

# Regulus

Newsletter of the RASC Kingston Centre

Vol. 50, No. 8-9

August - September 2023



**Perseid Meteors!**

On the Horizon ....

Centre Meetings

13 September 2023  
11 October 2023

Centre meetings occur on the second Wednesday of every month at 7pm EST from September through to June.

RASC Kingston Centre  
Annual General Meeting

8 November 2023

Annual reports and elections! Don't miss out on joining in person or online.

For more information visit us online  
<https://kingston.rasc.ca>

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The temperatures are telling us that Fall is just around the corner. Of course, this means we get more time to observe, but then we have to deal with dew and dampness... advice... dress in layers and keep your feet warm.

Michael Bird, who is also our Auditor, will be taking over the position of Social Convener starting in September. Watch the email list for news from Michael.

The August 9<sup>th</sup>, 2023 'Bring your own dinner at Lake Ontario Park' meet up sounded like it was a success. Kevin and I were out sick, so we missed seeing everyone. Of course, this cancelled our attendance at Star Fest, but John & Peggy Hurley were there, and Peggy won a door prize - a Celestron 130mm StarSense Explorer DX 130AZ from KW Telescopes. Congratulations Peggy!

The free Family Night Event was 'A Night Under the Stars' on August 10 at 7:30pm at Elbow Lake Environmental Education Centre. Rose-Marie B. And Rick W. volunteered to help out, and it too was a success.

The next Open House at Queen's University will be September 16, 2023. Help will be needed for this event, as this is the same weekend as 'Fall N Stars'. August's Open House was attended by Susan Gagnon, Laurie Graham, and a new volunteer, Ali Ahmadi, also helped out. It was reported that approximately 70 people attended.

This year's 'Fall'N'Stars' is set for September 15-17, 2023, at Johnson's R.V. Park in Prince Edward County. Check out <https://rascbelleville.ca/fallnstars/> This year it is Belleville's lead on the joint Star Party, with the RASC Kingston Centre in support. Registration is now open, and E-transfer can be used to pay for this event. If there are not enough signed up for this event, however, it might be Cancelled, so please sign up and enjoy the last Star Party this year!

## November Annual Meeting and Elections

We would like to encourage all our members to come forward and help out to help shape your Centre. We will be having elections for three critical positions at our next Annual General Meeting (AGM) on November 8<sup>th</sup>, 2023. The positions that are up for election are President, Vice President, and Treasurer.

Please note that after enjoying recent tenure as your Centre president, I will not be seeking re-election this year, instead giving the opportunity to another member of the club to lead us through the next few years.

Beyond board positions there are many other simple ways to help out at the Centre. If you have a passion for astronomy, some skills you want to share, and a little extra time, please come help shape the future of the RASC Kingston Centre. If interested in getting more involved, let us know! Please send a note to [kingston@rasc.ca](mailto:kingston@rasc.ca)

Have a Safe and Happy rest of your Summer and welcome to Fall! Clear Skies!



On the cover: RASC Member Brian McCracken assembled this fantastic composite shot of the Perseid meteor shower on the peak night of 13 August 2023. Using a Nikon Z9 Camera set to take a 10 second image every 12 seconds from 1am to 4am, he captured approximately 1000 images of the shower. Of these thousand captures, just 14 had meteor tails! The prizes were then combined into the composite shot using Photoshop. Interestingly, one can often tell the composition of the meteor by its trail - this shot has captured yellow trails (iron), purple trails (calcium), and green trails (nickel). Tech specs: Nikon Z9 Camera with Nikon Z24-70mm lens at f/2.8, ISO 4000.

# Centre News and Updates

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Stop the press! Got news to share? Send your centre news, updates, pics, sketches, notes, and links to the Regulus editor!

## *Queen's University Observatory Open House Volunteers*

Susan Gagnon, Ali Ahmadi and Laurie Graham worked the open house on Saturday, August 19th. The weather kept going back and forth but in the end, it was mostly clear. Attendance at the talk was quite good for a summer date - probably around 75 if Laurie had to guess.

We met up at 7:30 pm and the three of us set up the Centre's 6" dob and Laurie's 8" Meade SCT. The talk was entertaining and informative and was a different take on galaxies than usual, given by Mark Richardson.

The first group got to see a reddish crescent moon through Laurie's scope and Albireo via Susan. Once the moon was gone, Laurie set up on M13. Susan also showcased Mizar and Alcor. When Saturn rose above the clocktower, Laurie switched to that. At the very end, Laurie treated the remaining few people to the ring nebula.

