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Nova Notes



The Newsletter of the Halifax Centre of the Royal Astronomical Society of Canada

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Astrophotography for Everyone!



Use this
telescope to
take your very
own astrophoto.

In this very special issue **Dave Lane** introduces us to remote astrophotography using the Burke-Gaffney Observatory (BGO) 24-inch telescope or the Abbey Ridge Observatory (ARO) 14-inch Celestron telescope. **Art Cole** shows us how to process photos taken with the new system. **Dave Chapman** tells us about capturing a **comet's trail using the BGO**. **Keith Walker** captures supernova SN2016cok in M66 with a 5 minute exposure. **Jerry Black** uses the BGO to take a colour photo of M51, the Whirlpool Galaxy, and processes it in PixInsight.

May/June 2016

St. Croix Observatory

Part of your membership in the Halifax RASC includes access to our observatory, located in the community of St. Croix, NS. The site has expanded over the last few years and includes a roll-off roof observatory with electrical outlets, use of the Centre's new Go-To 400-mm Dobsonian telescope and 100-mm binoculars, a warm-room, and washroom facilities.

Enjoy dark pristine skies far away from city lights and the company of like minded observers searching out those faint "fuzzies" in the night. Observing nights (Fridays close to the New Moon or Saturday backup) are open to both members and their guests. If you are not a key holder and would like to become one, or need more information, please contact the SCO Manager, Tony McGrath .

Upcoming Observing Nights:

July 29 (alt 30)

August 26 (alt 27)

September 30 (alt Oct 1)

Meetings usually begin at 7:30 p.m. at Saint Mary's University in Room 101 of the Atrium Building (AT).

All meeting locations and presentations subject to change

Our next meetings are scheduled for:

September 16, 2016

October 21, 2016

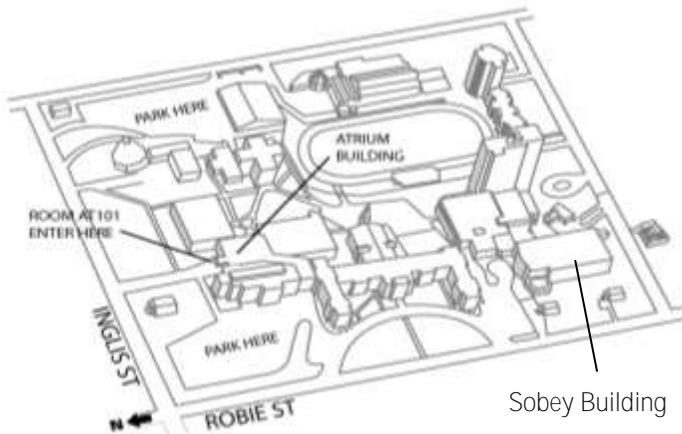
Visit <http://halifax.rasc.ca/> for information on upcoming meetings.

Meeting Location:

Saint Mary's University

Atrium Building (AT)
Room AT 101

The Atrium is located in front of the Patrick Power Library, between the Burke Building and Science Building.



Meetings are usually held on the third Friday of the month, except for the months of July and August, when there are no meetings.

Executive meetings begin at 6:30 p.m., usually in room AT306, and all members are welcome.

Halifax RASC Executive, 2016:

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Cover Photo

Burke-Gaffney Observatory

Cover Photo: A bird's eye view of the Burke-Gaffney Observatory with its Planewave 24-inch telescope looking skyward.

Picture Insert: A 3-minute long exposure of M33 taken automatically by Twitter user @caerward on the night of June 30.

From the editor *Tony Schellinck*

The launching of the BGO and ARO robotic telescopes has created an opportunity for amateur astronomers to start photographing DSOs of every description. In this issue we hear from Dave Lane, the system's architect and builder, about who is using it, and how others can start to use it. Art Cole and Dave Chapman both made the robotic system the subject of their columns this issue with Art illustrating how the photos taken can be processed and Dave providing us with a unique image, illustrating the tremendous variety of photo subjects now accessible to the couch astronomer. As well, two early users of the system recount their experiences with it and share with us their photos. Keith Walker discovered the system will take photos on any night where there is a clear patch of sky revealing someone's requested target. Jerry Black requested RED, GRN, BLU and LUM images of M51 in order to create colour images from the original filtered CCD images. Having these images motivated him to step into image processing.

Regular contributors Matt Payne, Tony McGrath and Paul Heath also provided articles. Matt tells us about the two largest radio telescopes in Canada and warns us of a pending reduction in support from the Federal Government. Tony reviews Parallax – The Race to Measure the Cosmos by Alan W. Hirshfeld and Paul captures the drama surrounding the Mercury transit.

David Griffith praises small scopes in his article, He explains their superiority over large scopes and introduces us to his fleet of scopes explaining the advantages and uses of each one.

