep and extended catalogs of PN covering their halos. We are therefore able to (i) analyze the relation of specific frequency with the ages and metallicities derived directly from the MUSE cubes, and (ii) use those relations to interpret the results from PN surveys in the halos of nearby galaxies.

55. **From Dwarfs to Giants: Studying Galaxy Evolution Using Globular Cluster Systems**
Veronika Dornan (McMaster University)
Co-author(s): Harris, William E.

Globular star clusters are some of the oldest structures in galaxies and can be excellent tracers of a galaxy's complex merger history. The strong linear relationship between the mass of galaxy's globular cluster system (GCS) and the mass of its dark matter halo has been known for several decades and has been found to be consistent for nearly all galaxies which have been investigated. However, at extremely high and low host galaxy masses, scatter begins to increase and the behaviour of this scaling relation becomes less well understood. We have observationally studied the GCSs of 27 massive elliptical galaxies to determine what properties are the strongest indicators of major mergers. We also have compiled a standardized literature catalog of dwarf galaxy GCS properties to determine how GC richness relates to dwarf galaxy evolution and what role morphology plays. This talk will discuss the similarities and differences of GCS and galaxy evolution at the most extreme masses, and will present the most complete and up-to-date view of the GCS-halo mass scaling relation, which now spans over seven orders of magnitude in total mass.

EIC and Indigenous Engagement Committee

56. **CASCA Indigenous Engagement Committee: Progress and Plans**
Rob Cockcroft (McMaster University)
Co-author(s): Laurie Rousseau-Nepton, Karun Thanjavur, Samantha Lawler, Julie Bolduc-Duval, Mark Halpern

Established in 2023 in direct response to a recommendation by the LRP 2020, the CASCA Indigenous Engagement Committee (IEC) has been actively fulfilling various charges in its mandate set forth by the Board. In addition to organizing workshops and discussion panels related to Indigenous engagement, we have also been working closely with the Education and Public Outreach (EPO) committee and the Westar sub-committee to develop resources for the CASCA membership as well as members of Indigenous communities. These resources are presented in our recently built website. In this presentation, we aim to showcase our progress and reach out to members keen to pursue educational and outreach partnerships with Indigenous communities.

List of abstracts (posters)

The poster # also refers to the order/location in the poster viewing area.

Long-Range Plan

1. **FIRSA – The Future of Canadian Far-Infrared Space Astronomy**
   Spencer Locke (Institute for Space Imaging Science, Dept. of Physics & Astronomy, University of Lethbridge) [faculty/staff]
   Co-author(s): Buchan, Matt; Gom, Brad; Johnstone, Doug; Leisawitz, David; Mundy, Lee; Naylor, David; Ricketti, Berke; Scott, Jeremy; Wilner, David

   Many fundamental questions leading current astrophysics research are directly addressed through high spectral resolution and high spatial resolution (i.e., sub-arcsecond) observations in the Far-Infrared (Far-IR); topics include: the origin of the universe, the requisite conditions for star and planet formation, and, ultimately, the conditions for the emergence of life. Over half of the energy emitted by the Universe appears in the relatively unexplored Far-IR spectral region, most of which is opaque from ground-based sites necessitating space-borne instrumentation. The European Space Agency (ESA) Herschel space observatory (2009-2013) has provided the first unfettered views of the universe in the Far-IR. These advances in both sensitivity and broad spectral coverage have served to revolutionize our understanding of the formation and evolution of planetary systems, stars, galaxies, and the universe as a whole. Herschel has shown what can be accomplished with a relatively large aperture single dish Far-IR observatory-class space telescope. Herschel observations have also served to highlight the "Far-IR gap", i.e., the dramatically poorer angular resolution and sensitivity of Far-IR facilities compared with either side of the spectrum. Many Herschel discoveries are waiting on enhanced spectral and spatial resolution follow-up observations to address the questions raised in this new window on the Universe. The foundational questions that Far-IR astrophysical observations will address require both imaging at high spatial resolution as well as spectroscopic resolution, i.e., hyper-spectral imaging, to understand the scene dynamics and associated underlying physical processes at play. Several national and international astronomy long range plans identify two milestones on the Far-IR roadmap: cooled apertures and interferometry. The first milestone involves a single dish telescope with an actively cooled aperture whereby sensitivity is increased. Overcoming the spatial resolution barrier at Far-IR wavelengths requires traditional imaging to be replaced by space-based interferometric techniques. We discuss short- and long-term opportunities for Canadian participation in Far-IR space astronomy through the NASA PRIMA mission and other opportunities, including Far-IR Space Interferometry, in the context of Canadian heritage and leading technological development in these areas.

2. **An overview of the space astronomy program at the Canadian Space Agency**
   Jean Dupuis (Canadian Space Agency / Agence spatiale canadienne) [faculty/staff]

   This presentation provides an overview of Canada's space astronomy program, tracing its evolution since the inception of the Canadian Space Agency (CSA). We will summarize key investments made over the years in mission definition, development, and scientific support, highlighting their alignment with the Long Range Plan and CSA's road-mapping initiatives. Additionally, we will showcase major accomplishments, including contributions to international space missions and the development of technologies essential to space astronomy. Finally, we will outline future opportunities for Canadian Involvement in space astronomy, emphasizing the program's impact on scientific discovery and global collaboration.

Education and Public Outreach

3. **Progress on the Westar Program**
Daniella Morrone (CASCA / University of Toronto) [faculty/staff]

The Westar Program, offered by the Westar Subcommittee, part of CASCA's Education and Public Outreach (EPO) Committee, is a revamped version of its predecessor, the Westar Lectureship. The Westar Program is a collaborative initiative to bring astronomy to underserved and underrepresented communities, with a particular focus on remote and Indigenous Canadian communities and foster long term and reciprocal relationships with these communities. The revamp of this program started in 2022, incorporating feedback from 12 individuals and consultations from Two Worlds Consulting. Since then, the Westar Coordinator, Daniella Morrone, was hired to develop the program and compile training, hands-on activities, and other resources for the program. Last year, the Westar Subcommittee put out a call for astronomers to astronomy institutes and departments across Canada and received 8 applications from the now Westar Astronomers who continue to undergo training in EDI and Indigenous awareness; we continue to accept applications from interested astronomers. Moreover, the Westar Subcommittee began a partnership with Connected North, an initiative to host workshops and sessions virtually at Indigenous schools across northern Canada, now with three activities offered through the Westar Program listed on their catalogue. Collaborations with other Canadian STEM outreach initiatives (i.e., Discover the Universe) are underway. Starting this year, we are taking in requests from the Connected North catalogue, developing workshops with CASCA's Indigenous Engagement Committee for CASCA members and the broader astronomy community, establishing and supporting connections through the Westar astronomers, and developing new connections through collaborations with outreach initiatives and Indigenous schools.

4. **Concerning the Invisibility of our Solar System**
Martin Connors (Athabasca University) [faculty/staff]

Modern astronomy enthusiasts and students can now treat solid bodies of the Solar System as "worlds" due to the fruits of about 60 years of robotic space exploration, including cameras giving detailed colour or false colour images. However, as many members of the public who responded to web promotion recently about how many planets were visible likely noticed, the Solar System is in fact quite empty. That empty space is not a void as it is traversed by invisible forces, particles, magnetic fields, and plasmas. The "Invisible Solar System" approach allows exploration of gravity as something that had to be discovered in its classical form, although with respect to ancient approaches. It goes beyond that to show how gravity was used as a tool in discovering Neptune, and later transformed into the Einsteinian view. Gravitational slingshots are explained by looking at spacecraft motion relative to planets and the Sun, and another practical aspect of gravity is correction of relativistic effects in GPS. The invisibility of the Solar System begins at the solar surface, with the acceleration of the solar wind to supersonic speeds, and it then has complex interactions with solid bodies, especially those like Earth which have magnetic fields. Smaller bodies of the Solar System, although now visited to some extent and imaged, are still mainly studied as points of light. Their orbital dynamics and the impact hazard are fascinating and important topics, made topical by the Lucy mission on its way to visit Jupiter Trojans. The invisible also leads to discussion of how we can "see" the invisible world, and the discovery of invisible radiations, of which infrared (by William Herschel) was the first. The early twentieth century led to the discovery of radioactivity, then an understanding of how the Sun is powered and with the necessary production of (invisible) neutrinos. Going back in time, the reactions of the Big Bang, although mostly converting protons to helium, were quite different from those in the Sun now, and have implications about the present composition of the Solar System. Of a different nature than that first discovered on Earth, space is "radioactive", an early discovery from the Space Age. This radioactivity ranges from solar energetic particles, to those energized in radiation belts, to cosmic rays. The Invisible Solar System's rich array of topics could be taught in introductory survey courses.

Exoplanets / planet formation

5. **Synthetic modelling of exoplanet transit light curve using state-of-the-art model stellar atmosphere limb darkening**

Ishan Kaushal (Memorial University of Newfoundland) [grad]
Co-author(s): Neilson, Hilding

Variations in intensity, flux, and linear polarization from the center to the limb of a host star play crucial roles in the photometric study of exoplanetary transits. Flux variations occur when a planet passes in front of a star, blocking a portion of the star's total light. Additionally, the planet's transit across the host star breaks the circular symmetry, resulting in a change in linear polarization. In this project, we are developing an exoplanet transit code that calculates the flux and linear stellar polarization for a given normalized planetary radius (p) using the stellar limb-darkening model. Our goal is to study the variations in the flux and linear polarization during the transit for different exoplanetary samples and probe the properties of stellar and exoplanetary atmospheres.

6. **Disk Wind-Driven Formation of the First Planetary Cores**

Olcay Ates Goksu (McMaster University) [grad]
Co-author(s): Delage, Timmy N.D. ; Halder, Richa ; Pudritz, Ralph

ALMA observations of protoplanetary disks (PPDs) reveal rich substructures of gaps, rings, and various asymmetries. These rings represent pileups of dust and pebbles and are generally thought to be the result of planet – disk interaction. At the same time, the enhanced concentrations of solids in rings make them ideal locations for planets themselves to form. One solution to this chicken and egg problem is that ring formation

may also arise from non-planet related causes, such as MHD processes. In particular, magnetized disk wind-driven ring and gap structures have been observed in simulations (eg. Suriano et al. 2019), backed by theory (Riols & Lesur 2019), and more recently, evidenced by ALMA (Bacciotti et al. 2025) and JWST (Pascucci et al. 2024) observations. Our research is focused on the question of how disk winds create rings and whether or not planets can form within them. We use DustPy (Stammler & Birnstiel 2022), a one-dimensional PPD evolution code with a viscously evolving gas disk and highly detailed treatment of dust growth, drift, and fragmentation. Our first goal is to modify this code to incorporate the effect of disk winds, namely the removal of angular momentum and mass loss due to the outflow, to show its effects on overall dust evolution. Next, we add the evolution of the poloidal magnetic flux that is critical for driving the disk wind (Pudritz & Norman 1986, Okuzumi et al. 2016). We thus create a self-consistently evolving three-component disk (gas, dust and magnetic field), allowing each component of the disk to inform the evolution of the others. We aim to observe wind-driven rings and gaps in our disk, and the local enhancements of dust density and growth associated with them. In particular, we are looking to see if the density/sizes of dust becomes large enough to trigger planetesimal and planetary embryo formation. These locations may then be used in our future work to inform the initial spatial and temporal distributions of planetary cores in our population synthesis models, which would be a first in the literature.

7. **Roman and the search for one hundred thousand new transiting exoplanets**
Kelsey Hoffman (Bishop's University) [faculty/staff]
Co-author(s): Rowe, Jason; TRExS Team

The Nancy Grace Roman Space Telescope's Galactic Bulge Time-Domain Survey will obtain wide-field, time-series imaging to search for microlensing events of extrasolar planet systems. The Roman Space Telescope Transit Program is being developed to leverage these observations in order to detect transiting exoplanets — by developing pixel-level simulations and building a robust transit search and vetting pipeline. The infrastructure for this program is based on proven techniques developed for Kepler, K2 and TESS. A key component of the program's success will be the transit search software pipeline and validation toolset, being developed by Canadian researchers, which will enable the identification and confirmation of new exoplanet candidates. With initial estimates suggesting the potential discovery of 100,000 new transiting planets, the Roman Space Telescope Transit Program is poised to revolutionize our knowledge of planetary systems beyond our own.

8. **Comparing Uniform & Observable Priors in Octofitter: Testing Predictivity of Orbital Parameters in Multi-Object Systems**
Kaitlyn Hessel (University of Victoria / NRC-HAA) [grad]
Co-author(s): Thompson, William; Marois, Christian

The introduction of direct imaging of exoplanets has filled an important region of planet detection parameter space, allowing for direct observations of wider orbit planets. However, larger separations result in longer orbital periods, meaning orbit modelling codes must work with shorter arcs of orbital data, making results highly dependent on the choice of prior in Bayesian orbit modelling codes such as Octofitter. Two common approaches are Uniform Priors, which assume no preference across parameter space but tend to underestimate confidence intervals, and Observable Priors, which adjust assumptions to align with observations and may yield more accurate results when less than 40% of an orbit is covered. I will present a study of how well these two choices of priors affect our ability to predict unseen observations by analyzing the convergence of orbital parameters (eccentricity, semi-major axis, position angle, and separation) in multi-object systems across different epochs, comparing results from Uniform and Observable Priors. This study will help determine which choice of prior better predicts orbital evolution and improve the reliability of orbit fits for exoplanet and binary star characterization.

9. **MAROON-X Reveals Two Aligned Stellar Obliquities for the Hot Jupiter Hosting M Dwarfs TOI-3714 and TOI-5293 A**

Ryan Cloutier (McMaster University) [faculty/staff]
Co-author(s): Erik Gillis, Drew Weisserman, MAROON-X science team, DAGGER team

Hot Jupiters (HJ) are 2-3 less common around M dwarfs than around FGK stars, suggesting that HJ formation and/or migration may proceed via distinct pathways around different types of stars. One source of insight into HJ formation mechanisms is to trace their dynamical histories through measurements of host stellar obliquities via the Rossiter-McLaughlin effect (RM). I will present two new detections of the RM effect for the hot Jupiter hosting early M dwarfs TOI-3714 and TOI-5293 A from transit observations with the MAROON-X spectrograph. These measurements represent only the second and third hot Jupiters around M dwarfs (HJMD) with detections of the RM effect. We find that both systems are well-aligned with sky-projected stellar obliquities of <20 degrees. Both stars are in wide binary systems that may be capable of driving high eccentricity migration via Kozai-Lidov (KL) oscillations. We conduct a population-level analysis of hot Jupiters around AFGK versus early M dwarfs and argue that KL migration is more efficient around M dwarfs, which should produce misaligned stellar obliquities in HJMD systems in the absence of efficient tidal damping. Our findings of aligned stellar obliquities for TOI-3714 and TOI-5293 A, plus the aligned obliquity of the one other HJMD with an RM detection in the literature (i.e. TOI-4201), support the expectation that M dwarfs, with their deep convective envelopes, do efficiently damp misaligned obliquities excited by KL oscillations.

10. **Resolving the Mystery of H_2O in the Atmosphere of τ Boötis b using Doppler Tomography**

Mitch Young (Queen's University Belfast)

The presence of H_2O in the atmosphere of τ Boötis b has long been debated in the literature, most recently with a tentative detection by Panwar et al (2024). With high-resolution cross-correlation spectroscopy (HRCCS) struggling to provide a definitive answer, we employ an alternate method to search for H_2O in the day-side atmosphere of τ Boötis b. Doppler tomography has been demonstrated to provide clearer detections of molecules in emission spectroscopy than HRCCS, including CO in the atmospheres of both of τ Boötis b and HD 179949 b as well as H_2O in the latter. It has even provided a marginal direct detection of CO on the night-side of HD 179949. Here, I present the initial findings of applying Doppler tomography to archival CRIRES observations of τ Boötis b, the same archival observations investigated in Panwar et al, to search for the presence of H_2O in the day-side emission spectrum.