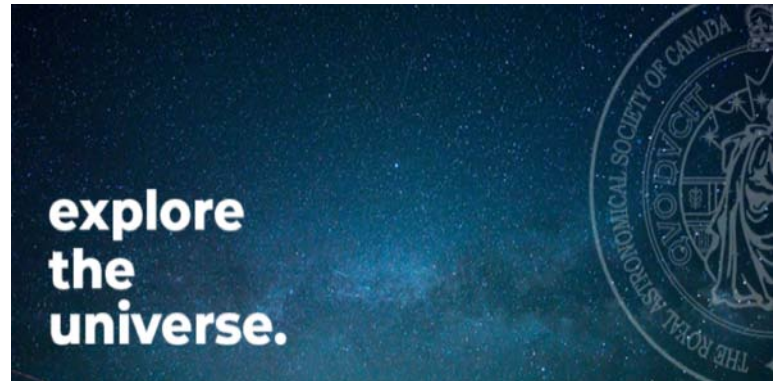
Ali was very helpful in finding stars and objects. Laurie's old eyes could not see Hercules due to the city lights and the twilight sky glow. Ali used the telrad and put the

telescope in the vicinity so that only a minor scan was required to nail it. He also regaled people with stories about the constellations, showed people which moon was which for Saturn, discussed all manner of topics astronomical, and was just generally a fountain of information and interesting anecdotes for the entire evening. A volunteer well worth cultivating.

I (Laurie) told Ali I enjoyed volunteering because I loved getting the "wow" response from people. We celebrated every wow and even had someone going wow while jumping up and down in excitement at having seen Saturn. Makes all the hard work worthwhile.

Each volunteer put in about 2.5 hours with setup, viewing, and teardown.

Cheers!



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## Editor's Eyepiece

**Andrew B. Godefroy**

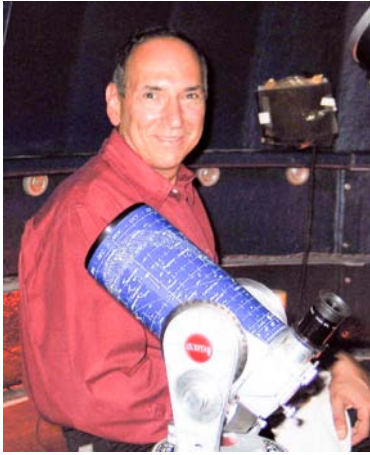


Welcome back! After a brief hiatus to make the most of being outdoors during the summer months, the RASC-KC will be returning to its monthly in person and online meetings beginning this fall, with the first gathering planned for Sept 13.

I always look forward to these meetings as they offer a tremendous opportunity to catch up with old friends, and make new ones, as well as see what everyone is currently doing with their own astronomy hobby. This said, there always seems to be more older faces at the meetings than younger ones, and

I'm not sure why that is. The range and scope of talks has always catered to diverse interests as well as different skill levels, but we seem a little stuck sometimes at getting more members out to the monthly meetings, even online. Perhaps there's a way forward to improve attendance, or at least give it some consideration. Of course, we'd love to hear from more of you, more often, so please consider submitting something to Regulus on whatever you're focused on at the moment.

Last but not least, I was saddened to learn of the passing of Blake Nancarrow on September 1. We had just hosted him as a guest speaker earlier this summer; he gave us a fantastic and memorable talk on the RASC Observing Programs. I have no doubt he will be sorely missed by all, and we will aim to post a more detailed obituary in our next newsletter.



## Meteors Scratch the Sky

Despite what you read online; it is possible to think of meteor watching as one of the most boring things you can do with the night sky. No cosmic

connection, no postulating about the origins of the Universe, no understanding of what dark matter might entail. When we look for meteors, we are in our own celestial backyard. We usually do not even use a telescope or binoculars; it's just sitting on a comfortable lawn chair and looking up at the sky. Even if we spot a shooting star as bright as the brightest of stars, it is only a large speck of dust that is probably only a few dozen miles above our lawn chair.

So why bother with watching meteors at all? It is because they are so close, so local, that makes this activity unique. A meteor may be a large speck of cosmic dust, but it strikes the Earth's upper atmosphere at a velocity of 40 miles per second. And that is precisely what I saw, 44 times, on the beautiful night of August 12, 2023.

That night began with the usual thickness of clouds, typical of the Arizona summer monsoon. But the clouds rapidly dissipated. Instead of clouds, stars began to appear. Well before midnight, I was out with Eureka, my 12-inch diameter telescope with which I would complete 2 hours of comet hunting before the night ended. One hour before midnight, another before dawn. In between, I counted my 44 meteors, one of which is in the accompanying picture.

The Perseids of 2023 were a very good meteor shower, but not the best. In November of 2001, Wendee and I were in the Australian outback during the peak of that year's Leonid meteor shower. We gathered on the shore of a dry lakebed and watched carefully as Leo the lion reared its handsome head above the eastern horizon. Then silently and swiftly, a bright shooting star appeared in the east, made its way across the sky, then slowly vanished in the west. One watcher said it all: "This trip was worth it!" A few minutes later, a second meteor did almost the same thing. After that the meteors came thicker and more often until, at around three in the morning, they suddenly began pouring out the sky at the

rate of about one meteor per second. One observer even saw a meteor after the Sun rose.