The summer is a busy time for many amateur astronomers, attending outreach events such as Nova East and the Keji Dark-Sky Weekend, providing talks on astronomy to the public, and viewing or photographing the night sky while vacationing or at SCO or in their backyard. I WANT PHOTOS FROM ALL OF YOU! The next issue of Nova Notes comes out mid-September and will be a scrape book issue full of photos from events, astrophotos taken or processed by folks over the summer, or just photos of us doing our thing. So plan ahead whenever you do anything and take a camera and record the event for history and then send the pictures to me. Please.

Clear skies,

Tony Schellinck
Nova Notes Editor

Nova Notes: The Newsletter of the Halifax Centre of the RASC

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Nova Notes is published five times a year, in February, April, June/July, September/October and December.

The deadline for the next edition is September 5, 2016

The opinions expressed herein are not necessarily those of the Halifax Centre.

Articles on any aspect of Astronomy and related activities will be considered for publication.

Two Nova Scotia Robotic Telescopes That You Can Use: the Burke-Gaffney and Abbey Ridge Observatories

Dave Lane (the Director at BGO and owner of ARO)

In the past year or two I developed and brought online two robotic observatories that any of you can use from the comfort of your easy chair. Both are almost identical: the Burke-Gaffney Observatory (BGO) at Saint Mary's University has a Planewave 24-inch telescope (nicknamed "Ralph") in light-polluted Halifax skies and the Abbey Ridge Observatory (ARO) has a Celestron 14-inch telescope (nicknamed "Sam") in fairly dark Stillwater Lake skies 23km west of Halifax.

The BGO recently completed a major renovation and telescope and equipment upgrade, funded principally by Dr. Ralph Medjuck. Part of that project involved automating the observatory along with a strong desire to make it much more productive (given the challenging weather in Nova Scotia) and to make it very easy to use by our students and others.

I chose to use the Twitter social media platform as the human-machine interface, since many students and others are already using it. Twitter has the advantage of being accessible from any web browser and apps are available for all tablets and smart phones.

Once the software was stable in late 2015, it was ported to ARO which came on line in early January. There are some minor differences between the two observatories (e.g., the filter options differ and the field of view of Sam is a bit smaller), but they run the same programs so behave almost identically to each other. From now on in this article, when I refer to "it" or "telescope" it could be either Ralph or Sam.

Overall, the project has been declared a success and it was recognized by Twitter as one of the 10 most innovative uses of Twitter in Canada. The Twitter interface was used extensively this past academic year by three astronomy classes. Observational projects undertaken ranged from simple images of deep sky objects to long term variability studies of an active galaxy and light curves of variable stars and extrasolar planets. It has also been used by high-school astronomy students and by many beginner and advanced amateur astronomers and astro-photographers in Canada and from many other countries.

HOW IT WORKS

A person interacts with the telescope using a Twitter account to send messages to the telescope and it replies back – Twitter calls these messages "tweets". As long as it understands what you "tweet" to it, it obeys your commands and provides you with personalized images of just about any type of astronomical object visible from Nova Scotia! In addition to being interactive, it also passively tweets what it is up to as it works. See the Twitter feeds at @smubgobs and @abbeyridgeobs.

It listens for your commands 24/7, but of course it can only do its

imaging work at night when most of us humans sleep, so it queues your imaging "requests" and runs them from the queue later. There are times when it has nothing to do and you can get control of it right away (a good reason to stay up late at night).

Each night after it becomes somewhat dark, it uses its cloud sensor to monitor the sky. If the skies are clear, it powers up the scope and other equipment, opens the dome, and focuses the camera and syncs the scope's position. After it has become fully dark and until shortly after the beginning of morning twilight it works through its queued observation requests, pausing if it becomes cloudy and restarting when it clears. Dodging clouds is a necessary "game" that it must play!

If the sky wasn't clear when it became dark, it waits patiently for it to clear. The cloud sensor allows it to take advantage of nearly any patch of clear sky that passes over it during the night. In the first six months of 2016, Ralph

was able to get some observations completed on 70 nights!

After it has closed its dome at dawn, it then takes whatever calibration images are needed, processes the night's images and posts them to the "completed" queue on its website. It then notifies the observers that they have images ready. The cycle then repeats for the next night.

This seemingly simple description is, in practice, rather complicated to reliably realize, and there are about 100,000 lines of program code that makes it all work!

HOW TO USE IT

The first step is to become authorized – see the first resource link below for how to do that. There is also detailed help information available there. After you are authorized, you are then considered an "observer" and can request images. You should start by sending a test message like:

@smubgobs #hello

If it received and understood your tweet, it will reply with:

#bgoreplies @davidjameslane Hi, I'm the Burke-Gaffney Observatory with its Ralph Medjuck telescope at Saint Mary's University!