Star & Cluster Formation

11. **Studying Protoplanetary Disks Around Herbig Stars with Subaru/SCExAO**
Camryn Mullin (University of Victoria) [grad]
Dong, Ruobing; Lucas, Miles; Johnstone, Doug; Hashimoto, Jun

Forming planets leave behind structural signatures in the disks they form in, such as spiral arms. The formation of symmetrical two-arm spirals is best explained by gravitational perturbations from young giant planets, however planet detections around spiral disks in the near-infrared (NIR) are rare. Spiral disks without detected planets could be driven by cold-start mechanism giant planets which are too faint to detect in the NIR. We selected a sample of 12 Herbig stars within 200pc, and detected 11 disks, 2 of which had two-arm spirals, implying at least 2 giant planets in the sample. This disagrees with the Bowler (2016) hot-start giant planet statistics around Herbig stars (3/110), implying different planet formation mechanisms. However, this sample of 11 well-studied disks is small and could be biased. To obtain a bias-free sample of two-arm spiral disks, we observed 6 other Herbig stars within 200pc using the polarimetric differential imaging (PDI) mode on the Subaru Coronagraphic Extreme Adaptive Optics instrument (SCExAO). PDI is optimal for disk detection because it filters out the overpowering unpolarized star light and isolates polarized disk light. Surprisingly, we did not detect any new disks in the sample of 6 Herbig stars. Using the same techniques, we added 3 Herbig stars with known disks to the SCExAO sample as a control group, and detected each disk clearly. Here we discuss the implications of our 6 non-detections and how this fits into our understanding of the Herbig star population.

12. **Insights into the physics encoded in star cluster dating techniques**
Isabella Armstrong (McMaster University) [grad]
Co-author(s): Sills, Alison; Cournoyer-Cloutier, Claude

Individual stars are born from gas clouds whereas star clusters can be assembled over time. Therefore, the 'age' of the stars within the cluster is not necessarily the same as the 'age' of the cluster itself because star formation and cluster formation could occur on different timescales. Understanding the relationship between timescales in cluster formation and assembly probes the physical processes occurring. In fact, these differences provide unique insights into the physics occurring within young star clusters, placing constraints on formation and evolution timescales. Observations provide a single snapshot of cluster evolution, and a single set of ages. Ages are typically derived using stellar evolution models (eg. isochrone fitting), while 6D kinematics can be used to find the time when the stars were most concentrated in space (e.g Gaia astrometry). Applying these same techniques to simulations, where it is known where and when every star formed, makes it possible to examine how each age evolves as a function of time, and how different ages evolve relative to each other. Furthermore, we can also ask

how well methods date the formation of stars versus the formation of clusters, whose ages are not necessarily the same. In this work, we focus on dynamical methods, which look at the trajectories of either individual stars or entire cluster populations, comparing them to an isochronal age, calculated from when the stars in the simulation formed. These derived ages can then be related to physical processes driving cluster evolution such as sub clustering, star formation rate, merger histories, and gas dispersal. Furthermore, we can ask how assuming a spherical cluster or that all stars formed in the same place bias results. Ultimately, this work will further our understanding of what exactly these ages are measuring in observations.

13. **A multi-scale ALMA view of starless and protostellar dense cores in Aquila**
Samuel Fielder (University of Victoria) [grad]
Co-author(s): Kirk, Helen; Dunham, Michael; Offner, Stella

Star formation is governed by many complex physical processes that intertwine at all scales, some of which include turbulent motions, mass inflow, thermal pressure and magnetic fields. These physical processes have direct impacts on the formation of many types of systems (e.g., single stars, multiple star systems, stellar clusters). Recent work studying a survey of all starless cores in Orion B North with ALMA (Fielder+2024) showed that protostellar cores and only a few percent of starless cores have high-density material (>10^7 cm^-3) on small scales (~100's of au), with only a few complex fragmenting regions. We extend this view into fragmentation with a new archival ALMA main- and compact-array analysis of the 100 most gravitationally unstable cores in the Aquila region. We utilize data from many spatial scales to show how the material is arranged on small and larger scales. A few % of the starless cores in Aquila are high-density (>10^7 cm^-3) on similarly small scales (~100's of au), while around half of the starless cores have moderately high densities (>10^6 cm^-3) on larger spatial scales (~1000's of au). We also find a significant number (~20%) of unstable cores that show highly complex fragmentation morphologies, which are strong candidates for higher-order multiple systems.

14. **Mining the ALMA Archive: Building a Catalog of Structured Young Protostellar Disks**
Lance Schonberg (Queen's University) [grad]

Observations of structure in the form of rings and gaps in the disks of young stellar objects (YSOs) is a potential indication of planetary development. To date, most research and observations have been done on older, unembedded disks, but disk structure and possibly planet formation may already be happening in the youngest protostellar disks. Previous research has shown structure in a small number of younger YSOs. The ALMA interferometer Science Archive is a vast reservoir of data, containing more than 10,000 observations of YSOs. Making use of high resolution, high sensitivity (sub)millimeter wavelength data from the ALMA Archive, paired with specialized code packages designed to fit or examine individual disks from their visibility data, we are building a catalog of young disks with structure. With a large sample, we will implement population statistics to infer qualities about the patterns of structure in their evolutionary timeline. Broadly, we present preliminary results covering the approximately 100 objects examined so far.

15. **The Formation of Star Clusters in High-resolution Galaxy Simulations**
Tamara Koletic (McMaster University)
Co-author(s): Pudritz, Ralph; Pillsworth, Rachel

Star clusters are groups of gravitationally bound stars located within a galaxy. Their formation is still poorly understood. However, observations from the James Webb Space Telescope (JWST) and Physics at High Angular resolution in Nearby GalaxieS (PHANGS) survey provide evidence that complex structures form due to the supercritical fragmentation of filaments—lanes of gas and dust in the galaxy (Zhao et al., 2024; Pillsworth et al., 2025). These filaments are pushed over the fragmentation threshold by gas accretion from supernova feedback and density waves and are connected through a hierarchy. On scales of 100pc, filaments fragment into molecular clouds which contain smaller, parsec scale filaments that fragment to form star clusters. To study cluster formation within this hierarchy, we use the RAMSES AMR code to run galactic magnetohydrodynamic (MHD) simulations with supernova feedback processes to identify filaments and clumps across multiple scales. We have pushed the refinement of the entire galaxy to 4.4 pc, a level on par with the highest resolved simulations in current literature (Jung at al, 2024; Strawn et al., 2024; Pillsworth et al., 2025). From here we will apply a clump finding algorithm to identify star clusters and characterize the clump mass function. In this work, we present simulations of cluster formation in the extensively observed galaxy NGC 628. We then compare the simulated clump mass function to the observed cluster mass distribution from JWST and PHANGS data. This study represents our first step in a program towards understanding the origin of the Initial Mass Function (IMF) in clusters by further zooming in to selected clusters in our simulations in order to resolve individual star formation.

16. **Investigating the Influence of Magnetic Fields on Bubble Morphology in Star-Forming Regions**
Raina Irons (Queen's University) [grad]

Magnetic fields play a fundamental role in the process of star formation, influencing the structure and evolution of molecular clouds. One challenge comes from the energy released from massive stars that can alter the magnetic field to align along the edges of expanding bubbles. Despite their importance, the precise role of magnetic fields in bubble evolution remains an open question, and a comprehensive statistical analysis of a large sample of bubbles is necessary in order to work towards understanding this question. Thermal emission from dust grains creates a linear polarization that heralds a circular magnetic field pattern in the plane of sky, which typically falls in line with the edges of a circular bubble. We then expect magnetic field lines to follow tangentially to the bubble, creating a circular pattern. We are applying generalized algorithms to polarization maps to study the impact of these bubbles on magnetic field lines. Our algorithm searches for this expected pattern to locate these bubbles. In doing so, we can determine broader trends in how bubbles influence their environment and establish a clearer relationship between polarization efficiency and bubble properties.

17. **Filamentary hierarchies and fragmentation from kpc to sub-pc scales**
Rachel Pillsworth (McMaster University) [grad]
Co-author(s): Roscoe, Erica; Pudritz, Ralph; Koch, Eric; Wells, Molly; Beuther,Henrik

Results from JWST, ALMA and the PHANGS surveys have ushered in major breakthroughs in star formation, illustrating the many complex structures that exist ubiquitously on spatial scales from the kpc galactic disk down to the 0.1 pc scale protostellar clumps. This structure, a hierarchy of filaments and superbubbles, dominates the structure of spiral galaxies like our Milky Way. In Zhao et al. 2024, we developed high-resolution galactic multiscale MHD simulations in RAMSES which show the formation of filamentary hierarchies ranging from GMC to cluster formation scales. We found that above a critical mass per unit length, filaments undergo gravitational fragmentation in a hierarchical manner, creating molecular clouds and cluster forming clumps within them. In more recent work, Pillsworth et al. 2025, we characterized the properties of filaments longer than 25 pc in length to connect current observations of filaments to the larger scale kpc swaths of spiral arms. In this presentation, we report the results of further zoom-ins of Zhao et al. 2024 to scales far below 0.1 pc to resolve the star-forming filaments of the galaxy. In particular, we are able to numerically resolve 0.07 pc scales within a 3 kpc subregion of our galactic multiscale MHD simulations. This allows us to study protostellar clump formation in which disks and streamers arise. We will also compare these high-resolution simulations with observations of protostars from the Herschel and the CORE programs.

18. **Dynamics of Dense Gas Filaments in the Serpens South Star-Forming Region**
Julian Caza (Queen's University) [grad]
Co-author(s): Fissel, Laura; Chen, Michael Chun-Yuan; Friesen, Rachel; Jarvis, Emma

Characterizing the dynamics of dense gas in hub-filament systems is crucial to understand the reservoir of mass from which young stellar objects can accrete. I will present a kinematic analysis of velocity coherent filaments in the Serpens South region using NH_3 (1,1) emission from VLA+GBT data as a dense gas tracer. We compare velocity gradients to the orientation of filaments and to the plane-of-sky gravitational acceleration field as estimated from the Herschel derived H_2 column density. Velocity gradients aligned perpendicular to filament spines are identified, which could indicate mass accretion onto filaments from their surroundings. There is also evidence of velocity gradients aligned parallel to filament spines which could be indicative of mass flow along filaments. We will particularly focus on the southeast filament where a large-scale velocity gradient towards the central hub has been measured previously. We also find areas where the inferred plane-of-sky gravitational acceleration field is aligned parallel to the velocity gradient field, suggesting that gas motion in these areas could be the result of gravitational infall onto filaments.

19. **Making the Next Generation of 3D Interstellar Medium Dust Temperature Maps**
Oluwasemoore Tijani (University of Toronto) [undergrad]

Dust is a significant part of the Milky Way's Interstellar Medium, known to absorb and scatter UV and visible light and re-radiate in the infrared frequency range. Previous work by Zelko et al, combined data from 2D dust emission maps (Planck & IRAS/DIRBE satellites) and 3D dust extinction maps (Bayestar19) to create the first ever 3D dust temperature map. This was done by modelling the dust emission as a single modified blackbody, with the total dust emission (I_ν) from each 2D pixel represented as a function of cumulating 3D reddening (ΔE_{B-V}) in each distance bin along the line-of-sight, with temperature being one of the parameters of the model determined with Bayesian inference. The current temperature map achieved only 27' angular resolution (from 5' data) because original data pixels needed to be grouped into lower resolution 'superpixels' to be able to infer temperature along the line of sight. This work builds upon the previous map by obtaining new temperature values located between previous temperature data points, thereby increasing the angular resolution to up to 6.9'. This is done with an algorithm that systematically regroups the emission and reddening data pixels before the Bayesian inference of temperature. This technique described can be applied anywhere superpixelization is used to infer parameters of a dataset. The dust temperature map has many potential applications in the analysis of 3D galactic magnetic field structure, finding/confirming star-formation regions and characterisation of the galactic interstellar radiation field.

Stars/Solar System

20. **Spectropolarimetric observation of chemically peculiar stars ESPaDOnS**
Viktor Khalack (Université de Moncton) [faculty/staff]
Co-author(s): Jarred Allison, Marharyta Sliusarenko

An extensive spectral observation of chemically peculiar stars (ApBp, AmFm, HgMn, and δ Scuti) has been carried out with the spectropolarimeter ESPaDOnS at the Canada-France-Hawaii Telescope (CFHT) following the comprehensive study of the selected targets using the TESS data. For most of them the high-resolution (R=65000) and high signal to noise (SNR>500) Stokes I & V spectra have been acquired for different rotational phases. Use of the Least Square Deconvolution (LSD) method has resulted in detection of a significant mean longitudinal magnetic field Bz in ApBp stars including roAp targets. New Bz measurement are consistent with the published data on magnetic field but have much smaller error-bars. We have successfully measured Bz in the known magnetic δ Scuti, while in other selected δ Scuti the measured field is close to zero even if their photometric variability suggests that a significant field might be present. The derived spectra for AmFm and HgMn stars are well suited for the detailed abundance analysis.

21. **Research Announcements for the Outer Solar System**
Laura Buchanan (University of Victoria) [postdoc]
Co-author(s): Wesley Fraser, JJ Kavelaars

In collaboration with the Legacy Survey of Space and Time (LSST) Solar System Collaboration (SSSC) and the Canadian Astronomy Data Centre (CADC), the Can-Rubin team is developing a research announcement system for Solar System related discoveries. Named the Research Announcements for the Outer Solar System (RAFTs), this is a publication system designed to quickly issue short, citable announcements relevant to Solar System research. RAFTs are intended to address the unique needs of the Solar System research community in the era of large-scale surveys (such as LSST), providing a platform for timely dissemination of findings. Hosted by the CADC, RAFTs will be freely accessible and easily discoverable with permanent DOIs assigned to each. Each announcement will feature a machine-readable section to facilitate rapid follow-up, and will be integrated with the LSST community forum to encourage further collaborations and engagement. The system will also feature a moderation process to

ensure high-quality and relevant publications. The announcements are expected to be brief, relevant, and may be urgent, though urgency is not a requirement for publication. The system is designed to be scalable, with the capacity to handle an increased volume of discoveries expected from the LSST. We will present a brief demonstration of the (in development) software interface, highlighting its user-friendly design and functionality for the community.

22. **Binary Stars as Sources of Chemical Anomalies in Stellar Clusters**
Zena Khadour (McMaster University) [grad]
Co-author(s): Sills, Alison

Globular clusters (GCs) are often regarded as simple stellar populations with uniform ages and chemical compositions. However, observations, particularly from the Hubble Space Telescope (HST), reveal peculiar abundance patterns, known as multiple populations (MPs). MPs are characterized by enhancements in He, N, and Na, alongside depletions in O and C. The origin of these abundance variations remains an open question in stellar population studies. This work explores the role of binary stellar systems as a potential source of MPs in GCs. Previous studies have demonstrated that mass transfer in binary systems can produce chemically enriched material consistent with observed MPs. A study from our group simulated isolated binaries, showing that expelled material from interacting binaries exhibits signatures of hot hydrogen burning, consistent with observed abundance spreads in MPs. Not only does mass transfer between individual binary systems play a role in the formation of MPs, binary systems are remarkably prevalent in clusters and have been shown to be highly sensitive to changes in their clustered environments. For example, denser, more massive clusters induce more rapid and extensive changes in their binary systems. My research lies at the intersection of binary evolution and their host cluster environment, focusing on how binary systems contribute to the emergence of MPs. More specifically, I will modify the physical characteristics of isolated binary models by varying primary mass, orbital period, and mass ratio. I will investigate the resulting yield due to such dynamical changes and compare them with observational data to assess the appropriateness of the model parameters. My results will significantly contribute to the ongoing debate about the sources of enriched material in GCs by highlighting the critical role of binary star systems.