What caused this burst of shooting stars? It appears that they originate from a comet. In December 1865 and January 1866, that comet was discovered by the German Wilhelm Tempel and Horace Tuttle of the United States. Because its orbit was identical to the orbits of the meteors, it was subsequently identified as the "parent comet" of the Leonid meteor stream. Moreover, because the comet passes close to Earth every 33 years, it was connected to the great meteor "storms" of 1833 and 1866.

In a similar way, Comet Swift-Tuttle, discovered in 1862 by the Americans Louis Swift and Horace Tuttle, was determined to be the parent comet of the Perseid meteors. As I watched them that unforgettable night, I was struck by the awe these tiny specks can generate as they race through our atmosphere. I was struck also by the wonder they generated in my mind: these always welcome visitors from space invariably enchant my soul.

A final note: One night in 1833, when Abraham Lincoln was a young lawyer, a deacon friend pounded on his door and woke him. "Arise, Abraham," he yelled. "The day of judgement has come." Lincoln leapt out of bed and strode to a window, and he saw countless shooting stars." Shortly after he became president, when several states left the union, Lincoln told this meteor story to some visitors. As he watched the falling stars in wonder, he also saw that the familiar constellations were still there in the sky. "The world did not come to an end then," he said wisely. "Nor will the Union now."

A fellow citizen who lived at the same time as Lincoln, and who likely admired and respected him, was Carl Schurz, who would be elected to the U.S. Senate a decade later. On April 18, 1859, on the eve of the American Civil War, he gave a lecture in Boston's Faneuil Hall. He said: "Ideals are like stars; you will not succeed in touching them with your hands. But like the seafaring man on the desert of waters, you choose them as your guides, and following them, you will reach your destiny."





Many of us would like to take images of the night sky either for their beauty or for their scientific value. What we're hoping to capture is the target, the whole target and nothing but the target.

Unfortunately, along with recording the light from our target we get a whole lot of other garbage that degrades our image, sometimes to the point that it has little or no beauty or scientific value. Some of this garbage comes from the night sky-light pollution mainly-but some of it comes from the electronics of the camera and some from limitations of the optical system and some just from basic physics. Here we'll ignore the light pollution and deal only with the camera and optics.

First, we'll start with a very brief review of how CCD/CMOS cameras register an image: The camera chip is a rectangular array of little square pixels each of which catches light from a small area of the image. When a photon lands on a pixel it kicks loose an electron which gets stored in the pixel. At the end of the exposure all the collected electrons are shuffled out pixel by pixel through a reader (Analog-Digital Converter) which converts the number of electrons (the total charge) in each pixel into a number called an Analog-to-Digital-Unit or ADU. These are the numbers that we see displayed on our computer.

As mentioned above there are a lot of problems with the data we get back. The process to correct some of those problems is called reduction (more often called calibration in the amateur world.) Let's examine the full image reduction process, then we'll look at how different parts of the process can be used to correct different problems we might see in our images. This will also allow me to define some of the terminology.

The first thing to note is that all the 'signals' we measure (bias, dark current, flat field) have noise - variability that slightly changes the values measured with each reading of the camera. Much like we do when we stack our images to average out the noise, we always shoot many reduction frames and average them together to get a better measure of the true average signal.

## Bias

When we read an image out from a camera there is a certain amount of noise - variability in the exact readings that the electronics produce for the electron charge in each pixel. Some pixels which have received very little light could even be reported as have a negative value. To prevent this from happening the camera manufacturer adds a bias voltage to the output, a small signal that ensures that no pixels read out as negative. The bias appears as a small signal, perhaps a few hundred ADU in all pixels. In CMOS cameras this can be adjusted by the user through the Offset parameter. You should adjust the offset to some low value high enough to ensure that no negative pixels are read from a bias frame. This signal has two variable components - random noise (called 'read noise') means that each pixel yields a slightly different value every time it is read out. On top of that random noise there is generally a variation with position on the chip - a fixed pattern that appears as single or lines of bright pixels which are consistent from image to image (**Figure 1**) It is important to realize that the bias signal is the same regardless of the duration of the exposure. This bias signal needs to be removed from our images using a master bias frame.

To create a master bias frame, we shoot a few dozen zero second (or as short an exposure as your camera can manage) exposures in the dark. If your camera is cooled it should be at the same temperature you plan to use for your 'light' or science frames. If your camera has adjustable gain and offset (most CMOS cameras) these should also match your light frame settings. By stacking all these bias frames together, we average out the random noise and get a better measure of the underlying fixed pattern bias signal.