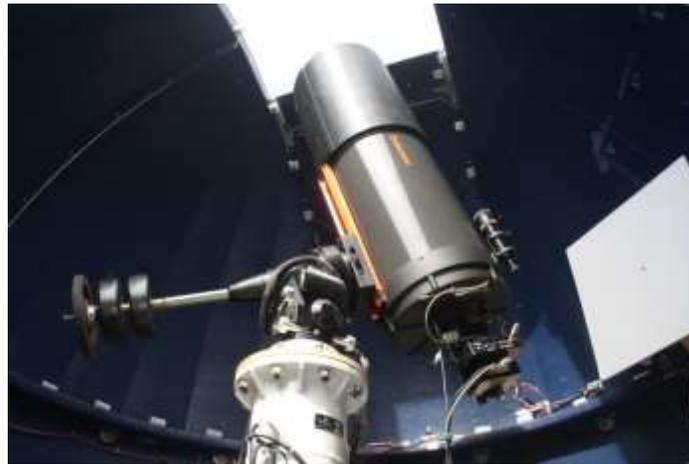
In the simplest form, sending the following tweet will cause it to take a 3 minute exposure of the galaxy Messier 65.

@smubgobs #request object=M65

Which it replies with:

#bgoreplies @davidjameslane Sorry, I cannot observe M65 in the next 30 days!

Oops, my mistake. M65 is a spring object in Leo and cannot be observed now. The telescope validates every request to make sure that it is in its database and reasonably observable from Halifax in the next month.



▲ The Abbey Ridge Observatory's Celestron C14 telescope mounted in a Losmandy Titan mount. Its imaging camera is an SBIG ST8 CCD.

If you want to check an object's validity before actually requesting it, try this:

```
@smubgobs #lookupobject object=M33
```

It replies with

```
#bgoreplies @davidjameslane Fixed object M33 found at position RA=01:33:53.4 DEC=+30d39'04,"and it can be observed now
```

Success! Now let's actually request it, but perhaps with a longer exposure than the default and let's improve the image quality by observing it when it is high in the sky and with a not too bright Moon:

```
@smubgobs #request object=M33 exposure=300 max-moon=75 minalt=60
```

It replies with:

```
#bgoreplies @davidjameslane Object M33 is in my request queue as ID 1574 (exposure=300 seconds filter=LUM)
```

When the observation actually takes place depends not only the availability of clear weather. Every time it is ready to make an observation, it scans through the queue to see which observations can take place at that moment. Then, it plays a "points" game involving a number of factors including the priority (e.g., our students and special projects get a higher priority), how far the telescope has to move from its present position, how long the object has been in the queue, and several other factors. The request with the highest point score is acted upon and then it tweets:

```
#bgoreplies @davidjameslane I have taken your observation of M33 (ID 1574)! I'll tell you when it's ready in the morning
```

In the morning after all images are processed, you will be notified. All of this happens while most of us are sleeping! You are provided both the raw data (a FITS format file) and a jpeg image automatically processed, which usually shows the requested object nicely. See the sample 3-minute exposure image of M33 taken on the night of June 30 on the cover of this issue.

ADVANCED USAGE

A "default" observer can have up to 3 requests in the queue at a time and exposures up to 5 minutes are allowed. Observers can be granted special privileges that allow, for example, up to 20 requests in the queue at a time, longer exposures, multiple filters in the same request, the ability to add new objects to the database, and the ability to have observations automatically re-run on multiple nights.

INTERESTING OBSERVATIONS

I have found it both interesting and gratifying to see how the observers have used the service and interacted with the Twitter interface. To date Ralph has completed over 1,400 requests covering a wide variety of celestial objects including planets, the Moon, com-

ets, asteroids, stars, nebulae, clusters, galaxies, and quasars.

A few things that I have found surprising:

How well the images come out for a wide variety of object types, both bright and faint, using the automatic processing with only a few minutes of exposure time from our light polluted skies

How easy and flexible the interface is to use. This has meant very few "support" requests from the observers.

The imagination of the observers in choosing interesting targets.

How enthusiastic several observers have been in taking images through several filters and combining those images into colour images.

How many observers have experimented with shooting the same object through different filters, including narrowband H-alpha and Oxygen-III.

While there have been many requests for common and bright objects such as M13 or the Orion Nebula, many other interesting and beautiful objects have been imaged – too many to mention here, but I will highlight a recent image taken by Sam for Centre member Andrew Frank. He requested an image of Make-

Make, one of the few dwarf planets out in the Kuiper Belt - I had no idea how easy it would be, but there it was on the image!

WHAT IS NEXT

As the software running the system has been quite reliable, my focus in the coming months will be directed towards: "live processing" so jpeg images are made available immediately; posting images to twitter (rather than just directing observers to the website); allowing for time-series observations (usually of variable stars); providing Facebook support;

automatic colour image processing; position offsets (eg. for creating mosaics).