23. **Replication and Identification of g-mode and Tidal Pulsation in HgMn Stars Using MESA and GYRE**
Jay Allison (Université de Moncton) [grad]
Co-author(s): Lovekin, Catherine; Mombarg, Joey; Khalack, Viktor; LeBlanc, Francis

Two different types of pulsation, g-mode and tidally induced, have been replicated using numerical simulation software to model stellar evolution and structure (MESA), and asteroseismology (GYRE), for two mercury-manganese (HgMn) stars in binary systems. Our results indicate that the first target, HD 30661, is a younger, more massive and luminous HgMn star dominated by g-mode pulsations. Potential signatures of multiple tidal modes were found in HD 30661. The second studied target, HD 89822, appears to be more evolved HgMn star on the main sequence which is dominated by tidal pulsations. HD 89822 possesses much lower mass and luminosity comparing to HD 30661. The frequency patterns of stellar pulsations observed in both studied stars are

well replicated by GYRE. Evolutionary models of both stars suggest potentially novel findings about how pulsations develop over time in HgMn stars.

24. **Rotation Periods of Candidate Single M6-M8 Dwarfs in TESS**
Samantha Lambier (Western University) [grad]
Co-author(s): Metchev, Stanimir; Miles-Páez, Paulo; Moranta, Leslie; Wolfe, Dakota; Hales, Joelene; Martinovic, Jeffrey

Recent studies suggest that the angular momentum evolution of ultracool dwarfs differs from the well-known spin-down evolution of hotter stars. Characterizing the distribution rotation periods of ultracool dwarfs in the solar neighborhood can help elucidate this evolutionary pathway just above, at, and below the hydrogen burning limit. In this presentation, we examine 395 candidate single ultracool dwarfs (~M6-M8) using TESS light curves. To determine rotation periods, we employed Lomb-Scargle Periodograms to provide a first estimate of the period, then refined them with a Gaussian Process approach, requiring multi-sector confirmation when available. We confirmed that the observed periodicity is not caused by contamination using TESS-Localize. We found over 100 rotation periods, ranging from 2 hours to 5 days. In our comparison with rotation periods reported in the literature, we found consistent results, confirming or updating 25 periods. Combined with published rotation periods for a broader range of spectral types, we find a lower envelope decreasing from 5 hours at early M dwarfs to 1 hour at L, T, and Y dwarfs.

25. **The White Dwarf Opportunity: Constraining Winds from the Galaxy's Smallest Stars using a Well-Behaved Neighbour**
Raven Westlake (McMaster University) [grad]
Co-author(s): Cloutier, Ryan; Sills, Alison

M dwarfs make up 70% of the galaxy's stars, but the habitability of their planets is currently uncertain. Measurements suggest that these stars are sometimes windy enough to strip the atmospheres of otherwise habitable planets. However, the true distribution of wind rates from M dwarf stars is poorly constrained due to low number statistics and observational difficulties. M dwarf wind rates can be inferred using metal pollution in the atmosphere of a companion white dwarf star. Due to the high surface gravities of white dwarfs, metals are not long-lived in their atmospheres unless material is being continuously accreted, such as from the stellar wind of its close M dwarf companion. I am building upon the existing measurements of M dwarf wind rates by recovering calcium absorption equivalent widths in 25 DA white dwarfs. Each of these belongs to a white dwarf – M dwarf spectroscopic binary, with spectra are available through the Sloan Digital Sky Survey. I am improving existing methodologies for constraining M dwarf wind rates via the calcium pollution in a companion white dwarf. My improvements extend the subset of white dwarf – M dwarf binaries for which M dwarf winds can be recovered. Specifically, my framework allows for white dwarf calcium absorption measurements in spectroscopic binaries with magnetically active M dwarfs. Calcium is magnetically sensitive, resulting in chromospheric calcium emission lines in magnetically active M dwarfs. By using a known correlation between Hα and Ca II K equivalent widths in magnetically active M dwarfs, I determine what white dwarf Ca II K equivalent width would be required to result in the observed Ca II K equivalent width

for each of my spectroscopic binaries. This framework lets us probe a wider wind regime than otherwise possible using white dwarf companions, providing insight into the true distribution of M dwarf wind rates and their implications for exoplanet habitability.

26. **Long Secondary Periods in Red Giants: AAVSO Observations and the Eclipse Hypothesis**
Melanie Szpigiel (University of Toronto Department of Astronomy & Astrophysics, and Dunlap Institute) [undergrad]
Co-author(s): Percy, John

Red giants are unstable to low-order pulsations, which cause periodic variations in brightness. Superimposed on this, some red giants also display an additional, longer secondary pulsation period (LSP). At least a third of red giants experience LSPs 5 to 10 times longer than their primary pulsation period. Current evidence suggests that these LSPs result from the eclipse of the red giant by a low-mass companion enshrouded in dust. To investigate this hypothesis, we analyzed visual and Johnson V photoelectric data from the American Association of Variable Star Observers (AAVSO) for 11 stars. Our study first focused on determining the cause of long secondary periods based on the relationship between the geometry of the eclipse and each star's phase curve, then examined whether this geometry changes over long timescales (many decades). In these eclipsing binary systems, the shape of the phase curve is influenced by the orbital configuration, including the size of the companion, the presence of surrounding material (ie a dust cloud), and whether it possesses a dust tail. We visually analyzed the phase curves for all 11 stars and found the stars with the largest LSP amplitudes (U Del and Y Lyn) show evidence for a dust tail on the companion. Meanwhile, most of the 11 stars only show a sinusoidal phase curve with a small amplitude. A second analysis was conducted to determine the fluctuation of the semi-amplitudes of the LSPs over these same timescales. This process was performed using a weighted wavelet analysis and confirmed that the semi-amplitudes vary slowly but significantly (up to a factor of 8). This is likely due to a change in the amount of obscuring dust surrounding the companion. There is no strong evidence the geometry of the system changes over these timescales. These analyses provided strong support for the original hypothesis made for the cause of LSPs. This project was supported by the University of Toronto Work-Study Program, and the Dunlap Institute.

27. **Angular momentum in aging brown dwarfs: spinning up or spinning down?**
Ethen Sun (University of Toronto) [grad]
Co-author(s): Bryan, Marta

Unlike M dwarfs, which can efficiently shed angular momentum through magnetized stellar winds, brown dwarfs are thought to have an angular momentum that is fixed at the time of formation. Therefore, brown dwarfs are expected to accelerate their spin as they cool and contract. The observational record does not clearly show this, as it is based on rotational modulation in light curves, which is limited to periods shorter than the observation and is infeasible for older, fainter objects. To date, no cluster older than 150 Myr has a sample of measured spins for substellar objects. The problem is worse at high mass (>45 M_Jup) where only a single object has been measured past 8 Myr. We are submitting a Gemini proposal to get vsini rotation speeds for 11 massive brown dwarfs in the Hyades and extend the observational record to 650 Myr of age. This data

will either confirm angular momentum conservation, or show that brown dwarfs have an unexpected mechanism to spin down which is not currently understood.

28. **Investigating the Influence of Metallicity and Mass Ratio on Orbital Eccentricity in Main-Sequence Binary Stars**
Abigail Denney (University of Toronto) [grad]
Co-author(s): Wu, Yanqin

Binary stars are incredibly prevalent among stellar systems and are key to understanding many important problems in astrophysics, including gravitational waves and galactic kinematics. This project investigated how metallicity and mass ratio influenced the orbital eccentricity of a population of main-sequence binary systems. Better understanding of these relationships will improve our knowledge of the formation and evolution of binary star systems. This project used data from GAIA's 3rd and most recent data release. GAIA has precision astrometry measurements of over 300 000 multi-star systems, including highly precise distance and proper motion measurements. For more precise metallicity measurements, this work used the LAMOST DR10 metallicities. The GAIA measurements of the secondary binary mass were expanded upon using Kepler's law and the main sequence mass-luminosity relation to produce a larger sample of mass ratios. We applied a correction to the GAIA data to mitigate observational biases due to the selection function and measurement uncertainties. The metallicity was determined to have a small impact on the eccentricity of the binaries after correcting for bias. The mass ratio appears to have a slight negative correlation with eccentricity, which disagrees with findings from simulation-based predictions.

29. **A Systematic Search for Radio Stars in the Northern Hemisphere**
Ryan Johnston (University of Alberta) [grad]
Co-author(s): Sivakoff, Gregory

Stellar auroras, akin to those on Earth, result from plasma-magnetic field interactions, producing flares and radio bursts. These magnetic processes play a role in shaping stellar environments and can impact the habitability of exoplanets by influencing atmospheric conditions and magnetic shielding. Radio observations of stars give us valuable information that we cannot get from other types of observations. Some stars, called radio stars, have exceptionally strong magnetic activity and produce radio bursts that are much more powerful than those from the Sun. These bursts can help us understand the shape and structure of a star's magnetic field, which affects things like stellar flares and the movement of charged particles around the star. Measuring polarization in radio bursts helps characterize stellar magnetic fields and the mechanisms responsible for their emission. Many radio stars have not been systematically identified, and until recently, only a few small-scale surveys had been conducted, largely due to technical limitations. Recent advances, including ongoing systematic surveys in the southern hemisphere, highlight the need for a dedicated catalog of radio stars visible in the northern hemisphere. The Very Large Array Sky Survey (VLASS) offers a unique opportunity to bridge this gap. While VLASS was not initially designed to produce science-ready circular polarization data, we can still make circular polarization measurements with additional processing. Small-scale studies have demonstrated the feasibility of extracting such data. Gaining a deeper understanding of the complex physics behind stellar magnetic fields relies on high-quality data. I present current progress in systematically identifying radio stars for the entire VLASS survey to create a comprehensive catalog of northern hemisphere radio stars. This also includes the development of a new specialized tool that identifies optimal observation times within VLASS, when a source is closest to the centre of the survey's moving beam. This tool will help users minimize systematic errors and increase data reduction efficiency for polarization studies with VLASS data. This will create a foundation for detailed studies of radio stars and prepare the scientific community for the influx of data from next-generation radio telescopes, which are expected to detect millions of radio sources, including many new radio stars.

30. **The Wind of the Red Supergiant 31 Cygni**
Philip Bennett (Dalhousie University) [faculty/staff]
Co-author(s): Duckworth, Noah; Brown, Alexander; Ayres, Thomas R.

Red supergiants are high-mass stars near the end of their life. These stars lose mass by stellar winds, which substantially affects their subsequent evolution. However, this later evolution cannot be modelled with certainty as the cause of this mass loss remains uncertain, and so modellers must resort to approximate parametrizations of the mass loss rate. We will present a summary of observations and preliminary analyses from Hubble Space Telescope (HST) Cycle 31 program GO-17416 (PI: Bennett), which observed the March 2024 total eclipse, and near-eclipse phases, of the eclipsing red supergiant binary 31 Cygni (K5 Ib + B3V) in the ultraviolet with medium and high-resolution modes of the STIS echelle spectrograph. In this binary system, the red supergiant primary eclipses its much smaller, but hotter, main-sequence companion. HST observations in the ultraviolet (where the supergiant's flux contribution is negligible) of circumstellar absorption by the red supergiant's wind along the line-of-sight to the companion, as its orbits behind the supergiant near eclipse, will be used to derive mass loss rates and construct models of the supergiant's wind. The objective of this program is to derive the first quantitative semi-empirical model of a red supergiant wind that is strongly constrained by observation.

31. **Stellar Atmosphere Modeling with SATLAS: A Case Study of 55 Cancri**
Tahere Parto (Memorial University of Newfoundland) [grad]
Co-author(s): Neilson, Hilding

Understanding the atmosphere of host stars is essential for accurately determining exoplanet properties such as radius, mass, and atmospheric composition. Accurately modeling the stellar spectrum ensures that observed spectral features are correctly attributed to the star, preventing misinterpretation of planetary atmospheric signatures. SATLAS is the spherical version of the ATLAS stellar atmosphere code. It utilizes precomputed model grids and an extensive database of atomic and molecular line opacities. Compared to plane-parallel models, spherical models provide a more realistic treatment of limb darkening. This is an important factor in transit depth calculations, which directly impact exoplanet radius estimates. In this study, we use SATLAS and SYNTHE to compute the synthetic spectrum of 55 Cancri, a well-studied G-type host star, as a case study. We compare our model predictions with high-resolution ESPaDOnS observations to assess how well the spherical atmosphere model reproduces the observed stellar spectrum. Here, we present our initial results and discuss the implications for exoplanet characterization.

32. **Decoding M Dwarf Chemistry: A New Framework to Derive Stellar Elemental Abundances**
Nicole Gromek (McMaster University) [grad]

Studying planets around M dwarfs represents our best chance to characterize potentially habitable super-Earths, due to their ubiquity throughout the galaxy and their small sizes enabling stronger planetary signals. In particular, measuring accurate stellar abundances of planet-forming elements is critical to our understanding of these exoplanet compositions and their formation processes. While these values can be reliably derived from optical spectra for FGK-type stars, the recovery of accurate abundances for M dwarfs is complicated due to broad molecular bands and discrepancies between models and observed spectra. These lingering uncertainties in M dwarf chemical compositions inhibit our ability to accurately model the interiors and atmospheres of exoplanets around M dwarfs. To address this issue, I have built a custom framework to extract elemental abundances from the spectra of cool stars via the spectral synthesis method. Using data from the near-IR high spectral resolution spectropolarimeter SPIRou, I use our framework to derive elemental abundances for five exoplanet hosts of interest: GJ 699 (Barnard's Star), TOI 1685, GJ 9827, TOI 1201, and K2-18. We draw special attention to the treatment of carbon and oxygen abundances to derive a more accurate C/O ratio. These results will be useful for placing strong constraints on the planets' refractory and volatile abundances, both of which are important diagnostics of planetary formation histories and interior compositions.

Local Group & Near-Field Cosmology

33. **High-velocity stars ejected from globular clusters: NGC 3201 candidates from Gaia DR3**
Abigail Battson (Saint Mary's University) [grad]
Co-author(s): Henault-Brunet, Vincent

Globular Clusters lose stars through a variety of mechanisms, some of which eject stars with a considerable velocity. In our work, we use Gaia Data Release 3 data to identify high-velocity star candidates in the regions around a large number of Milky Way globular clusters. Out of the 23 clusters in our final sample, we focus our analysis on the cluster NGC 3201, around which we find ~65 high-velocity candidates, making it one of the clusters with the highest number of high-velocity candidates in our sample. We estimate that the contamination of our sample of high-velocity candidates around NGC 3201 by foreground/background stars appears to be low, but also find that dynamical models of this cluster predict far lower rates of ejected stars than we implied by our sample of high-velocity candidates. We discuss possible ways to resolve the discrepancy.

34. **Characterizing the Metal-Poor C-19 Stellar Stream in DESI**
Nasser Mohammed (University of Toronto) [grad]

Milky Way-like galaxies evolved hierarchically within a dark matter halo, accreting mass through many mergers. Stellar streams are a result of this process, where the host galaxy's potential disrupts satellite dwarf galaxies or globular clusters (GC), leading them to form tidal tails. In this work, we present an update on the kinematic properties of the metal-poor C-19 using data from the first three years of observations from the Dark Energy Spectroscopic Instrument (DESI). We identify approximately 60 member stars with line-of-sight velocities, a roughly 2.5 times increase from the most recent measurements. C-19 merits particular interest for two primary reasons. First, while C-19 hosts chemical abundance characteristics of a GC, the observed kinematics of the stream are difficult to reconcile with a purely baryonic, disrupting-GC scenario. Second, its measured metallicity ([Fe/H] ≈ -3.3) makes it the lowest metallicity stellar population known to date, falling below the previously assumed universal metallicity floor. In this presentation, we provide our own analysis of the C-19 stellar stream, characterizing its 6-D kinematics with Bayesian mixture modeling techniques. We present a novel discovery of a "spur" in the C-19 stream, indicative of a past collision with another satellite. We measure a velocity dispersion of 7.9 (+1.4/-1.2) km/s and a metallicity of [Fe/H] = -3.36 (+0.04/-0.04)—in line with previous works identifying C-19 as a "hot," metal-poor stream—and consider these measurements in the context of a perturbed stream at the pericenter of its orbit.