## Dark Current

Every (amateur) camera is subject to dark current (**Figure 2**) The warmth of even a cooled camera causes thermal jiggling of the atoms in the camera chip and this results in electrons being released inside the pixels. These electrons are indistinguishable from those deposited by our photons, so they get added to the signal we read out of the camera. The number of these electrons is related to the temperature of the camera - the colder the camera the less thermal jiggling the lower the dark current. That is why many cameras are cooled (and why an uncooled camera performs better in the winter.) Generally, the dark current decreases by about a factor of 2 for every 6 degrees C that we reduce the camera temperature. By

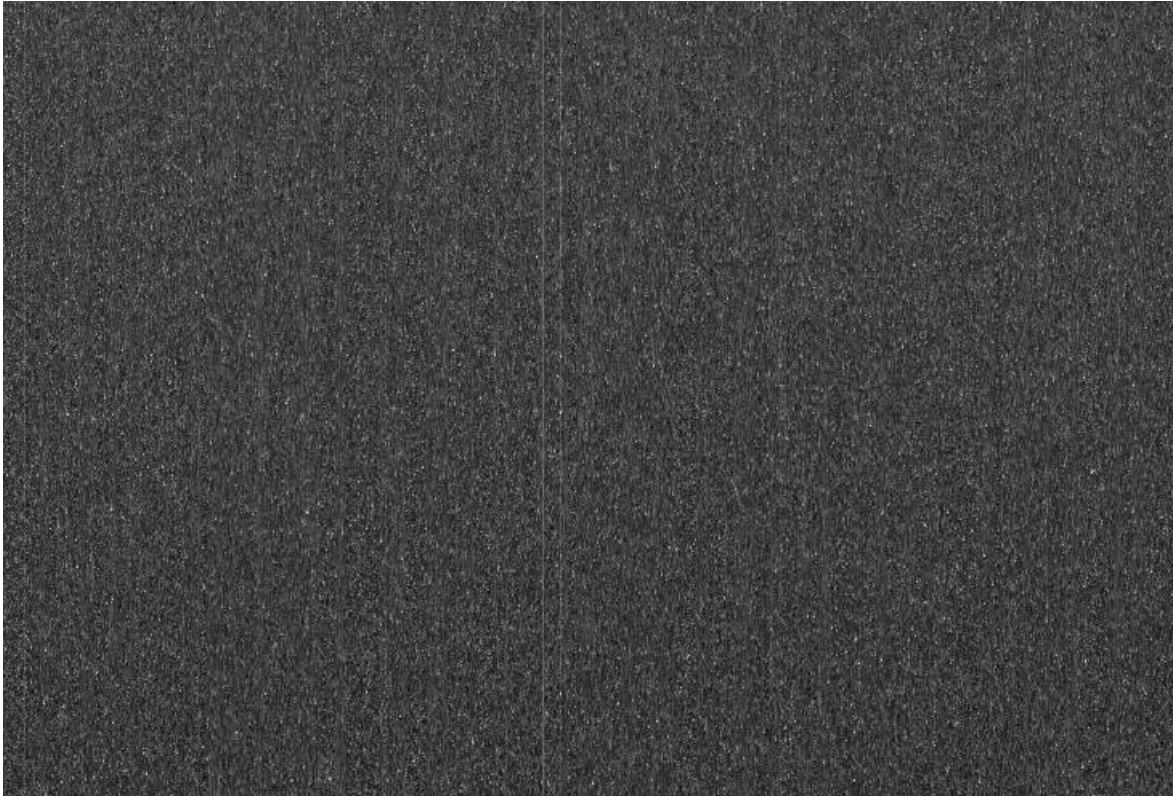


Figure 1:  
Master bias  
(stretched and  
cropped): the two  
vertical bright  
columns are fixed  
pattern noise in the  
bias frames.

