Skyward

March - April 2026 Edition

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Visit our website at http://www.rascmontreal.org/

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Cover Image: By Russell Fralich. Banff National Park. *Taken with my OM-1 Mark II camera and Panasonic Summilux 12 mm DG f/1.4 ASPH lens at f2.2 and ISO 1600. 15 seconds.*

Skyward

Newsletter of the
Royal Astronomical Society of Canada
Montreal Centre

SKYWARD is published by *Publications Skyward Enr.* for the Royal Astronomical Society of Canada, Montreal Centre. The Montreal Centre was founded in 1918 and is one of 29 centres across Canada dedicated to the advancement of astronomy. Anyone can become a member by applying on our website at https://rascmontreal.org/join-us/.

Note from the Editor

Hi fellow RASCals.

Well, farewell to Winter and Orion, both prominent in Russell Fralich's cover photo. It's been a long one. Perusing our Facebook Group, the observations have been few and far between. A few brave members managed some imaging at Thompson Park on April 11. Just as Orion and the Winter nebulae disappear over the horizon, Marc Ricard brings us but a taste of the upcoming galaxies in Canes Venatici. He claims that there are so many it's hard to know where to start. And if you have trouble spotting the galaxies, Nicole Laporte shared another sample of the Explore the Universe program with the clusters of Spring.

David Levy observes a Lunar eclipse at Mount Palomar with friends and imagines that Russell Porter is accompanying them. He then reflects on the Lunar events of his life from watching the first Moon landing while a counselor at summer camp to the Artemis II mission.

Be sure to read the Public Events, Outreach, Inreach article to learn about all the upcoming events.

Finally, Nader Daou presents part 2 of his citizen science project to classify stars using spectroscopy using a diffraction grating filter.

Did you enjoy this issue? Our contributors appreciate feedback at editor@rascmontreal.org

Ed. mfl

Word from the President

By Morrie Portnoff.

Greetings fellow RASCals,

Spring is here but Old Man Winter just won't give up easily. As I always say, astronomers have to be optimistic that clear warmer nights are around the corner. So, dust off those telescopes and get things ready for a fun observing season. Personally, I treated myself to a new mirrorless Canon EOS R6 Mark II and have been doing some star trail photos (lots of fun) (see next page. Ed.) and plan on doing lots of evenings photographing wide field-of-view landscapes. (Okay, blame me for the questionable weather. As President, the "buck" stops here.)

I would like to take this time to congratulate our former President, Bettina Forget who just earned her PhD from Concordia University in Art Education. Dr. Forget's (that has a nice ring to it) research was on the "…recontextualization of art and science, and how transdisciplinary education may disrupt gender stereotypes". Full details on Dr. Forget's background including her time with our centre can be seen at https://www.bettinaforget.com/vita/ Lets hope we can convince Bettina to grace us with an in person presentation of her work.

We have been long time residents at the Morgan Arboretum, as you all know. Over the years we have been trying to become more of a partner rather than "just" residents. We have supported the Arbo by participating in many of their public and member events. Recently we have been contributing to their monthly bulletin, inviting their members to attend our public events and if they see us at the Bellevue Observatory to drop by to say hello and have a look through the telescope.

Finally, a personal RASC related project I will be starting soon, is to preserve boxes of written documents such as observing journals of past members and other RASC Montreal "historical" documents. The Montreal Centre is the second oldest RASC Centre, going back to 1918, and I am passionate that our history must be preserved and more importantly shared amongst our and all RASC members. So, I will be scanning the boxes of documents which will be posted on the member section of our website as well as on National's website. Once I get going, I will have a dedicated article in Skyward highlighting the progress and interesting hidden finds.

As always, keep an eye out for more announcements of upcoming events over the next weeks and months. I hope to see you at these events. Feel free to introduce yourself if you are new to the Centre. Don't be shy and you will quickly find that we are a very welcoming group of friends.

For any member who wishes to help the Board or an Executive without the "commitment" you can choose a specific project or event and simply help out. We always need volunteers for events and special projects. Warning: Volunteering and helping can become habit-forming, bringing new friendships and skills. There is no known cure for this ailment.

If anyone has ideas or comments, I am always available. Just send me an email at president@rascmontreal.org or approach me at an event.

Clear Skies as always,

MOVIE NIGHT AT THE ASTRO THEATRE

Submitted by: Morrie Portnoff

Our resident cinephiles, David Shuman and Paul Simard are the faces behind these amazing movie nights. As we say, some are “so bad that they are good”. At least a good time is gauranteed as well as David’s famous movie snacks... even the hot peppers (private joke).

For those that have not attended a movie, watch out for the next announcement and join the fun.

Photo by: Morrie Portnoff

The happy audience at the last movie night featuring a classic Mars movie!

By Morrie Portnoff, Canon EOS R6 Mark II

Vice President's Report

By David Shuman, Vice President

Spring is here!

As I write this, Artemis II is about to launch to the moon with our very own Jeremy Hansen.

The SLS Rocket had its struggles this winter, however, with a few new seals and updates, all looks good for a liftoff attempt this week. Historical and exciting, as we will be returning humans to deep space for the first time since 1972.