In addition, I would like to forge relationships with teachers so it can be a resource for students, particularly those teaching astronomy courses (and there are quite a few of these locally).

INVITATION

To close, you are invited to use this service. Enjoy, and be sure to share your results with others!

RESOURCES

To learn about both telescopes and to receive authorization visit: for Ralph: <http://www.ap.smu.ca/pr/bgo-useme> or for Sam: <http://www.abbeyridgeobservatory.ca/robot>
Facebook Group: Robotic Imaging at BGO & ARO: <https://www.facebook.com/groups/1695977117312497/>
Observation Queues – the requested and completed observation queues: for Ralph: <http://www.ap.smu.ca/pr/bgo-useme/queues> or for Sam: <http://www.abbeyridgeobservatory.ca/robot/queues>



▲ A five minute image of Dwarf Planet Makemake (the "star" in the exact centre). The bright galaxy at lower right is NGC4725.

Lunatic Ramblings 5: Tweet Yourself to an Astrophoto

Dave Chapman

[This month, I am interrupting my Lunatic Ramblings to write an article on robotic imaging at BGO.]

In my heart, I am a visual astronomer. I love observing through telescopes and collecting photons with my eyes, however frustrating that can be. Don't get me wrong—I have nothing against astrophotography. I marvel at what “amateurs” can do with modest equipment in the digital age, both in the deep-sky and the solar-system departments. I do dabble a bit in wide-field astrophotography, using conventional camera lenses and sometimes tracking mounts. But now I am drawn to The Dark Side.

The “Darth Vader” character in my tale is played by Dave VIII Lane, Fellow of the RASC, Director of the Burke-Gaffney Observatory at Saint Mary's University, and friend. His genius transformed the new 24” PlaneWave telescope at BGO into a robotic telescope operated remotely by approved users using a simple set of commands sent by Twitter or email. I was enticed by Dave VIII during last year's RASC General Assembly in Halifax to test the service. Little did I know that I was the first other than him to tweet myself to an astrophoto! The object was an obvious summer target: M13, the globular cluster in Hercules. That was just the start. The result is here: <http://www.ap.smu.ca/~bgo/sm/id.php?id=27> (I should mention that I tweet as @astronomyns. My complete oeuvre can be reviewed at <http://www.ap.smu.ca/~bgo/sm/donequeue.php?observerid=4>)

I tried imaging a variety of objects, not all of which worked out. I soon learned the limitations of a field of view the size of the Full Moon and that stars of magnitude 6 and

brighter would actually overload the sensor at the shortest exposure time of 0.1 seconds. I thought I had discovered a previously unseen “blob” of nebula at the centre of one of my images, but that turned out to be a hotspot in the CCD caused by the imager just before me trying to take a 10-second photo of Betelgeuse! I believe that episode led to a new rule being automatically applied to requests preventing overexposure of bright stars.

I got into imaging double stars that were not too bright and not too close together. Then I branched out and started combining images taken with Red, Green, and Blue filters to produce full-colour images: red dwarf stars, coloured double stars, and deep-sky objects. By then, I was really into The Dark Side, with the stretching, aligning, colour-balancing and

such. It has been a steep learning curve! Elsewhere in this issue, Art Cole has taken a set of my raw filtered images and processed them much better than I could—have a look!

To illustrate my achievements with “Ralph” (the nickname of the BGO telescope), I offer my most interesting image: comet P/2016 BA14 (PANSTARRS). This rather obscure comet was discovered early this year, and it was noticed to have an orbit similar to comet 252P (LINEAR), and is probably a calf of that comet (read all about it here: <http://tinyurl.com/zqgwuv7>). P/2016 BA14 was forecast to make a near-Earth pass on 2016 March 21/22, and I thought it would be fun to snag it, so I casually requested an image on March 17 that just happened to be exposed

on the night of the flyby. I expected to see some movement in the 5-minute image, but the result surprised me: a significant streak! It was moving fast! Later, I learned that I had tweeted myself an astrophoto of the third-closest comet known to have passed Earth. Now that's cool!

Email if you have questions or comments!
dave.chapman@ns.sympatico.ca



▲ Dave Chapman's twitter-requested image of the obscure comet P/2016 BA14 (PANSTARRS), which passed Earth on 2016 March 21/22, showing its rapid angular motion over 5 minutes.

Canada's Radio Telescopes

Matt Payne

So I have now written a couple of articles for Nova Notes as a contributor to the newsletter. However, I have come to realize one important aspect of radio astronomy that I completely overlooked. In fact, I am surprised no one in the Centre picked up on the oversight earlier. Call it a mistake, error, brain-fart, whatever you can come up with for a descriptive adjective. I have



▲ John A. Galt – Radio Telescope (Photo: National Research Council of Canada and the Dominion Astrophysical Radio Observatory, British Columbia)

not described Canada's contribution to radio astronomy and radio science in all my previous articles. Canada, like the United States, has had amazing contributions to radio astronomy. Canada has its own radio observatories just like the United States has the National Radio Observatory in West Virginia, and the Very Large Array in New Mexico. Canada's radio observatories, two in particular, stand out for their contribution to radio science and radio astronomy.