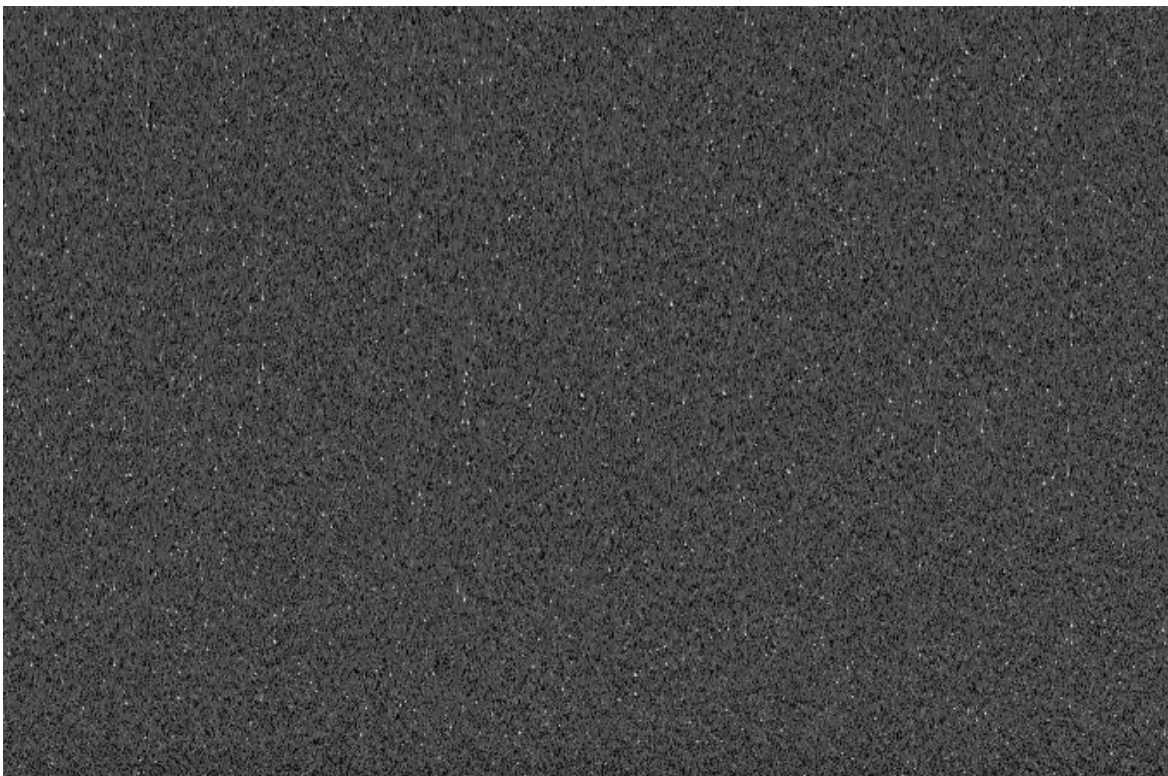


Figure 2:  
Master dark  
(stretched and  
cropped): in addition  
to the pixel-to-pixel  
variation in dark  
current there are also  
many bright 'hot'  
pixels, many of which  
are also charge traps  
- they have short  
bright tails pointing  
up the frame.

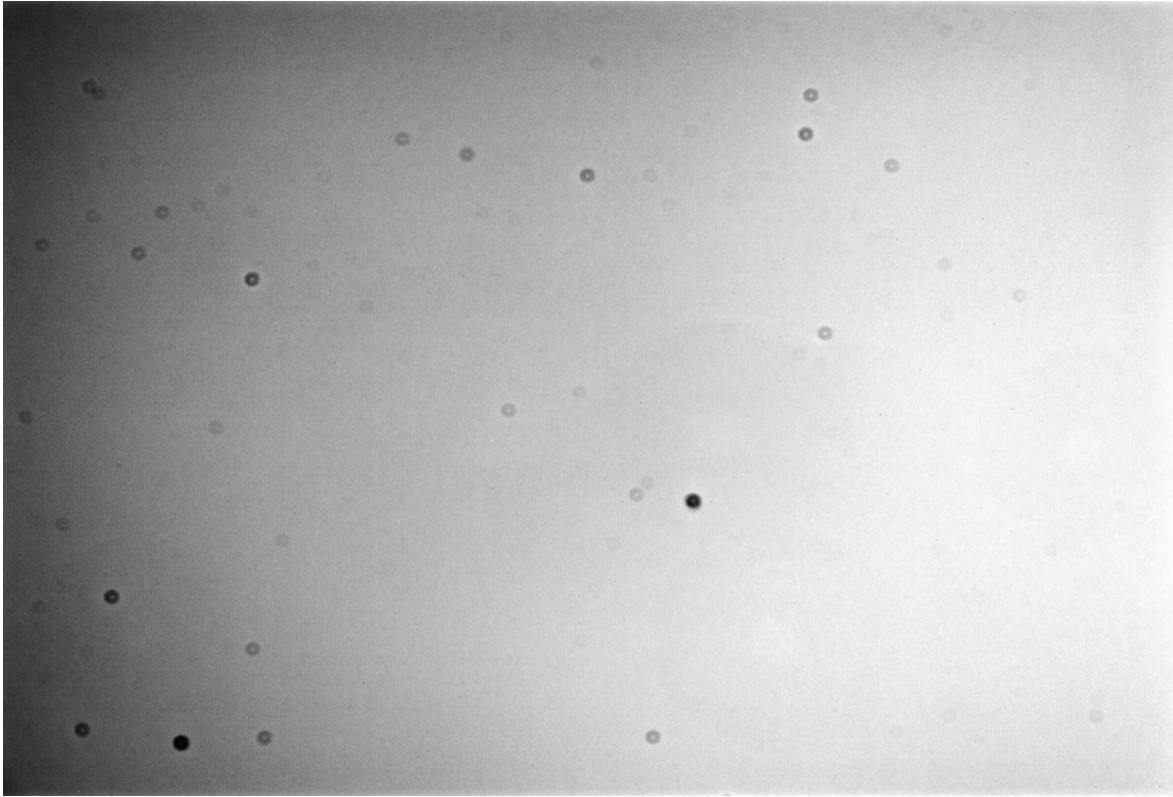


Figure 3:  
Master flat (stretched, downsampled): obvious vignetting which is not symmetrical about the frame centre, many dust donuts of consistent size meaning they are all on the same optical surface, probably the chip cover glass.

