

# CURRICULUM VITAE

David Alan Clarke, June 2021

(abbreviated version)

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## Education

B.Sc. 1981 Honours, Theoretical Physics, Queen's University at Kingston

M.Sc. 1984 Physics, Queen's University at Kingston

Advisor: Dr. Richard N. Henriksen

Thesis: *Two-dimensional gravitational collapse of a rotating interstellar cloud*

Ph.D. 1988 Physics, University of New Mexico

Observational Advisor: Dr. Jack O. Burns

Theoretical Advisor: Dr. Michael L. Norman

Dissertation: *A search for the effects of active magnetic fields in extragalactic radio sources*

## Positions Held

9/03–present Professor of Astronomy and Physics, Saint Mary's University

8/01–3/03 Acting Director of the Institute for Computational Astrophysics

8/00–7/01 Astronome Associé, Observatoire de Grenoble, France

9/95–8/03 Associate Professor of Astronomy and Physics, Saint Mary's University

10/93–8/95 Assistant Professor of Astronomy and Physics, Saint Mary's University

9/92–10/93 Research Associate, Harvard-Smithsonian Center for Astrophysics,  
Harvard University.

9/88–8/92 Post-doctoral Fellow, The National Center for Supercomputing Appli-  
cations, the University of Illinois at Urbana-Champaign.

## Post-Doctoral Fellows Advised

3. Dr. Alexander Men'shchikov (Ph.D., USSR Academy of Sciences), Research Associate,  
9/03–12/05.

2. Dr. Jean-Pierre DeVilliers (Ph.D., Alberta), NSERC Fellow, 1/99–8/00.

1. Dr. Rachid Ouyed (Ph.D., McMaster), CITA National Fellow, 9/97–8/99; co-advised  
with M. Butler (SMU).

## Graduate Students Advised

8. Ms. Samantha Pillsworth, 9/13–8/14; changed supervisors before thesis started.
7. Mr. Jonathan Ramsey (Ph.D., Astronomy, SMU, 2011), 10/03–07/11. Dissertation: *Into the Void: Simulations of protostellar jets from Keplerian discs extended to observational length scales.*
6. Mr. Nicholas MacDonald (M.Sc., Astronomy, SMU, 2008), 9/06–8/08. Thesis: *Bridging the gap: Observational properties of Extragalactic Jets.*
5. Mr. Kevin Douglas (M.Sc., Astronomy, SMU, 2000), co-advised with G. Mitchell (SMU), 9/95–4/00. Thesis: *A numerical simulation of the young stellar outflow DG Tauri B.*
4. Mr. Juan Ramon Sanchez Velar, 9/97–12/99. Thesis incomplete.
3. Mr. Michael A. Casey (M.Sc., Astronomy, SMU, 1996), 9/94–8/96. Thesis: *Numerical simulations of the extragalactic jet in M87.*
2. Ms. Yonghui Xie, 9/93–8/96. Thesis incomplete.
1. Mr. Byung-Il Jun (Ph.D., Astronomy, U. Illinois, 1995), co-advised with M. Norman (Illinois), 9/92–8/93. Dissertation: *Numerical modeling of radio emission from young supernova remnants.*

## Undergraduate Students Advised

8. Mr. Michael Power (B.Sc. Hons. Astrophysics, SMU, 2018), 9/17–4/18. Thesis: *On the theory of ambipolar diffusion, with applications to astrophysical jets.*
7. Mr. Chris MacMackin (B.Sc. Hons. Astrophysics, SMU, 2015), 9/14–4/15. Thesis: *Modelling the fragmentation of protostellar cores with ambipolar diffusion.*
6. Mr. Stephen Campbell (B.Sc. Hons. Astrophysics, SMU, 2014), 9/13–4/14. Thesis: *Chasing DRAGNs: A numerical investigation into the absence of plume structures in observations of double radiosources associated with galactic nuclei.*
5. Mr. Logan Francis (B.Sc. Hons. Physics, SMU, 2014), 9/13–4/14. Thesis: *MHD simulations of the fragmentation of molecular cloud cores.*
4. Mr. Nicholas MacDonald (B.Sc. Hons. Astrophysics, SMU, 2006), co-advised with J. Hahn, 9/05–4/06. Thesis: *Hydrodynamic simulations of spiral density waves.*
3. Mr. Michael Seymour (B.Sc. Hons. Astrophysics, SMU, 1997), 9/96–4/97. Thesis: *A numerical study of asymmetric double radio sources.*
2. Mr. Glen R. Petitpas (B.Sc. Hons. Astrophysics, SMU, 1995), 9/94–4/95. Thesis: *Steady-state solutions to the oblique CR-MHD jump-shock conditions.*
1. Mr. Jonathan L. Dursi (B.Sc. Hons. Physics, SMU, 1994), 9/93–4/94. Thesis: *Oblique magnetic fields in cosmic-ray mediated MHD shocks.*