The Dominion Radio Astronomical Observatory (DRAO) near Okanagan Falls, British Columbia was founded in 1960. The primary radio telescope at the facility is the 25-metre (84-foot) John A. Galt dish. The dish is named after the first radio observer at the facility, John Galt. The telescope operates on multiple frequencies (VHF/UHF and GHz). This allows the telescope the freedom to research a wide variety of radio phenomena in the Universe. The site of the radio telescope is rather unique because it is located within an area of British Columbia just north of Washington State that has seen a growth in population of the last 30 years, yet the location has remained very radio quiet. This is owed in part to the surrounding hills and mountains that block, deflect, and absorb stray radio frequencies that would otherwise interfere with the radio observations. The telescope has provided ground breaking research in study-

ing distant quasars in the 1960s and 1970s. More recently the telescope was used, along with the Synthesis Telescope, for work and completion of the Canadian Galactic Plane Survey. However, this telescope along with the Algonquin Radio Telescope in Ontario, is famous for being the first radio telescopes in Canada to make radio observations of space via distant quasars and pulsars utilizing VLBI or Very Long Baseline Interferometry.

The Algonquin Radio Observatory (ARO) is located in Algonquin Park Ontario near Lake Traverse. The observatory's main radio telescope is the 46-metre (150-foot) dish antenna operated by Thoth Technology. This is Canada's largest radio telescope dish located entirely within Canada and one of the largest free-swinging rotatable radio dishes in North America. ARO was founded by Arthur Convington who led the radio telescope research when the dish was completed and commissioned in 1965. As mentioned earlier, this telescope and the John A. Galt telescope were pioneers in the early use of Very Long Baseline Interferometry throughout the radio astronomy world. A technique of radio astronomy that was extraordinarily difficult in the 1960s and earlier 1970s but more common place today among radio telescope throughout the world. Currently the ARO is used in research of pulsars in deep space and is the official station for Canada's mission to Mars in the 21st century.

These two telescopes have made enormous contributions to Canadian science and the field of radio astronomy over the past 50 plus years. However, these two telescopes face a potential serious threat from within Canada. I realize Nova Notes should not be used as a political platform but change in national governments can be a positive or negative in terms of funding of space research. With the recent change in the federal government in Canada these two telescopes face the potential of huge losses in government grants and funds for continued space research. As we move through the beginning of the 21st century,



▲ Algonquin Radio Telescope (Photo: Algonquin Radio Observatory and Thoth Technology—Ontario)

hopefully these two telescopes will continue to make contributions to science and our understanding of the universe.

Starlight and Semiconductors: Processing the BGO Images

Art Cole

When I found out that the theme of the next Nova Notes was going to be the Burke-Gaffney Observatory at SMU and its automated interface, I thought, “Great! That’s an awesome idea!” My next thought was “Uh-oh, I’ve never used it.” Luckily, Dave Chapman came to the rescue and offered up



▲ Figure 1: The completed Messier 14 image using LRGB data from BGO. Each of the four subs was 180 seconds long.

his list of previously-taken BGO images for me to pick from. After going through Dave’s list I decided to process his images of M14 (a globular cluster in Ophiuchus) and NGC 1893 (a star cluster surrounded by an emission nebula in Auriga). Not only are these two objects much different from a processing point of view, they each had a full set of LRGB images.

This gets me to an important point I would like to make. The camera at BGO is a monochrome (or black-and-white) camera – it doesn’t take colour images. In order to create colour pictures using a monochrome camera, astronomers take a number of individual exposures through coloured filters, then combine the results on a computer to rebuild colour. This processing is called LRGB processing, which refers to the filters placed over the camera when taking the exposures. L is for luminance (i.e., no filter at all, giving a greyscale image of the object), and RGB stands for images taken through red, green, and blue filters. Although the RGB images capture colour information, note that they are greyscale too.

So if you want to make pretty colour pictures using BGO, make sure that you capture L, R, G, and B sub-images (or “subs”) of your objects. Luckily, BGO has a motorized filter wheel built into its interface, meaning that you can select individual filters for each of your subs and get a nice LRGB stack for your processing. Remember that you don’t need as much exposure for your RGB subs as you do for your L subs, so use your valuable BGO time for getting as much luminance as you can, while saving some time for colour.

Once BGO notifies you that all of your subs are ready, download the images from the BGO website. Make sure to download the FITS files, not the JPEG files. The FITS images contain unprocessed, raw camera data and have a better dynamic range than the JPEGs. At this point, you can start processing. There are three basic parts to the workflow: process the RGB subs to get a good colour representation of the object, process the luminance subs to get a good greyscale image, and then combine the two.