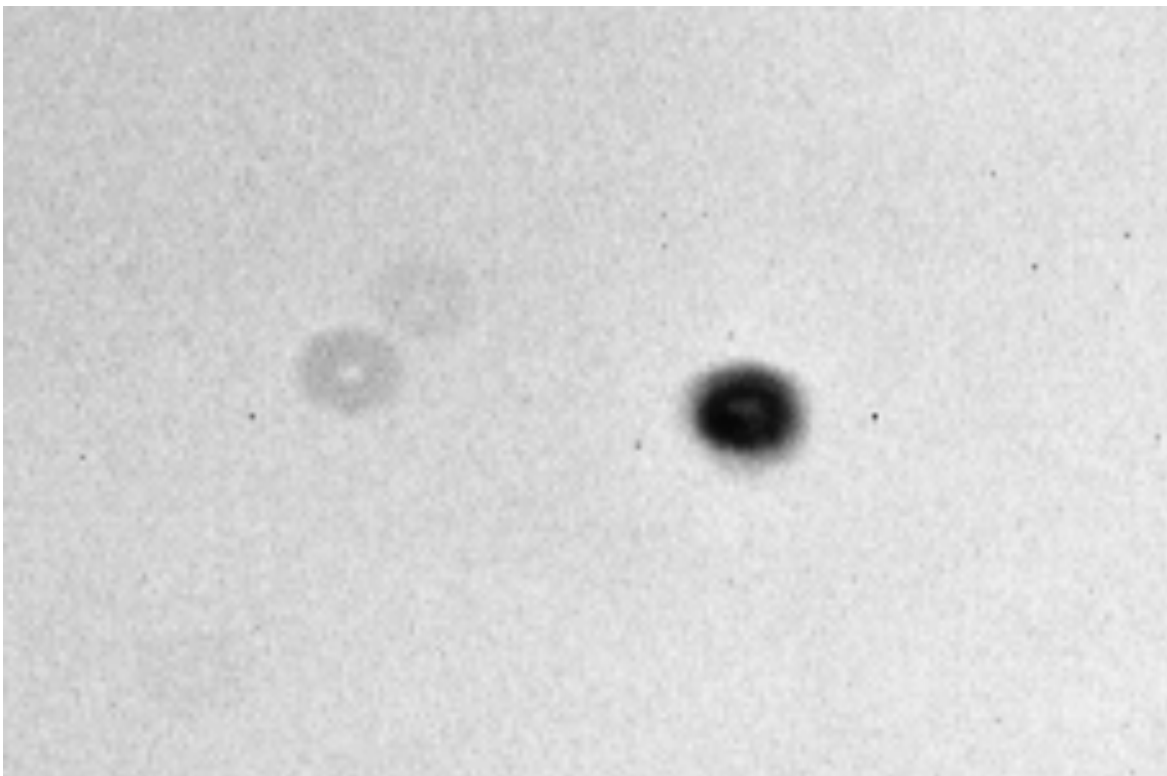


Figure 4:  
Master flat (stretched and cropped): The pixel-to-pixel variation is due to differences in the sensitivity of the pixels.

dropping the chip temperature 30C we reduce the dark current by  $2^5 = 32$  times. (Professional cameras are generally cooled to liquid nitrogen temperatures and have essentially no dark current.)

Some pixels in an image are “hot” - they have a dark current which is much higher than the average. They show up as annoying bright pixels, usually isolated single pixels, often brightly coloured if you have a one-shot colour camera, that are scattered across the image. Cooling the camera can greatly reduce the impact of hot pixels or even turn them into normal pixels.

To create a master dark frame, we shoot a few dozen images with no light falling on the camera (telescope capped, camera shutter closed if it has one, cameras often have light leaks so the room should be dark) with the camera at the same temperature/gain/offset as our light frames. Once again, we average out the noise in the dark current by stacking the dark frames together.

We need to make a choice for the duration of our dark exposures. The easy option is to shoot dark frames of the same duration as our science images. Then the master dark frame will be a good measurement of the dark current (and the bias) that’s in our science image and we can just subtract the master dark from the science frame. If we shoot science images at a couple of different exposures, then we must shoot a matching set of dark frames and create a separate master dark frame for each exposure duration. However, if we are shooting at several or even many different durations it will be burdensome to have to shoot and create a whole series of master dark frames.