## External Support

17. “Observational properties of magneto-centrifugally launched protostellar jets”, by David Clarke, submitted to NSERC (discovery grant). Level of support: \$20,000 per year, 5/12–4/17, no-cost extension to 4/18.
16. “Observational Characteristics of Computational Astrophysical Flows”, by David Clarke, funded by NSERC (discovery grant). Level of support: \$19,633 per year, 5/08–4/11, no-cost extension to 4/12.
15. “Galaxy Formation in the Early Universe”, by David Clarke & Alex Razoumov, funded by ACEnet (PDF Programme). Level of support: \$20,000 per year (PDF salary support), 9/07–8/09.
14. “ACEnet: Atlantic Computational Excellence Network”, by Mark Whitmore (MUN, PI), David Clarke & Robert Deupree (SMU), Peter Poole (StFX), Virendra Bhavsar (UNB), and 5 others. Level of support: \$9,934,611 from CFI, \$5 million from ACOA, \$4 million from Nova Scotia, \$1.5 million from Newfoundland and Labrador, \$250,000 from New Brunswick, and \$5 million from Sun Microsystems. Total: \$25,684,611, 4/04–3/09.
13. “**AZEuS**: an **A**daptive **Z**one **E**ulerian **S**cheme for Astrophysical MHD”, by David Clarke, funded by NSERC (discovery grant). Level of support: \$27,000 per year, 5/03–4/07, no-cost extension to 4/08.
12. “Multi-dimensional Astrophysical MHD/CR Simulations”, by David Clarke, funded by NSERC (research grant). Level of support: \$26,500 per year, 5/98–4/02, no-cost extension to 4/03.
11. “Multi-Disciplinary High Performance Computing at Saint Mary’s University”, by D. Clarke (PI), M. Butler, D. Guenther (Astronomy and Physics), P. Muir, S. Konstantinidis (Mathematics and Computing Science), and A. Charles (Finance and Management Science), funded by the Canada Foundation for Innovation (CFI, \$185,790), The Atlantic Canada Opportunities Agency (ACOA, \$112,139), Sun Microsystems (\$112,139), and Saint Mary’s University (\$54,406). Total: \$464,474, 7/99–6/00.
10. “Parallel Computing Resource for Astrophysics at Saint Mary’s University”, by D. Clarke (PI), M. Butler, D. Guenther, D. Turner, G. Mitchell, G. Welch, and M. West, funded by the Natural Science and Engineering Research Council of Canada (NSERC, equipment grant). Level of support: \$91,700 from NSERC; \$21,000 from SMU, 5/99–4/00.
9. “Compute Server for Large-Scale Computations in Theoretical Astrophysics (CITAH-PCII)”, by Peter Martin (CITA, PI), *et al.*, funded by NSERC (major equipment grant). Level of support: \$225,000, 5/97–4/98.
8. “12th ‘Kingston meeting’ on Theoretical Astrophysics”; Raised over \$13,000 from external sources to fund this meeting hosted by SMU in October 1996, including \$4,000 from CITA, and \$2,000 from the Fields Institute.