35. **Exploring Nearby Galaxies with Optical and Ultraviolet Machine Learning Analysis**
Monica Bellamy (University of Calgary) [grad]

Stars are the building blocks of galaxies. Their formation drives the evolution of the universe by forging the elements that make up planets and even life itself. Galaxies are vast, and the traditional methods to analyze star-forming regions manually are very challenging - only becoming harder and more complex as datasets grow into the realm of Big Data. To address this challenge, this research explores the significance of star formation and the benefits of machine learning applied to multi-passband optical and ultraviolet (UV) imaging data to automate the classification of astrophysical objects. Optical and UV imaging comes from the Neighbourhood Watch survey, bolstered by data collected with Astrosat/UVIT. By automating the classification of spatially resolved star-forming regions and globular clusters in the outskirts of nearby giant galaxies, this research enables efficient processing and interpretation of astrophysical observations, leading to a more comprehensive understanding of galaxy formation and evolution.

36. **All The Single Ladies: The First High-Resolution Spectra of Previously Unobserved UFD Members**
Anya Dovgal (University of Victoria) [grad]
Co-author(s): Venn, Kim; McConnachie, Alan; Margheim, Steven; Smith, Verne; Zaremba, Daria; The GHOULS Collaboration

The GHOST Ultrafaint Legacy Survey (GHOULS) targets the bright (V < 18.5) stars found within 3R(eff) in ultrafaint dwarf galaxies, in the southern hemisphere. GHOST is the new Gemini South high-resolution optical spectrograph, measuring spectra from 3830 – 10, 000Å, capturing the full optical regime necessary to analyse stellar chemistry in detail. Some of the UFDs studied in this program have very few unobserved or available stars matching the survey criteria, resulting in a subset of systems with only 1-2 observable members each. Even with such a limited set of observations, this new data will provide important information about these systems such as complete 6D kinematics, accurate metallicities, and give insight to their enrichment histories from preliminary chemical analysis. The goal of this work is to focus on measuring radial velocities, [Fe/H] metallicities, and occasional chemical abundances (C, Li, Ba) for these "single" stars. Ultimately this data tackles two projects: (1) it provides the first spectra for some systems lacking data, providing the missing RVs for 6D phase space and ascertaining memberships, and (2) completing the data for the brightest objects in previously studied UFDs, providing the Legacy component of this survey and completion of those analyses.

37. **More CHANG-ES in the Works**
Judith Irwin (Queen's University) [faculty/staff]
Co-author(s): The CHANG-ES Consortium

Continuum Halos in Nearby Galaxies, an EVLA Project (CHANG-ES) has revealed astonishing new insights into magnetic fields in galaxies and their halos. These include polarization results that point to large-scale organized magnetic fields, as well as small-scale circular polarization in cores. This talk will summarize some of the highlights from the CHANG-ES project, as well as new results and ongoing work that is piecing together contiguous waveband coverage from 1 to 7 GHz. For data, see the CHANG-ES public release website at projects.canfar.net/changes.

38. **Human machine understanding of astrophysical data**
Alejandro Ortega Cruz Prieto (University of Toronto) [undergrad]
Co-author(s): Alexander Laroche, Joshua S. Speagle, and Maria Drout

Gaia DR3 composes more than 220+ million BP/RP spectra. With so many data, different things can be better understood. But 220 million points is out of human bounds. Particularly, how can we find outliers, the points that give us the most information, in such a sea of data. Our approach is deep learning, an autoencoder that combines different types of data, spectra and light curve, with the aim of learning and picking up the emerging patterns in the data that allow for easy identification of outliers. The combination of over-parameterized models with diffusion models in our approach has allowed for the inference of one data type out of the second one. The process of inference has created a strong understanding of the data in the latent space, which matches an intuitive ordering of the data highlighted in geometrical symmetries and features in the latent space. We have found how specific axes in the latent space describe variations along each type of data.

Instrumentation

39. **Gladys A. Harvey: Canada's First Woman Radio Astronomer**
Timothy Robishaw (Dominion Radio Astrophysical Observatory) [faculty/staff]

Gladys A. Harvey (1916-1995) was a staff member of the Radio and Electrical Engineering

Division (REED) of the National Research Council of Canada (NRC) from 1948 to 1976. Gladys received B.A. and M.A. degrees from McMaster University in the field of mathematics, and then received a teaching certificate from the Ontario College of Education. After a number of years working in education, she applied for a position at NRC, where in March 1948, despite having no radio, electronics, or engineering expertise, she was immediately hired into REED based on the strength of her mathematics background. This was a couple of years after Canada's first radio astronomer, NRC's Arthur E. Covington, made the first detection of radio emission from the Sun, and despite having no prior experience or interest in astronomy, Gladys was assigned to work with Covington to conduct astronomical observations of the Sun at NRC's Goth Hill Solar Radio Observatory. Gladys spent many years at the observatory assisting Covington with instrumentation and observations before beginning to coauthor publications on astrophysical measurements of the brightness of solar radio emission at a wavelength of 10.7 cm, especially bursts of radio emission that coincided with solar flares from the surface of the Sun. This led to a single-author paper on this topic in the Astrophysical Journal in January 1964. Throughout the 1970s, Gladys worked with the NRC's 46-meter radio telescope at the Algonquin Radio Observatory, and her scientific interest shifted from solar radio emission to the search for variable radio emission from distant galaxies. We present an overview of Gladys's career and her research highlights, and we rely on family photographs and a recovered audio interview with Gladys to provide insight into her experiences as the first woman working in radio astronomy in Canada.

40. **Validating a SWIR Camera for Exoplanet Detection: The POET-STRATOS High-Altitude Balloon Mission**

Noel Wajnblum (Western University) [undergrad]
Co-author(s): Metchev, Stanimir; Wajnblum, Noel; Rowe, Jason; Pilles, Eric; Sabarinathan, Jayshri; Amey, Stephen

The search for exoplanets is advancing rapidly with continuous improvements in observational techniques and technology. The POET-STRATOS project aims to validate the astronomical use of a short-wavelength infrared (SWIR) camera in a near-space environment to assess the readiness of the proposed Photometric Observations of Exoplanet Transits (POET) mission. This mission seeks to detect exoplanets and characterize their atmospheres. We developed a custom-built imaging system integrating a Raptor Photonics Owl 1280 SWIR camera with a mini PC, which will be deployed on a high-altitude balloon to measure the infrared flux variations of exoplanetary systems. Successful validation of commercial infrared cameras for precise astronomical observations could enable their wider adoption in space-based missions, potentially reducing costs for remote sensing applications across a multitude of scientific disciplines.

41. **Canadian Gemini News**

Eric Steinbring (NRC/HAA) [faculty/staff]
Co-author(s): Côté, Stéphanie; Davidge, Tim; Fraser, Wes

We provide updates on Gemini operations over the last year, and show some statistics from Canadian use of the telescopes in recent semesters. Check out future plans, upcoming instruments and ongoing upgrades. Recently this has included the GHOST

and IGRINS-2 high-resolution spectrographs, which have shown great popularity. And those will soon be joined by the GPI 2.0 high-contrast planet imager, followed by the SCORPIO imager and spectrograph. The CASCA 2025 schedule has opportunities to meet with Gemini experts to learn about what's new and answer all your questions about Phase I and Phase II, or on getting help with your data reductions.

42. **Time-Resolved Point Spread Function Measurements of an Adaptive Optics System with a Single-Photon Avalanche Diode Array**
Theodore Grosson (University of Victoria) [grad]
Co-author(s): van Kooten, Maaike; Jackson, Kate; Veran, Jean-Pierre; Carrier, Simon

Astronomical observations requiring extremely high angular resolution necessitate advanced adaptive optics (AO) systems to overcome blurring caused by the atmosphere. AO reduces the size of the image point spread function (PSF), but it is not necessarily clear how the PSF evolves at AO system timescales (i.e., 500-1000 Hz). We have installed a commercially-available Single-Photon Avalanche Diode (SPAD) detector on the REVOLT AO testbench at the Dominion Astrophysical Observatory, allowing us to observe the visible PSF of the system at rates up to 96 kHz. This provides a time-resolved view of the evolution of the PSF at ~100 times the frequency of the AO system itself. We present initial results from these observations and discuss possible avenues for the use of this detector in time-resolved wavefront sensing, as well as lucky imaging behind an AO system to further improve resolution while minimizing signal loss.

43. **Supporting Transformative Science with NIRISS, the Canadian Instrument Onboard JWST**
Gaël Noirot (Space Telescope Science Institute, Canadian Space Agency) [faculty/staff]

The Near Infrared Imager and Slitless Spectrograph (NIRISS) is the Canada-made science instrument onboard JWST. It enables a wide breadth of astrophysical investigations from solar system science to the first few hundreds of Myrs after the Big-Bang. This is made possible thanks to its four observing modes: Aperture Masking Interferometry (AMI), Single Object Slitless Spectroscopy (SOSS), wide-field Imaging, and Wide-Field Slitless Spectroscopy (WFSS). AMI is designed for high-contrast, high-resolution imaging in the range 2.5-5.0 μm, allowing detection and characterization of exoplanets and spatially resolving extended sources such as protoplanetary disks or AGN. SOSS offers medium resolution (R~700) spectroscopy in the range 0.6-2.8 μm, optimized for time-series observations of transiting exoplanets and detailed characterization of their atmospheres. Imaging observations cover the entire NIRISS field-of-view (2.2x2.2 arcmin^2) and allow spatially-resolved photometry in seven wide- and five medium-band filters in the 0.8 μm to 5.0 μm range; these include six short-wavelength (< 2 μm) and six long-wavelength (> 2 μm) filters. The WFSS mode enables the acquisition of thousands of low-spectral (R~150), high-spatial resolution spectra in single exposures over the entire NIRISS field-of-view in the range 0.8-2.2 μm. Imaging and WFSS are especially suited for prime and parallel observations of extragalactic fields and spatially-resolved extragalactic astronomy. In this talk, I will review the current performance status of NIRISS and its observing modes and present the latest improvements made to the JWST pipeline and pipeline products by the NIRISS instrument team. I will also present planned calibration and pipeline updates that will further improve the quality of NIRISS data products. In the second part of this talk, I will

focus on the transformative science enabled by NIRISS. I will highlight the most recent results and exciting discoveries made possible by its four observing modes, and particularly that of its WFSS mode dedicated to extragalactic astronomy. To that extent, I will showcase some of the latest results from the NIRISS GTO program CANUCS, the Canadian Unbiased Cluster Survey, which enables a wealth of science from the local Universe to the highest redshifts.

44. **Initial Polarization Observations with TolTEC Millimeter Camera on the LMT**
Brandon Shane (Queens University) [grad]
Co-author(s): Fissel, Laura; Wang, Hailin; Lee, Dennis; Novak, Giles

TolTEC is a new, high-resolution millimeter-wavelength imaging polarimeter installed on the 50-meter Large Millimeter Telescope (LMT). The TolTEC camera feeds three focal plane arrays of polarization sensitive microwave kinetic inductance detectors (MKIDs) that simultaneously maps the sky at 1.1 mm, 1.4 mm, and 2.1 mm with a best resolution of 5 arcseconds. TolTEC will make resolved maps of magnetic fields within filamentary star-forming regions through high-resolution measurements of linearly polarized dust emission. We will give an overview of the TolTEC polarimeter, present publicly released initial data, and discuss constraints on the instrumental polarization obtained from TolTEC observations of the asteroid Pallas, which serves as an unpolarized reference source. These observations provide important insights into the instrument's polarization response and requirements for future TolTEC polarization studies.

45. **Thirty Meter Telescope Program Update**
David Andersen (TMT International Observatory) [faculty/staff]
Co-author(s): Fengchuan Liu

We provide an overview of recent advancements in the Thirty Meter Telescope (TMT) project, focusing on three major areas: community engagement in Hawai'i, design maturity, and TMT's comparative performance advantages. The TMT team has established a robust framework for sustained dialogue and collaboration with local communities, honouring the cultural and environmental significance of Maunakea while fostering mutual understanding. TMT continues to progress its design, encompassing enhancements to the structural, optical, and control subsystems. 85% of TMT is in final design or in construction. We will describe the current status of TMT systems, highlighting advances in adaptive optics, mirror alignment, and instrumentation designs. Finally, we discuss the scientific impact of TMT, providing a comparison of performance between TMT and exisiting and upcoming ground and space-based observatories. TMT's combination of aperture size and advanced adaptive optics and instrumentation will enable transformative discoveries, establishing its role as a premier ground-based observatory in the coming decade.

46. **The Colibri Telescope Array: A High-Cadence Robotic Facility for Time-Domain Astronomy**
Toni Cordeiro de Almeida (Western University) [grad]
Co-author(s): Metchev, Stanimir; Mazur, Michael; Girmenia, Anthony; Martz, connor

The Colibri Telescope Array, located at the Elginfield Observatory, 25 km north of London, Ontario, is a robotically operated facility designed for high-cadence

astronomical observations. Managed by the University of Western Ontario, Colibri consists of three identical 0.5-meter prime-focus Hercules telescopes, each equipped with a Kepler KL4040 sCMOS camera capable of acquiring images at rates of up to 40 frames per second. The system provides a field of view of 1.43 degrees with a plate scale of 2.52 arcseconds per pixel and achieves a limiting magnitude of G = 12.1 at a signal-to-noise ratio of 5 with an exposure time of 25 milliseconds. Currently, observations are unfiltered in the visible band (380-900 nm), with future expansion into the short-wavelength infrared (SWIR) band (900–1700 nm) under consideration, pending the acquisition of a suitable camera. Colibri is a versatile facility with broad scientific applications, including time-domain observations at sub-second timescales of transient phenomena, video astronomy and solar system objects tracking. Colibri is also fully capable of executing deep, long-duration monitoring sequences. Expansion plans include the acquisition of visible-light filters, the development of scripts for scheduling automated guest observations and satellite video monitoring. While the primary scientific goal of Colibri is the detection of kilometer-sized trans-Neptunian objects via serendipitous stellar occultations, we welcome collaborative projects in a range of ancillary research areas.

47. **The Balloon-borne Very Long Baseline Interferometry Experiment (BVEX)**
Maggie Oxford (Queen's University) [grad]
Co-author(s): Fissel, Laura; Bagchi, Mayukh; Thiel, Felix

Very Long Baseline Interferometry (VLBI) has been used to produce the first image of the black hole shadow of the M87 galaxy using the Event Horizon Telescope with < 25 microarcsecond resolution. Improving the resolution further would require telescopes to either be operated at higher frequencies, which is difficult due to the opacity of the Earth's atmosphere, or to be separated by distances greater than the diameter of the Earth. The Balloon-borne VLBI Experiment (BVEX) aims to demonstrate that VLBI can be accomplished between a balloon-borne telescope (operating above 99% of the atmosphere) and a ground based radio telescope, thereby offering the first step toward a solution to the current constraints on VLBI. BVEX is a one metre K-band telescope (21-23GHz) that will operate suspended from a stratospheric balloon. It will launch from Timmins, Ontario in August, 2025 as part of the CSA's STRATOS program. This poster will discuss the BVEX instrument, our position tracking requirements for phase stability, observations from initial testing, and an overview of our planned flight campaign.