In that case we can do ‘scaled darks’. For scaled darks we shoot one set of dark frames with an exposure at least if we expect to use for our longest light frames. We can then scale the master dark frame to match our science exposures. E.g., if we have a 300s master dark and 150s science frames then we can just divide the master dark frame by 300/150. Except there is a problem - remember the bias! The bias signal is part of all the dark and science frames. If we scale the master dark, then we are also scaling the included bias which means that when we subtract the scaled dark from the science frame only part of the science frame bias signal gets subtracted. Therefore, we must subtract a master bias frame from all our dark frames before stacking them into the master dark frame. Then subtract the master bias frame from all our science images. Only then can we scale the master dark and subtract it from the science frames.

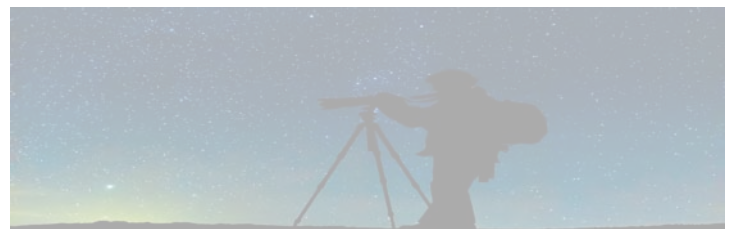
## Flats

Finally, we come to flat corrections. Most telescopes and camera lenses introduce vignetting (**Figure 3**) - a reduction of light in the corners of the frame. For example, the corner of the frame may receive only 80% as much light as the center - i.e., 4/5 times as much light. In addition, every pixel in a camera will have a slightly different sensitivity (**Figure 4**) For example, imagine a pixel which is 5% more sensitive than average so it is 1.05 times as sensitive. The fact that these deviations are given as something times the average tells us that we need to multiply or divide a correction rather than subtract it. These variations in sensitivity will show up as small-scale variations in the brightness of our nebula. Finally, any dust motes on the camera windows or filters cast shadows on the chip.

How do we correct these errors? If we take an image of a perfectly uniform light source, a “flat frame”, we will find that same corner will again receive only 4/5 times as much light, and our example over-sensitive pixel will respond with 1.05 times as much signal. By dividing our science image by the flat the 4/5 in the science image gets cancelled by the, now 5/4, from the flat and the 1.05 signal level from our pixel signal gets corrected by 1/1.05.

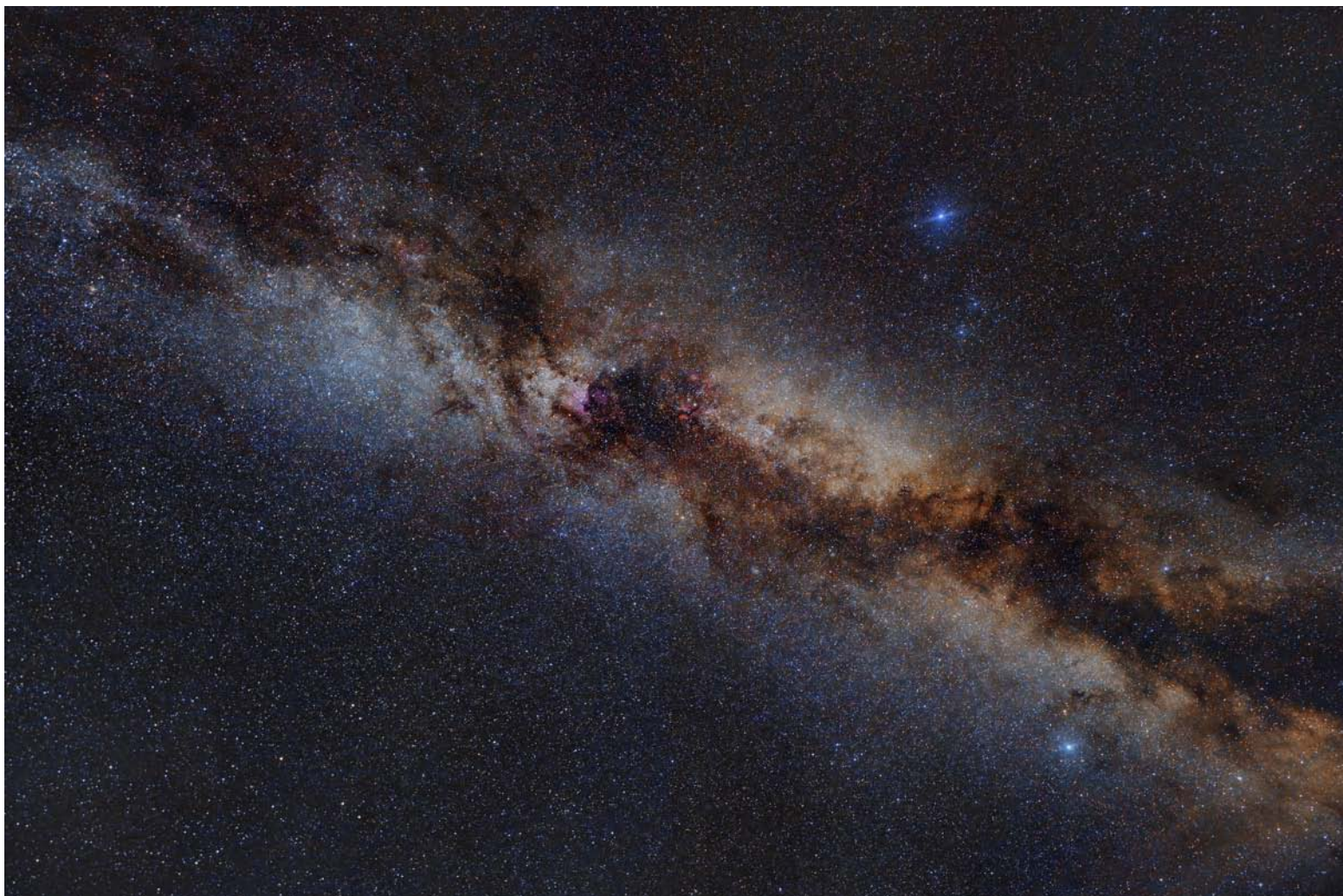
We create a master flat field by shooting a perfectly uniform bright field. We shoot a dozen or more flats through each filter we’ll be using, camera temperature/gain/offset, and focus should all the same as for our science images. The exposures should be such that the pixels are at about 50% of maximum signal (e.g., 32kADU for a 16bit camera.) We subtract the master bias (and a master flatdark or scaled master dark if the exposures are long enough) from all the flats and then stack them to create the master flat.