7. “Computational Astronomy and Astrophysics at Saint Mary’s University”, by David Clarke (PI), M. Butler, D. Guenther, D. Turner, G. Mitchell, G. Welch, and M. West, funded by NSERC (equipment grant). Level of support: \$75,000 from NSERC; \$11,000 from the Dean of Science, 5/95–4/96.
6. “Jet Dynamics and the Morphology of Extragalactic Radio Sources”, by Philip Hardee (PI) & David Clarke, supported by the National Science Foundation (NSF) via the Pittsburgh Supercomputer Center (PSC) grant AST930010P. Level of support on PSC Cray C-90: 200 Service Units (SU’s, where 1 SU  $\approx$  1 hour cpu), 10/94–9/95; 660 SU’s, 10/95–9/96; 750 SU’s, 1/97–12/97; 900 SU’s.
5. “Numerical Simulations of Astrophysical Gas Dynamics”, by David Clarke, funded by NSERC (research grant). Level of support: \$21,000 per year, 5/94–4/98.
4. “Realistic Models of Extragalactic Radio Sources”, by David Clarke, supported by the NSF via the Pittsburgh Supercomputer Center (PSC) grant AST930015P. Level of support on PSC C-90: 95 SU’s, 9/93–8/94.
3. “Multidimensional Supercomputer Simulations of the Interstellar Medium: A Link between the Gamma-Ray Sky and Cosmic Rays”, by David Clarke & Nebojsa Duric, funded by NASA through its Compton Gamma Ray Observatory Guest Investigator Program (Phase II; NRA 91-OSSA-22). Level of support: US\$52,000, 9/92–8/93.
2. “Magnetic Fields in Extragalactic Radio Sources”, by David Clarke & Michael Norman, funded by the NSF via the National Center for Supercomputing Applications (NCSA) grant AST920003N. Level of support on NCSA Cray-2: 400 SU’s, 2/92–8/93.
1. “Theory and Simulation of the Stability of 3D Jets”, by Philip Hardee, David Clarke, & Michael Norman, funded by the NSF via NCSA grant AST920003N. Level of support on NCSA Cray-2: 150 SU’s, 2/92–4/93.

#### Meetings organised/co-organised

3. The 2nd ‘Halifax meeting’ on Computational Astrophysics, sponsored by CITA and Saint Mary’s University, October 16–18, 2009 in Halifax, NS. LOC/SOC chair: B. Deupree.
2. The 1999 meeting of the Canadian Astronomical Society/Société Canadienne d’Astronomie, sponsored by CASCA and Saint Mary’s University, June 27–30, 1999 in Halifax, NS. LOC chair: D. Turner.
1. The 12th ‘Kingston meeting’ on Theoretical Astrophysics, sponsored by CITA, Fields Institute, and Saint Mary’s University, October 17–19, 1996 in Halifax, NS. Topic: “Computational Astrophysics”. LOC/SOC chair: D. Clarke.

## Books, written or edited

2. “A First Course in Magnetohydrodynamics”, a senior undergraduate, first-year graduate text in preparation by D. A. Clarke (nine of ten chapters and nine of nine appendices complete).
1. Proceedings of “The 12th ‘Kingston meeting’: Computational Astrophysics”, edited by D. A. Clarke & M. J. West, 1997, ASP Conference Series, Volume 123, (San Francisco: Astronomical Society of the Pacific), 374 pages.

## Commissioned Articles

2. “A truly embryonic star”, by D. A. Clarke, 2012, *Nature News and Views*, 492, 52–53.
1. “Jet Propulsion is Essential for Young Stars”, by D. A. Clarke, 1997, *Nature News and Views*, 385, 387–388 (1).