Here’s the workflow I used to process M14 and NGC 1893. This might be slanted a bit towards Images Plus, but the workflow in other tools should be similar:

Align all of the subs and use the *aligned* images for fur-



▲ Figure 2: The completed NGC 1893 image using LRGB data from BGO. Each of the four subs was 300 seconds long.

ther processing – there is no point in stacking unaligned subs.

Create the colour layer from the RGB subs. Combine the three R, G, and B images using the “Add” combine mode, but first designate the R, G, and B subs as belonging to the red, green, and blue channels, respectively. After combining, flatten the stack, and

Starlight and Semiconductors: Processing the BGO Images Continued

- save the resulting colour image.
- Stretch the colour image if necessary, in order to make it light enough to work with.
- Adjust the individual colour channels to get the background colour looking correct.
- Boost the colour using a saturation tool, and optionally blur the colour layer slightly to get rid of any colour noise you might have – remember, this is the colour layer only – object details will come from the luminance data! Save the colour image.
- Stack the luminance subs (assuming you have more than one), and process the resulting image, concentrating on stretching, noise reduction, and sharpening – all

the things you would normally do. Use masks as necessary. Get the object looking great in black-and-white. Save the luminance image.

Open the colour image and luminance images as layers within the same stack and combine using the “colour” combine mode for the colour layer and the “luminance” combine mode for the luminance layer. Flatten and save! That’s it!

If you want to get a jump on BGO LRGB processing without having to wait for an order to be filled you can always peruse the list of previously-captured images and download what other people have already ordered. The web site <http://www.ap.smu.ca/~bgo/sm/donequeue.php> contains a wealth of images that can be searched by object name. Note that many of the images have been taken through specialized filters such as oxygen III and hydrogen alpha, giving you interesting options for luminance subs.

Parallax – The Race to Measure the Cosmos Tony McGrath

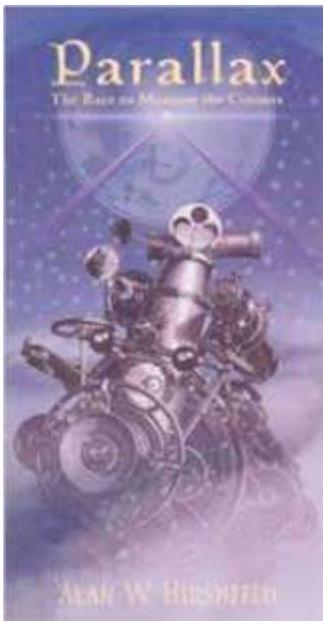
Parallax – The Race to Measure the Cosmos

Alan W. Hirshfeld

Henry Holt & Company 2001

283 pages, ISBN 0-8050-7133-4

A wonderful story of the search to confirm the Copernican theory. Written by Allan Hirshfeld, the story is a lovely stroll through the history of astronomy, where we learn the fundamentals of the



science being discussed as well as getting to know a little of the people behind that science. By the end of the 19th century, most people had accepted the Copernican theory that the earth orbits the sun, however no one could prove it conclusively. The proof lay in detecting the movement of a nearby star

The story is divided into three parts, the first of which explores how human understanding and models of the cosmos developed from the time of the ancients through to Copernicus. The writing is lively and fluid, and provides the reader with a summary of the concepts that is just right for the general reader. Part One concludes with a definition of the problem facing the early Copernican advocates, specifically that they could not produce any indisputable observational evidence to support the heliocentric claim.

Part Two opens with an introduction to Tycho Brahe and the confounding problem he faced with the appearance of a new star, what we today would understand to be a supernova, in 1572. For 18 months this beacon shone brightly where previously no star had been. Despite his best efforts, Tycho could detect no parallax. The inability of Tycho to detect any parallax put this new visitor to the heavens significantly

further away than any of the known planets, and suggested that the previously immutable heavens, the sphere of the stars, were indeed changing. It was on the basis of the work which Tycho did around this new star which prompted him to develop his own model of the solar system. This Tychonic model was a hybrid of the geocentric model of the ancients and the heliocentric model of the upstart Copernicus.

Any further advances in measuring parallax had to wait for the invention of telescope. It was this instrument that in the end would provide the tools for detecting parallax. The indefatigable Robert Hooke made an attempt at measuring it, and following in his footsteps, James Bradley. Both used telescopes mounted in the vertical, and while neither detected any motion in their chosen targets, Bradley did, in the course of his observations, discover a new phenomenon that we know as aberration.

Part Three describes the efforts that finally brought results. Success had to wait for technology to provide the requisite tools. In the end it took the dedication and mathematical genius of Bessel, armed with the finest telescope designed and built by Joseph Fraunhofer, in for the parallax of 61 Cygni to be measured.