48. **Simulating a UV Multi-object Spectrograph for the CASTOR Mission**
Charles Lee (University of Manitoba) [grad]
Co-author(s): Yeung, Jade; Woods, Tyrone; Côté, Patrick

The Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR) is a 1-m space telescope mission led by the National Research Council of Canada and the Canadian Space Agency. CASTOR will bridge the UV-optical gap for the post-Hubble era through its wide- and deep-field surveys and enable discoveries ranging from studies of galaxy evolution and AGNs to stellar astrophysics. The UltraViolet Multi-Object Spectrograph (UVMOS) is a proposed instrument on CASTOR that will provide low-medium resolution (R ~ 1400) spectrographic capabilities in the UV (150 to 300 nm). This instrument currently uses an Offner-type design with two concave mirrors, a convex grating with 1190 lines/mm, and a digital micro-mirror device (DMD) as the object selector. Current development and characterization work is underway at the University of Calgary, NRC Herzberg, the University of Manitoba, and CASTOR's international collaborators. The UVMOS will provide spectrographic data for studies in stellar chemical composition, AGN, and exoplanet research. Here we present the initial development of a simulation suite for the UVMOS instrument and discuss its application to key science goals of the CASTOR science working groups. We discuss how the simulation tool will complement ongoing characterization work and build upon CASTOR's existing software tools to further UVMOS design and science case studies.

49. **Remote Telescopes in the High Arctic - Affordable Optical Satellite Communications**
Ryan Wierckx (University of Manitoba) [grad]

Communicating with satellites from the ground is becoming more and more difficult, as bandwidth demands steadily increase, and radio communication bands become crowded, the need for higher bandwidth satellite communication has never been higher. At the forefront of this development is optical communications. Taking advantage of infrared laser technology, down-link speeds can well exceed the 1GB/s mark. As with most cutting edge technology, use is limited by lack of infrastructure. By developing and implementing inexpensive, completely remote operable optical telescopes in the northern regions of Canada, we hope to create the necessary infrastructure to provide future satellites, especially those in sun-synchronous orbits, such as CASTOR, with high bandwidth downlink capability, allowing offload of data to earth at speeds never before available. Operating and protecting precision equipment in Canada's arctic is no easy task, and so a small scale prototype has been developed at the University of Manitoba's Glenlea site, dubbed the Glenlea Remote Observatory (GRO), which has successfully engaged in remote operations throughout the cold Winnipeg winter. This test bench, Featuring a 36 cm telescope aboard a direct drive equatorial mount, is capable of tracking satellites at up to 20 degrees per second for the purposes of optical down-link. In addition to optical down-link capability, GRO has proven to be a useful teaching instrument for students, aiding in understanding what goes into operating a ground based observatory. GRO will serve as a prototype for a planned 60 cm remote observatory in development for the Inuvik Satellite Station Facility in the Northwest Territories.

50. **The Radio Revolution: A Primer for Non Radio Astronomers**
Gregory Sivakoff (University of Alberta) [faculty/staff]

In the last decade new facilities, surveys, and techniques have revolutionized our understanding of the radio sky. For the first time ever there are relatively high resolution and relatively sensitive surveys of the entire sky (combining the Very Large Array Sky Survey and the Rapid ASKAP Continuum Surveys). Several collaborations routinely observe the same patches of the sky adding the temporal dimension. Systematic polarization studies are also being performed. And an even greater resolution will come when the Square Kilometre Array comes online. However, astronomers outside of this sub-field have not always been equipped to integrate radio data into their research. In this presentation I will briefly describe some relatively straightforward resources that can help all astronomers interface with some of these revolutionary data sets.

51. **Toward reflected light exoplanet imaging with SPIDERS and CAL2: Project update of NRC focal plane wavefront sensors**
Christian Marois (National Research Council of Canada) [faculty/staff]
Co-author(s): Thompson, William; Lardiere, Olivier; Johnson, Adam; Mann, Christopher; Fitzsimmons, Joeleff; Fogal, Andre; Hessel, Kaitlyn; N'Diaye, Mamadou; Qiang, Fu; Heidrich, Wolfgang

High-contrast imaging instruments are limited by speckles having a broad range of life time, from fast KHz residuals from the atmosphere residuals (after adaptive optics corrections), to slowly (minutes to hours) changing non-common path aberrations. This noise is the main limitation for both ground-based and space-based high-contrast imaging, including the upcoming Habitable Worlds Observatory telescope. This noise is usually attenuated by clever observing strategies or powerful post-processing techniques, but these can still be limited by small wavefront evolutions with time and/or wavelength, and photon noise. I will discuss the SPIDERS pathfinder and the CAL2 National Research Council of Canada focal plane wavefront sensor projects, systems that allow both science observations and fast 100Hz wavefront sensing to be performed using the same data/camera. The SPIDERS pathfinder instrument for the Subaru telescope has been designed to validate new innovative concepts from focal plane wavefront sensing to high-contrast high-spectral resolution (up to R20,000) spectroscopy using an imaging Fourier Transform Spectrograph; SPIDERS FTS is the first of its kind in the high-contrast imaging field. The CAL2 project consists of upgrading the Gemini Planet Imager instrument calibration unit “CAL” with a next generation fast-speed and low-noise SAPHIRA-based facility-class near-infrared focal plane wavefront sensor. Both systems main technical goal is to improve sensitivity by up to 1-2 orders of magnitude very close to the coronagraphic focal plane mask, opening up a new regime of direct exoplanet imaging of Jupiter-mass exoplanets down to 5-10AU orbiting nearby young mass stars. I will discuss recent SPIDERS results, including early HWO R&D, and its schedule. With the CAL2 final design review completed Fall 2024, I will discuss CAL2 current progress toward its integration in the Gemini Planet Imager 2 instrument late 2025/early 2026.

52. **Instrumentation at the Observatoire du Mont-Mégantic**
Frédérique Baron (Université de Montréal) [faculty/staff]
Co-author(s): Doyon, René

The Observatoire du Mont-Mégantic (OMM) stands as one of Canada’s leading university-based centers for experimental astrophysics. Established in 1978 and jointly managed by Université de Montréal and Université Laval, the OMM has developed an extensive array of advanced optical and infrared instruments. Its scope has grown far beyond the telescope site, establishing itself as a national facility with international recognition. The OMM comprises the 1.6-m telescope and the Laboratoire d’astrophysique expérimentale, where new instruments are being developed for the OMM and other telescopes everywhere in the world. This talk will highlight current and upcoming instruments at OMM and LAE. At OMM, a new version of the Caméra PAnoramique Proche Infra-Rouge (CPAPIR 2.0) with an updated cryocooler will be deployed this fall. The Spectromètre Imageur de l’Observatoire du Mont-Mégantic (SpIOMM) is also getting a fresh look and will be upgraded with new EMCCD detectors. Additionally, VROOMM (Vitesse radiale optique à l’Observatoire du Mont-Mégantic), a visible (360 nm - 930 nm) high-resolution échelle spectrograph, is currently in its design phase from OMM. Specifically designed for precision radial velocity measurements of relatively faint stars, the instrument features a 4K photon-counting EMCCD, octagonal fibers, and a double scrambler, all housed in a thermally stabilized vacuum cryostat. At the LAE,multiple projects are underway for international observatories. We are developing the slicer subsystem for the Gemini Infrared Multi-Object Spectrograph (GIRMOS), which comprises three sub-assemblies: a staircase slicer with 42 300 µm wide mirrors, followed by 42 pupil mirrors and 42 field mirrors distributed over two rows to produce an image of the pupil for each slice. SPIROU au Pic du midi (SPIP), an infrared spectropolarimeter (1-2.4µm) specialising in the study of exoplanets orbiting in the habitable zone around young, low-mass stars, is currently being integrated in France. We designed and built the camera, characterised the detector and are updating APERO, our reduction pipeline to be able to reduce the SPIP data. Finally, we are currently working on the design of the three cameras for the YJH spectrograph of the ArmazoNes high Dispersion Echelle Spectrograph, or ANDES, a second-generation instrument for the Extremely Large Telescope in Chile. This presentation will provide an overview of these advancements and their impact on astrophysical research.

53. **News and highlights from CFHT**
Nadine Manset (CFHT) [faculty/staff]

We present recent and current CFHT activities from the technical and science groups, including outreach and community engagement efforts.

54. **Deep in the Lows: A Machine Learning Based Wavefront Reconstructor for the Lyot-based Low Order Wavefront Sensor**
Andre Fogal (University of Victoria, NRC-HAA) [grad]
Co-author(s): Thompson, William; Marois, Christian; Lardière, Olivier; Mann, Chris; Johnson, Adam; Fitzsimmons, Joeleff

Next generation exoplanet imaging instruments, such as the Subaru Pathfinder Instrument for Detecting Exoplanets and Retrieving Spectra (SPIDERS), employ low-order wavefront sensors to achieve the contrast necessary to image exoplanets. SPIDERS uses a Lyot-based Low Order Wavefront Sensor (LLOWFS), which detects low-order aberrations in the incoming light and corrects them using a deformable mirror. Currently, wavefront reconstruction relies on a linear reconstructor, but this approach struggles with the inherently nonlinear nature of the problem, leading to instability and crosstalk. To address this, we are developing a machine learning-based wavefront reconstructor based on a convolutional neural network (CNN). The CNN is trained on SPIDERS bench data with a known wavefront. Unlike the linear reconstructor, the CNN's ability to model non-linearity reduces instability and crosstalk, leading to more effective wavefront control. Implemented in the Julia programming language, the CNN will integrate seamlessly with the SPIDERS real-time control system, providing the rapid (~100 microseconds per image) predictions necessary for closed-loop operation. I will present results demonstrating the CNN's performance in real-time operation, maintaining a stable loop when integrated into the control system. This new approach is broadly applicable to low-order wavefront sensing and can help drive contrasts lower as we search for other worlds.

Galaxies

55. **Comparing the SIMBA Cosmological Simulation with WALLABY Observations**
Mathieu Perron-Cormier (Queen's University) [grad]
Co-author(s): Nathan Deg, Kristine Spekkens

The ongoing untargeted HI survey WALLABY is projected to image ~2300 galaxies at resolutions higher than 5 beams across and marginally resolved galaxies. This sheer quantity of data will allow powerful statistical comparison of galaxy populations between observations and simulations, but such comparisons require robustly derived mock observations. To that end, we present a method to construct mock HI cubes adapted to MFM and SPH simulations and utilize it to develop a WALLABY-like sample of mock observations from the SIMBA cosmological simulation. We present a method to construct mock HI cubes adapted to MFM and SPH simulations. We develop a mock sample of the SIMBA cosmological simulation designed to be comparable to WALLABY. We use the PQMass test to compare the SIMBA mocks with WALLABY across different parameters including the Deg et al. 2023 asymmetry parameters. We find signatures of differences in the asymmetries, but these differences are of low statistical significance because of our limited sample. The method by which we constructed a mock realization of WALLABY using SIMBA and compared the two is general and could be applied to any simulation and set of parameters.

56. **Searching for Globular Clusters in NGC 7332 and NGC 7339**
Heather Lenz (University of Calgary) [undergrad]
Co-author(s): Langill, Phil; Taylor, Matthew

The spatial distribution of globular clusters (GCs) in galactic halos offers critical insights into the formation and evolution of their host galaxies. We combine new CFHT/WIRCam Ks-band imaging with archival CFHT/MegaCam optical data to identify GCs around the giant lenticular galaxy NGC 7332 and its spiral companion NGC 7339 using a uiKs colour-colour diagram. Given their close proximity to each other (35.2kpc assuming a shared distance of 20.5Mpc), we investigate the potential gravitational interaction by analyzing the spatial and colour distributions of their GC systems. The Ks-band data was obtained with CFHT/WIRCam as part of a proposal written for an inaugural undergraduate international learning experience provided by the University of Calgary in Spring 2024, led by Dr. Langill and Dr. Taylor. As part of this program, twelve students participated in writing proposals for CFHT and Gemini North, visited each observatory's base facilities, and toured the telescopes at the summit of Maunakea. The uiKs diagram is a powerful tool to separate GCs from background galaxies and foreground stars by their magnitude variations across three filters. Early results have identified 90 GC candidates orbiting NGC 7332 and NGC 7339, providing key insights into their potential interaction and evolutionary histories.

57. **The Impact of Galaxy Mergers on Molecular Cloud Properties and Star Formation**
Barbara Maeve (McMaster University) [grad]
Wilson, Christine

The process by which stars form is central to understanding how galaxies evolve over time. While it is well known that stars form in molecular clouds, the complex relationship between cloud structure and star formation is not entirely understood. By focusing on the Antennae Galaxies – a pair of galaxies in the midst of a merger and a prolonged burst of star formation – I aim to investigate how merger-driven alterations in molecular cloud properties shape star formation. I use high-resolution data from the Atacama Large Millimeter Array (ALMA) and the PYthon-Cloud PROPertieS (PY-CPROPS) algorithm to analyze the physical characteristics of molecular clouds, such as mass, radius, and surface density. Interestingly, a plot of the size-linewidth coefficient versus mass surface density reveals that the velocity dispersion within the clouds is too high for them to be in virial equilibrium. This suggests that the clouds may be unbound or, alternatively, that they require substantial external pressure to maintain virilization. Future work will compare cloud catalogs derived from two independent CO lines to ensure the reliability of the molecular cloud catalog and verify the accuracy of the results.

58. **The role of gas stripping in the quenching of satellite galaxies**
Megan Oxland (McMaster University) [grad]
Co-author(s) Bravo, Matías; Parker, Laura

Understanding the timescales associated with star formation quenching provides key insights into the mechanisms driving galaxy evolution in dense environments. We first investigate quenching as a function of infall time using a large observational sample of low-redshift galaxies from the Sloan Digital Sky Survey. We use galaxy position in projected phase space as a proxy for time since infall to examine how specific star formation rates evolve in group and cluster environments. Our results show clear trends of increasing quenched fractions with infall time, as well as significant pre-processing of cluster galaxies. We then compare these findings to a sample of simulated galaxies from the semi-analytical model SHARK. Conducting a similar analysis though tracing the actual time since infall, we find that SHARK's default environmental quenching prescription is too aggressive and does not reproduce observational trends. We test simple modifications to the models controlling the stripping of gas from the ISM and CGM to improve the match with observations.

59. **Ergodicity of FIRE: Star Formation Variations within and between Simulated Galaxies**
Fraser Smith (Saint Mary's University) [grad]
Co-author(s): Hayward, Christopher; Hopkins, Phil; Faucher-Giguère, Claude-André; Kereš, Dušan; Quataert, Eliot; Wetzel, Andrew

The statistical assumption of ergodicity is, at least theoretically, an enticing concept in the study of galactic star formation. If galactic star formation properties can be shown to exhibit ergodicity then individual evolution can be inferred via ensemble behaviours, most notable in this regard is the star formation main sequence (SFMS) and specifically departures from it. In prior research using simulations of isolated galaxies and commonly applied star formation techniques we found insufficient variability in star formation properties: individual galaxies were unable to explore the full scatter about the SFMS. However, evidence for partial ergodicity was found whereby ergodic-like behaviour could be recovered when averaged over mass bins. I will preview recent

results from our collaboration with the Feedback In Realistic Environments (FIRE) project. With state-of-the-art star formation feedback modeling, FIRE simulations have considerably higher variability in star formation histories at high redshifts and lower masses. This additional variability allows systems to more closely approach ergodic behaviour over cosmic time. Moreover, both low-mass and high-mass galaxies reach ergodicity over time, despite different overall star formation behaviours. Mergers and changes in morphology are also considered in this ergodic context. Lastly, and perhaps slightly surprisingly, the choice of star-forming main sequence considered does not significantly impact the observed ergodicity of SFMS deviations.