In two subsequent articles I will address some of the details of taking flat frames and will go through an assortment of the most common problems you might see in your images and how to use image reduction to correct them.



## Member's Photos

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*Above: Tim Trentadue captured this amazing panorama of the Cygnus Region during the Parseid meteor shower using a Sony A4Rii with Sigma 20mm @ f1.4. Processed in Pixinsight and Photoshop.*



*Left: Shelley Jackson snapped this wonderfully rich image of the Moon in its waning Gibbous phase on September 4 using an Askar V, ZWO ASI183mm pro and ZWO filter wheel with Ha filter. Processed with Autostakkert and Pixinsight.*

## About Us

### The Royal Astronomical Society of Canada

RASC is a national, non-profit, charitable organization devoted to the advancement of astronomy and related sciences. Founded in 1868, The Royal Astronomical Society of Canada is Canada's leading astronomy organization, bringing together over 5000 enthusiastic amateurs, educators, and professionals. In addition to many national services, our 30 Centres offer local programs across Canada.

### The Royal Astronomical Society of Canada Kingston Centre (aka Kingston's Astronomy Club)

We are Kingston's Astronomy Club, a local centre of The Royal Astronomical Society of Canada, founded on June 2nd, 1961. We hold monthly meetings, on the 2nd Wednesday of each month (September-June), via zoom videoconferencing and in person, from 7:00-9:00pm Eastern Time.

\* We do public outreach programs in the form of helping the Cubs and Guides, teachers, Science Fairs and many public Education and Public Outreach events.

\* We help out our members with questions in astronomy and equipment use, and hold private observing sessions, and also with Queen's University Observatory Open House, on the third Saturday of each month, at Ellis Hall, Queen's University.  
<https://www.queensu.ca/observatory/>

\* We support the local Frontenac, Lennox & Addington County Science Fair (FLASF) with a prize in astronomy.

\* We are here to answer your questions on astronomy.

JOIN US!

<https://kingston.rasc.ca/join>

## Board of Directors & Officers 2022-2023

*Honourary President: David H. Levy*  
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The Royal Astronomical Society of Canada Kingston Centre provincially incorporated as a Not-For-Profit Corporation in September 2005 and has been a registered Charity with the Canada Revenue Agency since September 2006.

CRA Registration #827905720RR0001

### Benefits of Membership to the RASC Kingston Centre

#### RASC Central based benefits:

- \* Annual edition of the Observers Handbook
- \* Bi-monthly RASC Journal (digital)
- \* Monthly Bulletin of the RASC (digital)

#### Centre provided benefits:

- \* Monthly Centre Newsletter – Regulus
- \* Weekly social videoconference chat (members and guests only)
- \* Monthly videoconference meetings (open to the public)
- \* Equipment loan program