Refereed Publications (students/PDFs in **boldface**, citations as of 12/21 given parenthetically; over 1,400 known citations, H-index = 23)

32. “Adiabatic and isothermal, two- and one-fluid models for ambipolar diffusion”, by D. A. Clarke, **M. T. Power**, & **C. T. MacMackin** *in preparation*.
31. “MHD simulations of the formation and propagation of protostellar jets to observational length scales”, by **J. P. Ramsey** & D. A. Clarke, 2019, *MNRAS*, 484, 2364 (4).
30. “AZEUS: An Adaptive Zone Eulerian Scheme for Computational MHD”, by **J. P. Ramsey**, D. A. Clarke, & **A. B. Men’shchikov**, 2012, *ApJS*, 199, 13 (10).
29. “Simulating Protostellar Jets Simultaneously at Launching and Observational Scales”, by **J. P. Ramsey** & D. A. Clarke, 2011, *ApJ*, 728, L11 (16).
28. “On the Reliability of *ZEUS-3D*”, by D. A. Clarke, 2010, *ApJS*, 187, 119 (30).
27. “Astrophysical Jets”, an invited review paper by D. A. Clarke, **N. R. MacDonald**, **J. P. Ramsey**, & **M. Richardson**, 2008, *Physics in Canada*, 64, 47.
26. “Three-Dimensional Simulations of Jets from Keplerian Disks: Self-regulatory Stability”, by **R. Ouyed**, D. A. Clarke, & R. E. Pudritz, 2003, *ApJ*, 582, 292–319 (89).
25. “Effects of Magnetic Fields on Mass Entrainment of Supermagnetosonic Jets”, by A. Rosen, P. E. Hardee, D. A. Clarke, & A. Johnson, 1999, *ApJ*, 510, 136–154 (45).
24. “Dynamics & Structure of Three-Dimensional Poloidally Magnetised Supermagnetosonic Jets”, by P. E. Hardee, D. A. Clarke, & A. Rosen, 1997, *ApJ*, 485, 533–551 (51).

23. “Formation of Cavities in the X-Ray Emitting Cluster Gas of Cygnus A”, by D. A. Clarke, D. E. Harris, & C. L. Carilli, 1997, MNRAS, 284, 981–993 (59).
22. “A Consistent Method of Characteristics for Multidimensional Magneohydrodynamics”, by D. A. Clarke, 1996, ApJ, 457, 291–320 (110).
21. “Emission and Dynamics of a Heavy Three-Dimensional Magnetised Jet”, by P. E. Hardee & D. A. Clarke, 1995, ApJ, 451, L25–L28 (18).
20. “Destabilisation of Strongly Magnetised Jets”, by P. E. Hardee & D. A. Clarke, 1995, ApJ, 449, 119–133 (15).
19. “The Stability and Collimation of Three-dimensional Jets”, by P. E. Hardee, D. A. Clarke, & D. A. Howell, 1995, ApJ, 441, 644–664 (58).
18. “Heirarchical Numerical Cosmology: Methods and Code Tests”, by P. Anninos, M. L. Norman, & D. A. Clarke, 1994, ApJ, 436, 11–22 (37).
17. “The Evolution of Cosmic Ray Mediated MHD Shocks: A Two-Fluid Approach”, by **B.-I. Jun**, D. A. Clarke, & M. L. Norman, 1994, ApJ, 429, 748–758 (17).
16. “On Jet Response to a Driving Frequency and the Jets in 3C 449”, by P. E. Hardee, M. A. Cooper, & D. A. Clarke, 1994, ApJ, 424, 126–137 (48).
15. “Relic Radio Emission in 3C 388”, by K. Roettiger, J. O. Burns, D. A. Clarke, & W. A. Christiansen, 1994, ApJ, 421, L23–L26 (49).
14. “Propagation and Stability Properties of Radio Jets in Cluster Cooling Flow Atmospheres”, by C. Loken, J. O. Burns, M. L. Norman, & D. A. Clarke, 1993, ApJ, 417, 515–527 (18).
13. “Nonlinear Dynamics of a Three-dimensional Jet”, by P. E. Hardee & D. A. Clarke, 1992, ApJ, 400, L9–L12 (49).
12. “VLA Observations of the Inner Lobes of Centaurus A”, by D. A. Clarke, J. O. Burns, & M. L. Norman, 1992, ApJ, 395, 444–452 (75).
11. “Ram Pressure Confinement of a Hypersonic Jet”, by C. Loken, J. O. Burns, D. A. Clarke, & M. L. Norman, 1992, ApJ, 392, 54–64 (37).
10. “Atmospheric Morphology of the Propagating Jet II: The Effect of Atmospheric Gradients”, by P. E. Hardee, R. A. White III, M. L. Norman, M. A. Cooper, & D. A. Clarke, 1992, ApJ, 387, 460–483 (39).
9. “Origin of the Structures and Polarisation in the Classical Double 3C 219”, by D. A. Clarke, A. H. Bridle, J. O. Burns, R. A. Perley, & M. L. Norman, 1992, ApJ, 385, 173–187 (72).
8. “Computational Astrophysical Fluid Dynamics”, by M. L. Norman, D. A. Clarke, & J. M. Stone, 1991, *Computers in Physics*, 5, 138–151.