Tony McGrath

Size Matters: The Case for Small Scopes

Dave Griffith

It is undeniable that the more aperture you have, the more you can see. While an 80-mm scope may reveal a galaxy as a faint smudge, a Dobsonian light bucket might reveal spiral structure and dark lanes. The optics cannot be denied: telescopes collect *light* and bigger ones do it better. But is bigger always better? I used to think so.

Like many stargazers, I have cycled through a number of scopes over the years, from the spindly little Tasco refractor that ignited my passion for stargazing (thank you, little scope!), to a 12" Dobsonian. In between was a 10" SCT on a very bulky mount, a 5" Schmidt-Newtonian (also a Tasco but, interestingly, one excellent little instrument!), an Edmund Scientific Astroscan, a 4.5" short-tube reflector, an 8" go-to SCT and an 8" Dob. I used them all, but in retrospect, the smaller ones got more sky time than the big ones, primarily because they were just easier to transport quickly.

When I lived in the country, the bigger scopes thrived. Take one out to the backyard and presto: beautiful black skies in which to leisurely fish for Deep-Sky Objects (DSOs). Now I live in a very well-lit town so need to travel beyond that persistent and pervasive fog of light pollution if I want to see more than the moon, planets, and brightest Messiers. That in itself is a disincentive, as I need to pack, travel, view, travel and unpack. Add to that some arthritis in my back and shoulders, and all of a sudden those big, beautiful pieces of glass begin to lose their luster. Sometimes it literally *hurts* to go observing. Suddenly I became a textbook example of that wise observation: the telescope you see the most with is the telescope you actually *use* the most.

I now possess about 287-mm of aperture, but distributed nicely among three portable, yet capable little scopes: a 120-mm short-tube, rich-field refractor, a 127-mm Maksutov-Cassegrain, and a 40-mm Coronado PST. I plan my outings, which might involve one scope, or several, depending on what's up and what I want to focus on. While none of my scopes are *big*, they are dedicated to specific applications, which I feel is a big advantage over one big instrument of a particular optical configuration.

Each type of scope has its advantages and disadvantages. For most backyard astronomers, there is no single perfect scope. Traditional Newtonian reflectors, for example, suffer from coma, which can cause seagull-like images at the edge of the field. All but the most expensive refractors suffer from the

colour fringing known as chromatic aberration. Closed-tube designs require more cool-down time. Short-tube refractors and Newtonians offer limited magnification. Longer focal length refractors and Maksutov-Cassegrains offer narrower fields of view.

My main deep sky scope is the little 120-mm short-tube achromatic refractor. While not optimal for detailed views of the moon and planets, it offers magnificent wide field views of star clouds, diffuse nebulae, star clusters and larger galaxies. M31 is lovely in it, as is the Double Cluster in Perseus. The Veil is easy, even from my back yard. Chromatic aberration (CA) is usually not an issue as DSOs are typically dimmer objects, and it is most obvious on bright targets like the moon, Jupiter, and Venus. I do have a fringe filter to cure much of the CA if I do choose to sneak a few peeks at these. Magnification is limited in this fast scope but much of what I look at is better viewed with a wide field at low magnification anyway.

On nights when the moon and or planets are available, my Mak-Cass really is the scope of choice. This small scope has a longer, folded light path, hence is capable of more magnification, and the optics of this type of scope are tack sharp, approaching the capabilities of an apochromatic refractor. Because of its higher magnification capability, it also is excellent for smaller DSOs that can take more magnification, like planetary nebulas and some globular clusters. Maksutov-Cassegrains are also excellent on double stars.

And of course, clear sunny days just beg for a session with my little PST. It could be argued that the price of one of these is prohibitive given the fact it only is good for one object, but then again, how many objects are as constantly dynamic and changing as our star?

A Note on Mounts: Portability and ease of use also depends on your mount. As I am purely a visual observer (I am quite content to enjoy the magnificent images captured by my fellow RASC members!), I prefer a simple yet sturdy mount for star hopping (I have owned go-to scopes and they are wonderful, but I am an old school star hop-

per I guess!). I have a *SkyWatcher AZ-4* mount which is ideal for the 120-mm wide field; sturdy and simple for lower-power nudging or sweeping, it is buttery smooth. I did opt for the additional stability of steel tripod legs over aluminum. I use an *Explore Scientific Twilight I* mount with manual slow motion controls for the Mak-Cass, however. I found that with higher magnifications, it was difficult to track by nudging. A bit heavier but still manageable. Both mounts allow for relatively easy pointing to the zenith. No batteries, no controllers, no counterweights...just mount, point, and shoot. The little PST usually sits atop a lighter AZ-3, although even a camera tripod can



▲ Dave Griffith stands behind his fleet of small scopes.

suffice in a pinch for this amazing little scope.