60. **Effect of Ram Pressure on Star Formation in Satellite Galaxies**
Lauren Foster (McMaster University) [grad]
Parker, Laura

Ram pressure stripping is an environmental quenching mechanism that removes gas from galaxies infalling into groups and clusters, and in extreme cases, can lead to jellyfish galaxies with extended gas tails. Studies of jellyfish galaxies have suggested that ram pressure can compress the gas on a galaxy's leading edge, leading to a brief period of enhanced star formation. In our work, we study a large statistical sample of infalling satellite galaxies to quantify the strength of ram pressure-induced star formation enhancement using Ultraviolet Near Infrared Northern Survey (UNIONS) u-band imaging as a star formation tracer. Applying several metrics to compute galaxy asymmetries, we compare the leading and trailing sides of each galaxy, using the Coma Cluster as a test case since it has a large number of jellyfish galaxies. We then compare these measurements to environmental properties of each galaxy, such as their time since infall and host halo mass. We find that any statistical star formation enhancement is small for infalling galaxies regardless of their environment, suggesting that this effect is either uncommon or short-lived.

61. **Measuring Physical Properties of Globular Cluster Populations at Intermediate Redshift with SED Fitting**
Jinoo Kim (McMaster University) [grad]
Co-author(s): Harris, William

Globular clusters (GCs) are fundamental tracers of galaxy formation and evolution, preserving information about early star formation histories and chemical enrichment. While extensive studies have characterized GCs in the local universe, their properties at intermediate redshifts remain unexplored. The James Webb Space Telescope (JWST) provides an opportunity to apply spectral energy distribution (SED) fitting techniques to distant GCs, enabling more precise determinations of their physical properties compared to traditional color-magnitude analysis. This study analyzes GC candidates in Abell 2744, a massive galaxy cluster at $z = 0.308$ with a lookback time of 3.5 Gyr, using deep JWST/NIRCam imaging from the UNCOVER survey. Photometry from eight broadband filters (F070W–F444W) is used to perform SED fitting, allowing constraints on mass, age, and metallicity distributions. The application of SED fitting to an entire GC population in an intermediate redshift galaxy cluster is still in its early stages. This study highlights the potential of JWST for advancing extragalactic GC research and provides a first look at the level of analysis possible with future datasets. By bridging the gap between well-studied nearby GCs and their high-redshift counterparts, this approach

offers a pathway to understanding the formation and evolution of GCs across cosmic time.

62. **The Intrinsic Flattening of Galaxy Disks**
Jeremy Favaro (Saint Mary's University) [grad]
Co-author(s): Courteau, Stéphane ; Comerón, Sébastien; Stone, Connor

Highly inclined (edge-on) disk galaxies offer the unique perspective to constrain their intrinsic flattening, c/a, where c and a are, respectively, the vertical and long radial axes of the disk measured at suitable stellar densities. The ratio c/a is a necessary quantity in the assessment of galaxy inclinations, three-dimensional structural reconstructions, and total masses, as well as a constraint to galaxy formation models. I used the 3.6 μm maps of 133 edge-on spiral galaxies from the Spitzer Survey of Stellar Structure in Galaxies and its early-type galaxy extension to revisit the assessment of c/a, now free from dust extinction and away from the influence of a stellar bulge. I present a simple definition of c/a and explore trends with other galactic physical parameters: total stellar mass, concentration index, total HI mass, mass of the central mass concentration, circular velocity, model-dependent scales, and Hubble type. Other than a dependence on early/late Hubble types and a related trend with light concentration, no other parameters were found to correlate with the intrinsic flattening of spiral galaxies.

63. **Globular cluster SED fitting: a new method for tracing local universe galaxy evolution**
Kate Hartman (McMaster University) [grad]
Co-author(s): Harris, William E.
In most nearby galaxies, integrated photometry of globular clusters (GCs) - bright and information-dense tracers of galaxy history - is available in just two filters, allowing for only a single colour index. While photometric colour indices are an efficient proxy observation for metallicity, it can be difficult to derive detailed physical GC properties from the one colour index that is typically obtainable for each galaxy. There are two major exceptions to this trend: NGC 4874, which has Hubble Space Telescope (HST) images available in 10 wide-band filters, and NGC 2937, the only galaxy in the nearby universe with both HST and James Webb Space Telescope (JWST) data. I took advantage of this special opportunity and tested spectral energy distribution (SED) fitting procedures on present-day GCs. SED fitting can yield multiple physical GC metrics at once, including metallicity and mass, both key properties for mapping host galaxy history. Because JWST's NIRCam produces images in two filters per exposure, we will have more and more chances for present-day GC SED fitting as observations accumulate in the JWST archive. As a demonstration of this powerful new analysis method, I will present proof-of-concept SED fitting results for bright GCs from NGC 4874 and NGC 2937, plus derived GC properties from both galaxies and the inferences we can make about their evolutionary history.

64. **Observations of globular cluster populations at cosmological lookback times of 3-4 Gyr**
Kaitlyn Keatley (McMaster University) [grad]
Co-author(s): Harris, Bill

As some of the oldest objects in the local universe, globular clusters (GCs) and GC populations retain valuable information about the history of their host galaxies. These populations can also be used to probe the gravitational field of massive galaxy clusters, which is dominated by dark matter. However, observational restrictions make it challenging to understand their formation and evolution, motivating high-resolution studies at greater lookback times. With the James Webb Space Telescope (JWST), we are able to expand these observations to a much greater redshift and further investigate the nature of these ancient systems. This research focuses on two strong lensing galaxy clusters: RXJ 2129.7+0005 at redshift 0.234 (lookback time of 2.90 billion years), and Abell 370 at redshift 0.375 (lookback time of 4.11 billion years). I have conducted photometry utilizing four bands from the short wavelength channel of NIRCam (F090W, F115W, F150W, and F200W). In this talk, I will present and compare colour-magnitude diagrams of the GC population in the two galaxy clusters and completeness curves of each sample. Additionally, I will present the spatial distribution of GCs—radial and azimuthal—and explore subpopulations divided by colour. This work contributes to the limited studies of full GC populations at intermediate redshift.

65. **A multi-line analysis of dense gas tracers across the Antennae**
Ashley Bemis (Waterloo Centre for Astrophysics, University of Waterloo) [postdoc]
Co-author(s): Wilson, Christine; Ledger, Blake; Bouvier, Mathilde; Huang, Ko-Yun

As extreme systems, galaxy mergers are important testbeds for constraining star formation models and the baryon cycle. The Antennae, the nearest gas-rich major merger, is particularly important as it shows interesting, and in some cases surprising, variations in the star formation efficiency of dense gas (SFEdense) at sub-kpc scales. LHCN/LCO appears to be enhanced in the nuclei relative to the overlap, indicating a higher dense gas fraction (fdense), while multiple SFR indicators are suppressed relative to LHCN in the nuclei indicating a lower SFEdense. Additionally, LHCN is enhanced relative to $LHCO^+$ in NGC 4038, but not elsewhere in the Antennae. This indicates that the conversion of molecular line luminosities to dense gas masses does not follow the standard expectations. We present the first multi-J radiative transfer modeling of dense gas tracers at sub-kpc scales across the Antennae. We constrain the physical conditions of the gas exciting HCN and HCO^+ using data from ALMA and the SMA. This includes the J=1-0, 3-2, and 4-3 lines of HCN and HCO^+ in both the NGC4038 nucleus and super giant molecular clouds in the overlap region. We combine these data with CN and HNC J=1-0 observations to explore chemical variations in dense gas tracers at these scales. Finally, these results are compared against radiative transfer modelling and the predictions of turbulent star formation models to assess if we are observing true variations in SFEdense and fdense, or if the emissivity of HCN is enhanced in the nuclei due to physical conditions of the gas.

66. **Surveying Atomic Gas in Nearby Low-Mass Galaxies with CHORD**
Akanksha Bij (Queen's University) [grad]
Co-author(s): Spekkens, Kristine; Hopkins, Hans; Liu, Adrian; Lang, Dustin; Hill, Alex; Foreman, Simon; Ceppas de Castro, Rebecca; Pereira, Olivia; Chakraborty, Arnab

Observations of dwarf galaxies continue to challenge cosmology due to poorly constrained models of galaxy formation and evolution. Mapping the neutral Hydrogen (HI) content of low-mass gas-rich galaxies can be a powerful tool for understanding the underlying baryonic physics. However, obtaining a census of galaxy properties requires large population studies, which tend to be limited by telescope sensitivity. The Canadian

Hydrogen Observatory and Radio-transient Detector (CHORD), currently under construction at the Dominion Radio Astrophysical Observatory (DRAO), is a next-generation radio telescope that will deliver the largest HI census of the local galaxy population to date. CHORD's high sensitivity will probe the faintest gas-rich galaxies in the local universe, pushing an order of magnitude further down the HI mass function than the current state of the art. We will present an overview of local HI galaxy science goals with CHORD, HI source count forecasts for the CHORD Pathfinder phase in 2025 and Full CHORD starting in 2026, focussing on the prospects for pushing the gas-rich galaxy surveys into the range 10^5 solM < M_HI < 10^7 solM, where population studies do not yet exist.

67. **Disentangling SFR Timescales: An Updated Identification Method for Rejuvenating Galaxies**
Dylan Lazarus (McMaster University) [grad]
Co-author(s): Parker, Laura

Most galaxies transition from star-forming to quenched as the Universe evolves; however, some galaxies can have their star formation reignited after being quenched. Minority populations, such as these rejuvenating galaxies, are crucial for constraining models of galaxy evolution and understanding the diverse evolutionary pathways of galaxy growth. Detecting rejuvenation remains challenging and requires photometric and spectroscopic measurements to constrain star formation histories. We have developed a method for identifying rejuvenating galaxies in the local Universe using UV imaging and optical spectroscopy. We build upon a recent selection method that identifies a galaxy as rejuvenating if it is quenched in the UV—purportedly tracing star formation on ~100 Myr timescales—but star-forming in H-alpha (~10 Myr timescales). Shortly after a burst of star formation, most of the UV emission originates from the same massive stars that dominate H-alpha. Therefore, these indicators cannot always be interpreted as tracing distinct star formation timescales. To address this, we derive a relation to convert a galaxy's H-alpha emission to the UV emission produced by ionizing stars, allowing us to isolate the UV emission from stars below 20 solar masses. We can then compare two SFR indicators tracing distinct timescales. This, coupled with dust corrections, offers a significantly more reliable classification diagnostic for identifying rejuvenating galaxies in large surveys. I will present this method as well as the galaxy properties for a sample of rejuvenating galaxies selected in the SDSS.

68. **The Role of Galaxy Environment in Pressure-Regulated Star Formation and Gas Content in Galaxies**
Taavishi Jindel (McMaster University) [grad]

Pressure-regulated feedback-modulated (PRFM) models predict that star formation in galaxies is governed by the balance between interstellar medium (ISM) pressure and the energy output of massive stars. While multiple surveys have empirically confirmed the predictions of PRFM models at kiloparsec scales, the influence of large-scale environment on these models remains uncertain. I will present new observational evidence demonstrating that environment plays a key role in the ISM pressure balance and star formation regulation of galaxies. Specifically, I compare the resolved relationships on 1.2 kpc scales between molecular-to-atomic gas ratios, star formation rates, and molecular gas depletion times as a function of dynamical equilibrium pressure in both field and cluster galaxies. My study focuses on galaxies in the Virgo Cluster, using data from the VERTICO (H2) and VIVA (HI) surveys, and a comparison sample of field galaxies from the HERACLES (H2) and THINGS (HI) surveys. I find that at a given dynamical equilibrium pressure, cluster galaxies exhibit higher molecular-to-atomic gas ratios and star formation rates than field galaxies. Additionally, using atomic gas deficiency as a proxy for cluster-specific environmental mechanisms, I will show how these mechanisms significantly reshape the relationships between gas content, star formation, and ISM pressure in these galaxies.

69. **Galaxy Stellar Halo Growth: Probing Merger-Driven Mass Assembly**
Devin Williams (Saint Mary's University) [grad]
Co-author(s): Damjanov, Ivana; Sawicki, Marcin; Souchereau, Harrison; Chen, Lingjian; Desprez, Guillaume; George, Angelo; Annunziatella, Marianna; Gwyn, Stephen

How do galaxy mergers shape galaxy stellar mass growth and morphological evolution over large cosmic timescales? Galaxy stellar haloes, predicted to form through hierarchical accretion, serve as key tracers of past merger activity. Observations tracing the buildup of stellar halo material in galaxies enable us to test predictions of merger-driven stellar mass growth. In our work, we study the buildup of stellar haloes over ~5 Gyr (0.2 < z < 1.1) in a sample of ~330,000 star-forming and quiescent galaxies from the CLAUDS+HSC-SSP datasets, ranging from the most massive galaxies to those with a tenth of the Milky Way's mass. We analyze extended stellar halo emission down to <0.05% of the night sky's brightness by measuring the radial light profiles of galaxies from their deep photometric images. We trace rest-frame g-band emission (~4000-5500Å) in galaxies across our full redshift range as this emission traces the populations of long-lived, lower-mass stars forming the bulk of a galaxy's stellar mass. We study trends in galaxy assembly by connecting the evolution in median light profiles with the underlying stellar mass growth in galaxies. I will discuss our recently completed study (Williams et al. 2025, submitted to APJ, arXiv: 2412.03662) which probes how galaxy stellar halo buildup depends on galaxy stellar mass, redshift, and star-forming status. Our analysis also constrains the relative contributions of in-situ star formation and ex-situ accretion to stellar halo mass assembly, quantifying the role of mergers in building up galaxy stellar haloes across cosmic time.

70. **Structural evolution of galaxies: from disks to disks??**
Elizaveta Sazonova (University of Waterloo) [postdoc]
Co-author(s): Sazonova, Elizaveta; Morgan, Cameron; Balogh, Michael

The details of the structural evolution of galaxies remain elusive. Why are disk galaxies star-forming, whereas bulge-dominated galaxies are not? When did disks first form? With new and upcoming data, such as that from JWST, we are now able to probe the evolution of galaxies from the earliest times. However, quantifying this vast amount of data remains a significant challenge, since measurements of galaxy structure are extremely dependent on image properties: resolution and depth, which both depend on the redshift of the source. Carefully accounting for changes in these image properties, we measured the structure of galaxies in the JADES survey spanning the last 12 billion years. Using a Uniform Manifold Approximation and Projection (UMAP) technique, we created a 2D representation of the diversity of galactic morphologies. We show that while morphological disks and spheroids exist at all cosmic times, in agreement with other JWST analyses, high-redshift “disk” and “spheroid” galaxies are distinct from their local counterparts. Therefore, while galactic disks do form early, they still strongly evolve over the cosmic time to form present day galaxies, and much remains to be learnt about this evolution.

71. **Identifying backsplash galaxies with machine learning**
Roan Haggar (University of Waterloo) [postdoc]
Co-author(s): Sazonova, Liza; Knebe, Alexander; Taylor, James

The evolution of galaxies is dependent on their present-day cosmic environment: whether the galaxies are isolated, or live in dense regions such as galaxy clusters. However, their evolution also depends on the environments they have experienced in the past. Backsplash galaxies are a key example of this -- galaxies that have previously passed through the centre of a galaxy cluster, but now reside in the cluster outskirts. These galaxies cannot easily be distinguished from those infalling for the first time, and so it is difficult to know whether to attribute galaxy properties in the cluster outskirts to the cluster itself, or to pre-processing en-route to the cluster. Using The300 Project, a suite of hydrodynamical simulations of 324 galaxy clusters, we compare the properties of backsplash galaxies to those approaching a cluster for the first time. We develop a machine learning model, trained on these simulations, which is able to distinguish between backsplash and infalling galaxies based on their present-day properties, with an accuracy of up to 90%. Crucially, this model only uses observationally measurable galaxy properties, such as their line-of-sight velocities and stellar masses -- this means it can be easily applied to real observations of galaxy clusters, to build pure samples of backsplash and infalling galaxies. This tool can therefore be used to disentangle the different environmental effects on galaxies in past and upcoming spectroscopic observations of galaxy clusters, by constraining the environmental histories of their member galaxies.