7. “Numerical Models of Extragalactic Radio Sources”, by J. O. Burns, M. L. Norman, & D. A. Clarke, 1991, *Science*, 253, 485–592 (30).
6. “Atmospheric Gradients and the Stability of Expanding Jets”, by P. E. Hardee, M. L. Norman, T. Koupelis, & D. A. Clarke, 1991, *ApJ*, 373, 8–22 (22).
5. “Numerical Simulations of a Restarting Jet”, by D. A. Clarke & J. O. Burns, 1991, *ApJ*, 369, 308–313 (60).
4. “Numerical Observations of a Simulated Radio Jet with a Passive Helical Magnetic Field”, by D. A. Clarke, M. L. Norman, & J. O. Burns, 1989, *ApJ*, 342, 700–717 (84).
3. “Numerical Simulations of a Magnetically Confined Jet”, by D. A. Clarke, M. L. Norman, & J. O. Burns, 1986, *ApJ*, 311, L63–L67 (150).
2. “Limb Brightening and Filamentation in the Inner Radio Jet of Centaurus A”, by D. A. Clarke, J. O. Burns, & E. D. Feigelson, 1986, *ApJ*, 300, L41–L46 (32).
1. “Numerical Simulation of the Growth of Thick Accretion Discs”, by D. A. Clarke, S. R. Karpik, & R. N. Henriksen, 1985, *ApJS*, 58, 81–106 (15).

#### Scientific web sites maintained

1. [AZEuS web site](#) (AMR-MHD code). Site includes code description, test problems, and access to publications, but the code AZEuS itself is still not available for download.
2. [ZEUS-3D web site](#) (MHD code). Site includes code description, user manual, test problems, and access to *ZEUS-3D*, versions 3.5 and 3.6. Unique downloads as of July, 2018: 743
3. [EDITOR web site](#) (*FORTTRAN* precompiler and manager). Site includes user manual and access to *EDITOR*, version 2.2.

#### Oral Presentations (Invited)

5. “High-Performance Computing in Canada”, an invited talk to the Graduate Student Workshop at the 2003 CASCA meeting in Waterloo, June, 2003.
4. “Total Intensity Filaments in Extragalactic Radio Sources: Signature of Weak-Field MHD Turbulence”, an invited talk to the Paris workshop on Astrophysical Magnetohydrodynamical Turbulence, Paris, France, July, 2001.
3. “A Hydrodynamical Model of the X-ray Cavities in Cygnus A”, an invited talk to the NRAO workshop “Cygnus A—A Study of a Radio Galaxy”, NRAO Greenbank Observatory, Greenbank, WV, USA, May, 1995.

2. “CMoC: A Multidimensional MHD Algorithm Stable to the Effects of Velocity Shear”, an invited talk to the mini-symposium on *Computational Magnetohydrodynamics in Astrophysics* at the Cornelius Lanczos International Centenary Conference, University of North Carolina, Raleigh, NC, USA, December, 1993.
1. “An Overview of Computational MHD Jets and Their Comparison with Recent High Resolution Radio Images”, an invited review talk at the IAU Symposium No. 140, *Galactic and Extragalactic Magnetic Fields*, Heidelberg, F.R.G., June, 1989.

plus > 30 invitations for departmental/institutional colloquia and public lectures in Canada, the U.S., and France, plus > 60 contributions to various conferences, meetings, and workshops.