So rather than apportioning all my aperture into one scope, I now have “the fleet”. I can take both scopes and switch them up, but more often I’ll decide on a particular class of object and focus on that, and the scope best suited for it. For longer excursions such as camping trips or Nova East, I will of course take the entire fleet. All are relatively grab-and-go portables, lightweight, easy to mount and store. The largest is only 5”. Even an arthritically challenged fellow like me can get by with nothing more than a few aches and pains, a small price to pay for a ticket to the heavens. There *is* room for Tylenol in my gear bag. I choose now to travel to the stars in a subcompact, not an SUV. Does size matter to me? Indeed, it does!

“Fleet” Specifications

TELESCOPE	SkyWatcher 120mm Short Tube Achromat	SkyWatcher 127mm Mak-sutov-Cassegrain	Coronado PST Ha Solar Scope
OTA Length	59.5 cm	33 cm	40 cm
Aperture	120 mm	127 mm	40 mm
Focal Length/Ratio	600 mm f/5	1500 mm f/12	40 mm f/10
Weight (OTA)	3.97 kg	5 kg	1.41 kg
Max Magnification (Realistic?)	120x	250x	~75x
Pros	Wide field, no central obstruction; no need for optical alignment	Tack-sharp optics, higher mag; no need for optical alignment, minimal aberrations	See Sol in H-alpha!
Cons	Chromatic aberration, low magnification range	Narrow field, central obstruction, long cool-down time	Solar only, aperture limiting, leaving you wanting more (Oops, did I just say that?!)
Best for...	Wide-field deep sky (diffuse nebula, star fields and clusters, larger DSOs)	Lunar, planetary, double stars, some DSOs	Sunspots, filaments, granulation, prominences, flares

Finding a Quasar using BGO by Keith Walker

I have taken several images with the robotic telescopes, both monochrome and colour through filters. I don’t do Twitter, so I use the email interface. It is dead simple to use.

I only had to get creative with my requests once, when I wanted to target a quasar that was not in the database. Luckily, my target was within the field of view of a galaxy that *was* catalogued, so I just specified that object and got my picture.

I like how it schedules automatically based on weather. One night recently, the forecast was for clouds all night. I was quite surprised to get an email notification in the morning that my image was ready. Apparently there was a clear period during the night, and it went ahead and took my picture.

I use it for images where I want a larger image scale than my normal rig. It is especially handy when I have my regular (8”) rig set up and don’t want to tear it down to mount my larger (11”) scope.

The photo to the right is my most recent image from the BGO. It is supernova SN2016cok in M66, taken June 8th, 5 minutes exposure time.



▲ Supernova SN2016cok in M66, taken June 8th, 5 minutes exposure time. (Photo: Keith Walker)

Ralph captures M51 in Colour by Jerry Black

The Astronomy and Physics Department at Saint Mary's University in Halifax operates the Burke-Gaffney



▲ M51, the Whirlpool Galaxy, initial image from BGO. (Photo: Jerry Black).

Observatory which now houses a Planewave 0.6-metre CDK24 telescope. Earlier this year its robotic

interface using Twitter and Email became available to the public.

This has been a wonderful resource to explore the cosmos and astrophotography for a novice like myself. Having a properly polar aligned telescope and CCD camera available to photograph objects of interest makes the jump into astrophotography a series of simpler smaller steps. My first image (shown left) received back from "Ralph" whet my appetite to try more.

I found myself using the email interface more often as I'm not a big Twitter user. Both were easy to use once authenticated. The open access nature of the robotic interface makes it interesting to see what other requests are being queued at the same time. By requesting RED, GRN, BLU and LUM images (actually multiple replicate images taken over several nights) I've been

able to step into image processing a bit to create colour images from the original filtered CCD images. A 'non-linear' combination of these is shown below. This is a work in progress, and I have still have a lot to learn. [I've been trying the multi-platform software "PixInsight", although there are numerous packages dedicated to the subtleties of astronomical image processing].



▲ M51, the Whirlpool Galaxy, image processed with Pixinsight. (Photo: Jerry Black).

FOOD FOR THE SOUL Paul Heath

(May 2016 Meeting)

Midnight Marble

The warnings are clear,
The fiery cauldron you shan't get near
For this is a sight the eyes cannot bear.

Yet we gathered in clusters, in droves crowded near,
For we heard of a rarity soon to appear.

We search through our tomes
And whispered our spells, spoke aloud our prayers,
Or trekked far where 'twas said, would be fair.

We gathered in clusters, in droves crowded near,
For the rarity, it soon would appear.

We covered our hopes with silvery hues,
And perched as pirates who spy on you do,
Then bending, to look up at the cauldron's fiery brew.

A shadow like toffee stuck on the rim, and slowly crept
in
Till surrounded, with the cauldrons fiery brew,
As each pace in the line stepped up to view,
It hardened and darkened to something quite new.

The shadow now solid and Midnight in hue,
Floated above
A Midnight Marble on a fiery brew.

By Paul Heath