72. **Stellar Populations of Ultra-Compact Dwarf Galaxies**
Ryan Primdahl (University of Calgary) [grad]

Ultra-compact dwarf galaxies (UCDs) are massive compact systems of stars typically found in the central regions of galaxy clusters. They have luminosities in the range of -13.5 to -11.5 mag, half-light radii of 10 to 30 pc, and central velocity dispersions of 25 to 45 km/s. These physical parameters suggest that UCDs and other compact stellar systems (CSSs) may have shared formation histories. One possible explanation is that UCDs were once the nuclei of dwarf elliptical galaxies. This stems from their high dynamical mass-to-light ratios, implying that they could have originated as a larger galaxy whose stellar envelope was tidally stripped over time. Another possible explanation is that UCDs could be merged young massive clusters produced by violent galaxy mergers. To obtain a deeper understanding of their formation histories, we can study the stellar populations of these UCDs by investigating their chemical properties through chemodynamics. This is done using spectral absorption lines of various age and metallicity indicators of UCDs, and comparing their strengths to what we would expect for globular clusters and dwarf galaxies. I will present early results coming from a spectral (R~2700) analysis of UCDs observed with the JWST’s NIRSpec instrument in IFU mode. I utilize full-spectrum fitting of simple stellar populations via PPXF to obtain

spatially resolved stellar ages, metallicities, and star-formation histories of the UCDs. Combined with kinematic results, I will explore the potential correlations between the chemodynamics of UCDs containing central massive black holes (and hence of galactic origins) and those without (implying stellar cluster origins).

73. **Exploring Star Formation with Made to Order Galaxies: A Tailored High-Resolution Simulation of NGC 5055**
Emily Rock (Mcmaster University) [grad]
Co-author(s): Wadsley, James; Wilson, Chris; Keller, Ben; Pettitt, Alex

Nearby galaxy observations using the VLA (THINGS), ALMA (e.g. PHANGS) and Integrated Field Units provide high-resolution snapshots of galactic star formation and the ISM. However, computational tools, such as simulations, are required to study galaxies over long time scales. Historically, simulations have produced generic galaxies for comparison with observations in terms of global properties. It is, therefore, difficult to assess detailed correctness and key physical drivers in these generic galaxies. Our project, Better Extragalactic Simulation Physics On Known Examples (BESPOKE) allows us to tailor simulations to a specific target galaxy. In this study, we have created a high-resolution simulation using a parallel SPH code, GASOLINE2, to replicate NGC 5055. This galaxy is a well-studied nearby galaxy that has been observed in many different wavelengths. This allows for a more direct way to test how realistic our simulation is by comparison of velocity dispersion, star clusters and the Kennicutt–Schmidt relation. With BESPOKE we are probing star formation models by analyzing how simulation cases differ with different star formation efficiency, supernovae feedback energy, and gas density at star formation. Further, with our realistic simulation of NGC 5055, we are exploring the dynamic pressure balance within the galaxy to answer the question of what holds up a galaxy.

74. **Probing the Faintest Galaxies Below the Confusion Limit**
Yunting Wang (University of British Columbia) [grad]
Co-author(s): Hill, Ryley; Scott, Douglas; Vernstrom, Tessa

The far-infrared to submillimetre sky is composed of emission from dust-enshrouded star-forming galaxies. The number counts of these galaxies imposes critical constraints on models of galaxy evolution in cosmological simulations. To obtain the strongest constraints possible, the faintest galaxies below the confusion flux limit can be statistically leveraged using the "probability of deflection" (or P(D)) method. However, the correlation between galaxies, i.e., large-scale clustering of galaxies, complicates the analysis, and has been shown to impact the results of galaxy number counts near the confusion limit. Here I outline a method to measure and correct for galaxy clustering, simultaneous with a P(D) analysis, which provides unbiased estimates of the distribution of the faintest galaxies below the confusion limit. I illustrate this with data from Herschel-SPIRE in the GOODS-N field. In principle, this method could be applied to any other observations where galaxies are mostly unresolved and where the beam and noise are well characterized, such as with SCUBA-2, CCAT and other upcoming submillimetre facilities.

75. **Automated Detection of Dwarf Galaxies in NGC5128 Using Image Processing and Deep Learning**

Cameron Leahy (University of Calgary) [grad]

Future detections of dwarf galaxies, especially beyond the Local Group, can help resolve long-standing tensions in the (ΛCDM) Lambda Cold Dark Matter cosmological paradigm. Historically, detecting dwarf galaxies outside the Local Group was challenging due to their intrinsic faintness. Over the last 20 years, the advent of wide-field CCD imagers has enabled dwarf galaxy populations to be reported beyond the Local Group for the first time. In this talk, I will present a custom-designed algorithm for the automated detection of dwarf galaxies in imaging data taken of the nearby giant elliptical galaxy NGC5128. The imaging data comes from the SCABS survey (Survey of Centaurus A's Baryonic Structures), a DECam survey centered on NGC5128 that captures 72 square degrees of sky in the five optical SDSS filters (u',g',r',i',z'). The detection algorithm uses a combination of image processing techniques, conventional tools, and machine learning to reveal dwarf candidates in the imaging. In addition, artificial galaxy experiments are employed to obtain completeness limits of the dwarf galaxy population estimate returned by the algorithm. Applying the algorithm and accompanying completeness analysis to the entire SCABS survey will significantly improve our understanding of NGC5128's dwarf galaxy system. This will pave the way for future investigations aiming to establish the properties of these extra-Local Group dwarfs, whose results may offer resolutions to some of the long-standing conflicts between dwarf galaxy observations and our current model of universe formation.

Galaxy Clusters

76. **The impacts of AGN feedback on galaxy clusters and their surroundings**
Isaac Rosenberg (University of Toronto, Canadian Institute for Theoretical Astrophysics) [undergrad]
Co-author(s): Lokken, Martine; Hlozek, Renee

The cosmic web, the largest structure in the universe, is composed of interconnected filaments of diffuse gas that link galaxies and galaxy clusters. This project aims to explore the impact of active galactic nuclei (AGN) feedback on the structure and distribution of the Warm-Hot Intergalactic Medium (WHIM). AGN feedback—through black hole jets and winds—plays a key role in redistributing baryonic matter across the intergalactic medium. Stars and black holes are far too small to be incorporated into the simulations directly so AGN feedback is simulated much more crudely. The simulation will include a black hole particle, and a certain amount of energy will be released from it on every timestep. While some studies have looked at how simply switching jets on or off in hydrodynamic simulations impacts cosmic structure, there has not been much work on systematically testing different feedback implementations. This project focuses on how varying AGN jet parameters influences the WHIM. To quantify the impact of AGN feedback on cosmic structure, we use a range of statistical tools that measure the morphology of the WHIM and cosmic filaments. The T-web algorithm classifies the cosmic web into voids, walls, filaments, and knots, allowing us to study how AGN-driven outflows affect its large-scale structure. We also run algorithms to locate dark matter halos, helping us understand how feedback redistributes baryonic matter within and around these structures. Lastly I will discuss the potential to distinguish the feedback modes through the Sunyaev-Zel'dovich effect. Through this work, we aim to refine our understanding of the cosmic web and the physical processes that govern its evolution.

77. **Searching for the Extreme: SpARCS1049 Analogues in TNG-Cluster**
Bhuvan Manojh (McGill University) [undergrad]
Co-author(s): Webb, Tracy

The earliest epochs of galaxy cluster formation remain largely unexplored. SpARCS1049 is a rare example of a galaxy cluster caught in a stage of evolution that can teach us about the transformation of early proto-clusters to today's mature cluster systems. This cool-core cluster at z=1.7 exhibits a star-bursting core with extended tail-like morphology at optical bands. These features are thought to transpire due to a runaway cooling flow in the absence of AGN feedback. As the highest redshift cluster where AGN feedback fails, possibly due to the off-center sloshing of the Brightest Cluster Galaxy, SpARCS1049 provides a unique laboratory for studying dynamic nascent cluster environments. As a tool for understanding SpARCS1049, we turn to cosmological simulations. Using the new TNG-Cluster simulation from the IllustrisTNG project, we identify two rare analogues of SpARCS1049 and investigate the mechanisms driving their star formation. We find that the cores of these systems undergo a short-lived (~150Myr) star-burst phase due to the interplay between merger-driven gas flows, AGN feedback cycles, and the abundance of gas reservoirs in the central regions. Our results provide a basis for understanding the conditions feeding extreme star formation in cluster cores at early times.

78. **The Evolution of Galaxy Star Formation and Morphology in Groups and Clusters with IllustrisTNG**
Jing Yeung (McMaster University) [grad]
Co-author(s): Parker, Laura; Bravo, Matías

Satellite galaxies in groups and clusters typically have lower star formation rates and a higher early-type fraction compared to field galaxies, highlighting the significant role of environment in galaxy evolution. However, the timescales and the dominant mechanisms driving these transformations remain unclear. Recent studies of local galaxies show that the fractions of bulge-dominated and quenched galaxies increase with time since infall into groups or clusters. Motivated by this, we use the state-of-the-art hydrodynamic simulation IllustrisTNG (TNG100) to trace the time evolution of galaxy transformations as halos assemble. We explore how star formation and morphology change over time for galaxies infalling for the first time as well as for satellites that have been pre-processed before reaching their final halo. Using the fraction of counter-rotating stellar particles as a proxy for the bulge-to-total ratio (B/T), we find that satellite galaxies develop more prominent bulges after infall, whereas the morphologies of central galaxies evolve very differently over the same time period. Similarly, the evolution of star formation in satellites differs from that in centrals, which continue to build stellar mass. We find that star formation and morphology change as a function of infall time in a way similar to low-z observations, but low mass satellites in TNG100 are systematically more quenched than observed galaxies. We are also investigating the evolution of other galaxy properties in satellites, such as gas mass, to further explore galaxy transformation mechanisms.

79. **A nascent intra-cluster medium at z=4.3: detection of the Sunaev-Zeldovich effect in the SPT2349 protocluster**
Scott Chapman (NRC/UBC/Dalhousie) [faculty/staff]

The Intracluster medium (ICM) is the dominant visible matter in galaxy clusters, existing primarily in the form of hot, metal-rich ionized plasma, and providing the most robust measurements of the cluster mass scale. This hot gas can be characterized by its X-ray emission and the ability to scatter the photons from the Cosmic Microwave Background (CMB), known as the thermal Sunyaev Zeldovich (tSZ) Effect. X-ray observations of nearby galaxy clusters suggest that this hot ICM gas can be established well before the time of cluster formation ("ICM-preheating"). However, due to the faint observational signature at early times, it is still unclear when and how this hot gas was heated prior to the gravitational collapse of the cluster progenitor, known as a proto-cluster. I will present the robust detection of the tSZ decrement in an intense protocluster core SPT2349-56 at z = 4.3, which is the highest galaxy overdensity yet discovered in the early universe. The tSZ signal in SPT2349-56 is too strong to be solely produced by the gravitational energy of the protocluster, and requires substantial additional energy injection. Our finding suggests that ICM-preheating plays a crucial role in the early establishment of the hot intracluster gas in galaxy clusters. The energetic processes in such early protocluster cores (extreme star formation and excess radio-loud AGN), coupled with the rapid and massive cold flows of gas into the cluster center, can apparently lead to a much stronger tSZ signal than expected at z > 4. Our study suggests that observing the hot ICM using the tSZ at z > 4 may be a new emerging field, offering previously unforeseen insights into the formation of massive galaxy clusters.

Compact Objects / High-Energy / Supermassive Black holes

80. **Applying the Superlet Transform to AGN Timing Analysis**
Thomas Hodd (Saint Mary's University) [grad]
Co-author(s): Gallo, Luigi

Active galactic nuclei (AGN) are highly variable systems on timescales from hours to years. This variability is key to our understanding of the physical processes and structure that surround the central supermassive black hole. Traditionally, Fourier analysis has been utilised to probe this variability. Since the Fourier transform has no time resolution it is unable to detect localised events in AGN light curves. To solve this problem the short time Fourier transform and more recently the wavelet transform have been used to introduce some temporal resolution into the analysis. However, both methods must choose between either good temporal or frequency resolution at the expense of the other. We present an investigation on the use of superlets in AGN timing analysis to achieve time-frequency super-resolution. By defining a set of wavelets to form a superlet, and computing the corresponding superlet transform, good resolution in both time and frequency space may be achieved. We compare the results of the superlet transform to the wavelet transform and explore how this may be used to improve our timing analysis of AGN.

81. **A Spectral Energy Distribution Variability Study of the Eclipsing AGN NGC 6814**
Lucy Pothier-Bogoslowski (Saint Mary's University) [undergrad]

Gallo, L. C. ; Gonzalez, A. G. ; Buhariwalla, M. Z. ; Miller, J. M.

The local Seyfert 1.5 active galactic nucleus (AGN), NGC 6814, is known to exhibit complex variability, eclipses, and even changing-look behaviour. In this work, we utilize optical-to-X-ray data obtained over 10-years with the Neil Gehrels Swift Observatory to examine the short-term (i.e. daily) and long-term (yearly) variations in the spectral energy distribution (SED). This includes five epochs of data with three epochs of high-cadence monitoring in 2012, 2016, and 2022. Model-independent methods of examining the variability suggest that the three monitored epochs exhibit distinct behaviour. X-ray weakness in 2016 can be attributed to the previously observed eclipses, while similar behaviour in 2012 is associated with continuum changes and slight neutral absorption. The multi-epoch SED models are consistent with a black hole ($\log(M_{BH}/M_{\odot}) \approx 7.6$) that is accreting between $\dot{m} \approx 0.01 - 0.1$. While the corona (primary X-ray source) is compact, all epochs are better fit with an accretion disk inner radius that is much larger than the innermost stable circular orbit, implying the possibility of a non-standard accretion disk or central structure in NGC 6814.

82. **Multiwavelength Cross-Correlation Using Millimeter AGN Light Curves from the Atacama Cosmology Telescope**
Erika Hornecker (University of Toronto) [grad]
Co-author(s): Hincks, Adam; Foster, Allen; Hood John

The Atacama Cosmology Telescope (ACT) was a ground-based CMB experiment in the Atacama desert in Chile that observed the millimeter sky between 2008 and 2022 at frequencies ranging from 90 GHz to 220 GHz with three detector arrays. The combination of the ~arcminute angular resolution, large footprint, and high cadence of the experiment made the instrument an excellent tool for millimeter time-domain science. We now have an initial catalog of ACT light curves containing the ~200 brightest active galactic nuclei (AGN) in its data, sampled over several years. In this talk we will describe how we are using these light curves for multiwavelength cross-correlation with optical and gamma-ray light curves. Cross-correlating emission in these different bands can aid in understanding which of the leptonic or hadronic processes is most often responsible for emission in the two components of the blazar SED, and the relative locations of the emission regions for different wavebands.

83. **Modelling AGN wind properties using 3rd-order Chandra MEG Absorption Spectra**
Jordan Adamski (Saint Mary's University) [grad]
Co-author(s): Gallo, Luigi

The inward and outward accretion flows of active galactic nuclei (AGN) are related. Winds are believed to play a role in the accretion flow (e.g. removing angular momentum and allowing material to continue falling inward). Additionally, the outflowing winds can impact large scales by depositing mass and energy into the environment of the host galaxy, affecting its evolution. These winds exhibit different properties (e.g. densities, ionization) and outflow velocity. To constrain these parameters the winds must be modelled within high resolution spectra. We examine the advantages of using the 3rd-order grating spectrum over the higher signal-to-noise 1st-order spectrum from the Chandra observation of the bright Seyfert 1 galaxy NGC 3783. The improved resolution over the 1st-order spectrum can provide sharper, deblended lines that permit us to better constrain the wind properties. We present a comparison between the 1st- and 3rd-order line properties. This is a proof-of-concept work that will lead to the examination of other bright Seyfert galaxies in the Chandra archive.

84. **The High-Resolution Spectrum of Dual AGN Candidate MCG-03-34-64**
Cameron Semenchuck (Saint Mary's University) [grad]
Co-author(s): Xu, Yerong; Gallo, Luigi

The galaxy MCG-03-34-64 is a candidate dual AGN with a separation of ~100pc between its black holes. Multiwavelength imaging analysis reveal two resolved Fe Kα peaks in X-rays, two resolved radio peaks at 8.46GHz, and three resolved [O III] centroids that are spatially coincident, and suggestive of the dual AGN morphology. We examine the high-resolution spectrum of this galaxy, using archival XMM-Newton Reflection Grating Spectrometer (RGS) data, to try distinguishing the ionized plasma surrounding these AGN. We identify numerous emission lines in the 0.45-1.77 keV band. We determine line shifts and widths, and examine various line ratios to estimate plasma temperatures and densities. Finally, we test collisionally ionised and photoionised plasma models to determine the physical origin and location of the hot gas around the dual AGN.

85. **Suppressed Star Formation in Diffuse Disks**
Jason Young (SETI Institute, Williams College)

Classical low surface brightness (LSB) spiral galaxies are gas rich yet have low star-formation rates and diffuse stellar populations, which poses a paradox to the modern view of galaxy evolution. Star formation in most galaxies is linked to the availability of gas, with gas-rich systems typically exhibiting high star-formation rates. What stabilizes the gas in LSB spirals against star formation? Here, we use a combination of 21 cm HI and optical emission line velocity fields to study the disk stability in this low-density regime. Stellar mass maps from the optical data and HI mass maps from the 21 cm data enable a robust estimate of the disk mass, allowing for the estimation of disk stability parameters and a halo mass profile. This kinematic information is used in tandem with fitted star-formation histories and emission line ratios to understand the role of dynamics in suppressing star formation.

86. **Modelling Neutron Star Observables in the Schwarzschild Metric With Oblate Rotationally Deformed Surfaces**
John Ngo (University of Alberta) [grad]
Morsink, Sharon

Neutron stars serve as natural laboratories for exploring the physics of matter at nuclear densities. The relationship between their mass and radius holds the key to understanding the behavior of matter under extreme conditions, with implications that span both astrophysics and nuclear physics. However, direct measurements of neutron star radii are hindered by their small size, and mass estimates are generally limited to those in binary systems. Instead, observations from x-ray telescopes like NICER, Chandra, and XMM-Newton are used to infer properties from spectral fluxes and timing observations. These depend on the neutron star's mass, radius, rotation, and oblateness. In this poster, I present preliminary results from the ongoing development of NS-SWORDS (Neutron Star - Schwarzschild With Oblate Rotationally Deformed Surface).

Our code models an oblate neutron star's surface properties and observables within the relativistic Schwarzschild metric, thereby bypassing computationally costly raytracing methods. It features a realistic atmosphere model and a flexible choice of neutron star shape functions. Further, by integrating with the Rotating Neutron Star code, we can directly incorporate neutron star shapes computed from realistic equations of state. This approach enables efficient exploration of neutron star surface properties and observables across a broad parameter space

87. **How initial magnetic field topology impacts accretion disk geometry**
Gibwa Musoke (Canadian Institute for Theoretical Astrophysics) [postdoc]
Co-author(s): Ripperda, Bart; Philippov, Sasha, Liska, Matthew; Porth, Oliver; Gail, Braden; Hankla, Lia

Black hole X-ray binaries (BHXRBs) and Active Galactic Nuclei (AGN) transition through a series of accretion states in a well-defined order. The accretion states, each associated with different luminosities, spectral and variability characteristics and outflow properties, are thought to be triggered by physical changes in the accretion disk around the central black hole. The physical changes in the disk responsible for state transitions may be connected to changes in the mass accretion rate onto the central black hole and/or the topology of the magnetic fields in the disk. In this work I analyse high-resolution 3D General-relativistic magneto hydrodynamic simulations of accretion disks around spinning black holes. I show how the magnetic topology of a geometrically thin accretion disk at initialization can affect the global geometry of the accretion flow and the physical mechanisms at play in the disk. Simulations in which the disk is initialised with a purely poloidal magnetic field can lead to the development of a truncated accretion disk, where the inner regions of the disk comprise a hot turbulent flow while the outer regions of the disk remain cool and geometrically thin. The inner regions of the truncated disk are saturated by poloidal magnetic flux and contain a persistent, thin current sheet at the disk midplane. The current sheet continually reconnects, which can heat plasma in the inner disk regions to coronal temperatures. Simulations in which the disk is initialised with a purely toroidal field can lead to the development of a geometrically thin, cool Shakura-Sunyaev accretion flow and an absence of strong poloidal magnetic flux.

88. **RS CVn variables: Potential X-ray Binary Imposters?**
Suhasini Rao (University of Alberta) [grad]
Co-author(s): Sivakoff, Gregory; Heinke, Craig

RS CVn variables are chromospherically active binaries that are among the brightest stellar radio sources apart from accreting compact objects like X-ray binaries (XRBs). The strong relation seen between the typical radio luminosity densities (LR ~ 10^14 – 10^16 erg/s/Hz) and X-ray luminosities is thought to arise from surface magnetic activities, with significant brightness spikes (LR ~ 10^18 erg/s/Hz) seen during flaring events. Coincidentally, XRBs also show a similar correlation between their X-ray and radio luminosities, with XRBs in quiescence exhibiting radio luminosities comparable to those of RS CVn binaries. The combination of new surveys like the Very Large Array Sky Survey (VLASS) and the Rapid ASKAP Continuum Survey (RACS) with astrometric measurements from Gaia has provided an exceptional opportunity for large-scale statistical analyses of the radio properties of RS CVn binaries. Our work has revealed

some of the brightest RS CVn stars observed to date, including three candidate RS CVn systems that (surprisingly) exhibit persistent and relatively stable radio emission across all three VLASS epochs (and sometimes two RACS-low epochs), spanning a total of seven years. Here I present radio properties of RS CVn binaries, contextualize them within the broader challenge of distinguishing these systems from quiescent XRBs, and look forward to next generation surveys that could be conducted with facilities like Square Kilometre Array-Mid currently under construction in South Africa.

89. **The role of millisecond pulsars in constraining black hole populations in globular clusters**
Noha Hoque (Saint Mary's University) [undergrad]

New insights from mock data Millisecond pulsars (MSPs) are rapidly rotating neutron stars with extremely stable spin periods, which can be used to analyze the central dynamics and mass distribution of globular clusters (GCs). This poster focuses on generating mock MSP data within a simulated GC to investigate their effectiveness in constraining the presence and properties of central black holes. By analyzing the contributions from the GC's gravitational potential to MSP spin period derivatives, we aim to quantify how pulsar observations can minimize the uncertainty for the black holes at the cluster's center. The simulated MSP observations are drawn from a selected of Cluster Monte Carlo (CMC) model, with pulsar positions sampled based on the distribution of neutron stars. Spin and orbital period derivatives are randomly generated, incorporating effects from the cluster's gravitational field, the Milky Way's potential, pulsar proper motion, and intrinsic factors like magnetic braking. The primary goal is to generate mock pulsar data in a simulated cluster to assess its effectiveness in constraining the black holes when fitting dynamical models to the data. Once we have mock pulsar observations, we integrate them with other observational data and fitting dynamical models.

90. **Radiation and Hydrodynamics in Luminous Red Novae: An Enhanced FLED Framework**
Devotosh Ganguly (University of Alberta) [grad]

Luminous Red Novae (LRNe) are stellar merger events characterized by distinctive light curves: a rapid rise in luminosity, a plateau, and progressively redder spectra. Modeling these transients requires coupling hydrodynamics with radiative transfer to account for the complex interplay of shock heating, adiabatic expansion, and photon diffusion. We present an updated version of the Flux-Limited Emission-Diffusion (FLED) method, implemented in the Smoothed Particle Hydrodynamics (SPH) code StarSmasher, to improve the treatment of radiative transport in stellar mergers (Hatfull and Ivanova 2025). In contrast to the previously published version of FLED, which relied on a fixed opacity choice, we now handle transitions between optically thin and thick regimes by dynamically mixing Planck and Rosseland mean opacities. Planck means are used where matter and radiation interact weakly, while Rosseland means apply in the diffusion limit dominated by multiple scatterings. In intermediate regimes, flux is computed using the opacity that minimizes the local rate of change of radiative energy density, leading to smoother and more physically accurate transitions. We also introduce a ray-based flux transport scheme, in which rays are traced from each particle to others along discrete angles until a threshold optical depth is reached. This helps estimate the radiative energy gradient more accurately by identifying contributing neighbors in both optically thick and thin regions. The improved FLED method is adaptable to other astrophysical problems involving complex radiative transfer.

91. **Active Galactic Nuclei Survey Simulator: The Use Case of CASTOR**
Viraja Khatu (Canada-France-Hawaii Telescope Corporation) [faculty/staff]
Co-author(s): Gallagher, Sarah; Côté, Patrick; Woods, Tyrone; Momin, Sana; Hall, Patrick; Willott, Chris; Sigut, Aaron; Richards, Gordon; Hutchings, John

In the era of extensive astronomical surveys and a plethora of science possibilities resulting from them, survey planning and optimization is vital. A carefully designed survey with precise science goals holds a strong chance of meeting the science expectations of its working team while ensuring an optimal use of telescope time and labour. Considering the above factors, we are developing an Active Galactic Nuclei (AGN) Survey Simulator to plan for large-scale AGN variability surveys with next-generation facilities. In the poster, I will present a use case of the Cosmological Advanced Survey Telescope for Optical and ultraviolet Research (CASTOR; a proposed, Canada-led ultraviolet [UV] mission). AGN are supermassive black holes residing at the centres of all massive galaxies that release tremendous energy over a broad range of wavelengths. Their power distribution peaks in the UV, where CASTOR will be most sensitive. UV emission emerges from regions close to the central black hole which allows us to look directly at the ionizing continuum in these objects. In addition, AGN are more variable and vary on several timescales in the UV. Hence, UV monitoring is important for AGN to derive their variability timescales and thus their sizes (applying time-domain methods), to ultimately obtain central black hole masses. Large-scale surveys of AGN at various cosmic epochs is essential to understand how supermassive black holes grow over cosmic time – a long-standing question in AGN science and a key goal of CASTOR. The parameter space in consideration for extensive monitoring campaigns is complex, involving physical parameters of the targets, instrumental specifications, and observing constraints. An optimum interplay amongst them is critical for the success of a campaign yielding desired science results. The AGN Survey Simulator is a simulation pipeline that optimizes the survey parameters and delivers their best possible combination for an intended science goal (in the form of measured outputs). We are currently building the pipeline to design CASTOR AGN time-domain surveys – simulating the "true" continuum and emission-line light curves for selected AGN, simulating the imaging and spectroscopic instrument responses to derive the "observed" light curves, and calculating variability timescales and black hole masses. The pipeline design is generic to make it adaptable for survey planning with different kinds of data and instruments across facilities.

92. **Investigating the AGN variability timescale - black hole mass relationship with Gaia, SDSS and ZTF**
Adrien Hélias (Western University) [grad]
Co-author(s): Barmby, Pauline; Gallagher, Sarah

Active Galactic Nuclei (AGN) exhibit variability in their luminosities with variability timescales that correlate with the black hole mass at the centre of the AGN. Nevertheless, the correlation lacks significant data in the intermediate-mass black hole

(IMBH) range to be fully established. In order to find more IMBHs with timescale measurements, we study a catalogue of 872 228 AGNs from Gaia DR3 called GLEAN. We cross-match the GLEAN sample with optical spectra from SDSS DR17 and light curves from ZTF DR21. After fitting the light curves with a damped random walk model, the GLEAN light curves have insufficient sampling to extract reliable amplitudes and timescales. On the other hand, well-sampled ZTF light curves allow more accurate estimations of these parameters. The fractional variability amplitude is an effective, model-independent metric for measuring variability amplitude, but only when derived from high-quality light curves. We select 127 GLEAN-ZTF-SDSS objects that meet strict noise and light curve sampling criteria, for which we provide the DRW amplitudes, timescales and black hole masses. Though we do not find any IMBHs in the resulting AGN sample, we confirm a relationship between the damped random walk timescale and the black hole mass that is consistent with previous studies.

93. **Verification of Cas A neutron star cooling rate using Chandra HRC-S observations**
Jiaqi Zhao (University of Alberta) [grad]
Co-author(s): Heinke, Craig; Shternin, Peter; Ho, Wynn

The young neutron star (NS) in the Cassiopeia A (Cas A) supernova remnant is a fascinating test for theories of NS cooling and dense nuclear matter. Chandra observations of the Cas A NS have indicated that its surface temperature is declining rapidly, with temperature declines reported over the last 13 years ranging from <1% to 4% per decade. Recently, the cooling measurements have converged to ~2% per decade. A leading theory is that this rapid decline is caused by the neutrons in the NS core transitioning from a normal to a superfluid state. However, most of the Cas A NS observations were performed by the Chandra ACIS detectors, which suffer complicated systematic effects, leaving uncertainty in the cooling rate. In this report, we test the rapid cooling of the Cas A NS with newly obtained and archival Chandra HRC data over a time span of 25 years. As the Chandra HRC detector operates on different principles than the ACIS detectors, it will have independent systematics and serves as a cross-check on the cooling measurement. Assuming a fixed hydrogen column density (Nh), we measure the cooling rate of the Cas A NS to be 0.57% ± 0.27% or 0.55% ± 0.25% per decade, depending on the choice of background extraction regions. Allowing the Nh to vary with time (estimated using ACIS data), the cooling rates for the differing background regions are 1.11% ± 0.25% or 1.09% ± 0.26% per decade. These measured cooling rates are slightly but significantly smaller than the measured rates using ACIS data, implying systematic uncertainties have not been eradicated. However, the high significance of the cooling (4-sigma for the varied Nh) with an independent dataset indicates that the NS cooling is real. The range of cooling rates found in this study places constraints on the maximal critical temperature of triplet neutron superfluidity.

94. **Dude, Where's My Stars? Probing Compact Stellar System Evolutionary Connections via Central Black Holes**
Solveig Thompson (University of Calgary) [grad]
Co-author(s): Taylor, Matthew; Tahmasebzadeh, Behzad; Valluri, Monica; Vasiliev, Eugene; Côté, Patrick; Roediger, Joel; Ferrarese, Laura; Woods, Tyrone

Compact stellar systems include objects such as globular clusters, ultra-compact dwarf galaxies (UCDs), and nuclear star clusters. UCDs bridge the gap between globular

clusters and dwarf galaxies, often appearing as the most massive star clusters orbiting a galaxy or galaxy cluster. However, there is increasing evidence that at least some UCDs are the remaining cores of tidally stripped nucleated dwarf galaxies. Many compact stellar systems display a dynamical mass-to-light ratio that is higher than can be explained through stellar population models alone, suggesting there is more to them than meets the eye. If they are of galactic origin, then UCDs are likely hosts of central black holes, as supported by previous detections of supermassive black holes in some of the most massive UCDs. The presence of a central black hole in a UCD indicates it was once a larger nucleated dwarf galaxy that has lost its diffuse stellar envelope to tidal stripping in a galaxy cluster environment. Analyzing compact stellar systems for black holes at different stages of this evolutionary pathway will illuminate the evolutionary connections between nucleated dwarf galaxies and UCDs. Due to various technological and observational constraints, only a handful of the biggest and the brightest UCDs have been searched for central black holes. To truly understand the evolutionary pathways compact stellar systems undergo in galaxy clusters, a wider range of compact stellar systems must be probed for central black holes. In this talk, I will discuss my current efforts using the James Webb Space Telescope (JWST) to probe the evolutionary connections between UCDs and nuclear star clusters. In particular, I will highlight new results of one UCD with a detection of a 2.2 million solar mass black hole, implying a progenitor mass of nearly 10^10 solar masses. From this mass, it is assumed the progenitor was probably a small spiral galaxy.