Alex Stefanescu and I are planning to attend the annual NEAF convention in Suffern, NY. We will report back on all the new goodies that are showcased at that event. For those that don't know what NEAF (**N**orth**E**ast **A**stronomy **F**orum & Space Expo) is, it's the largest telescope/space show in the world where vendors display the latest in equipment, and many top-tier talks are given throughout the weekend. Thousands attend.

We have had our first of four Mars Madness Movie Marathon evenings with the next one set for May 23rd. Much fun is in store. The last two movies will be in the fall.

For our annual Swap-Table event we are trying something a bit different. It will be a public event held at the I.K. Williamson Library at JAC. Hoping to have more people participate in this event to sell and trade equipment.

Fear not, we will still have our annual Pot-Luck dinner at the Arboretum, in conjunction with a members' "Telescope Tune-Up evening", details to follow soon.

Public Events, Outreach, Inreach

***Karim Jaffer**, Coordinator - Public Events*
***Nader Daou**, Director of Outreach*

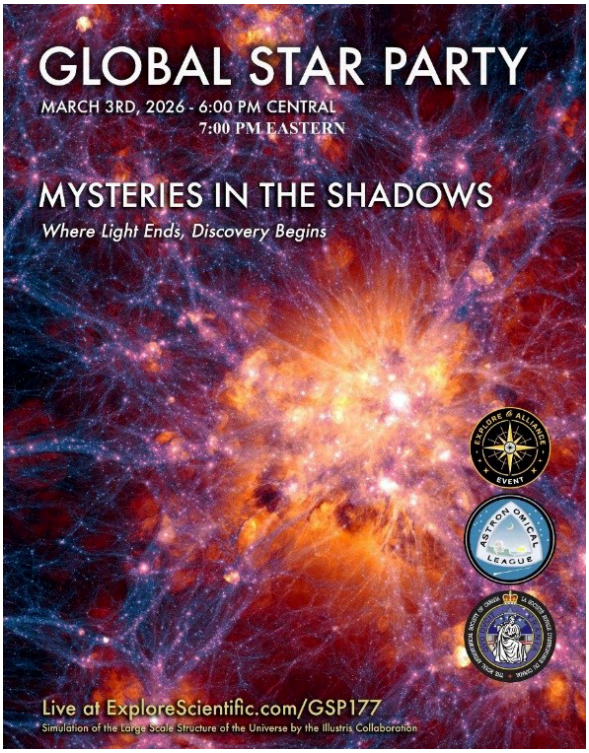
Recent Events

A total lunar eclipse was enjoyed by a large part of North America on Tuesday, March 3rd approaching sunrise, but here in Montreal we were clouded out of the last umbral shadow phases and the total lunar eclipse itself. Even the early umbral phases were only observed through clouds, and with heavy winds.

That said, our astronomy outreach community is truly global and we were able to send in a few images to the Virtual Telescope Project livefeed, originating in Italy:

https://virtualtelescope.eu/

We were also happy to share our brief views and some of the other moon-based observing – including the JAC students first experiences with sketching the Moon, all during that evening's Global Star Party #177!



https://www.youtube.com/live/k-2gwqbWJgY?si=biO_yIGrCkO-X9J6

As a Countdown to Earth Hour 2026, and a launchboard for our RASC Montreal Light Pollution Abatement Committee, we hosted a Public Zoom event on Sunday, March 22nd. After a short intro and overview of our Centre's activities our RASC Montreal Secretary Michael Finkelstein and JAC student Olivia-Anne Yuan gave very informative and motivating presentations about Light Pollution and initiatives to protect Dark Skies. Look for more initiatives by our committee over the coming year and reach out to Michael if you're interested in getting involved.

Following these short presentations, Russell Fralich continued his series of presentations "Finding Dark Skies when you Travel" showcasing his astrophotography on the road with stories and pics from his adventures over the past months. Revisit his

talk on the recorded link below, and join us for the May Library Night for a different aspect on his travels – also being shared during the upcoming RASC General Assembly.

https://www.youtube.com/live/CO3QnaWgOKI

Upcoming Events

Wednesday Apr 22nd 8 p.m. Lyrids Meteor Shower Event

After the success of last year's Lyrids Event we are happy to have another spring meteor shower party with a nearly-first quarter Moon to enjoy as well. JAC Space Club member Sebastian Hasbun Poveda will share a short talk on meteor showers, the Lyrids, and why we do Outreach.

If weather permits we will enjoy nature's fireworks on the field that evening.

Saturday Apr 25th 6 p.m. – 9 p.m.

John Abbott College Agora (15 rue Maple, SAdB)

International Astronomy Day 2026

Telescope Clinic + Astro Garage Sale

This year, our annual Swap Sale goes public! Reserve your table space and volunteer some time to help with a Telescope Clinic as we bring astronomy to the people during IAD 2026.

RASC Montreal members and JAC Space Club students are invited to sign up by April 19th to ensure your spot! https://bit.ly/IAD2026

Any transactions are negotiated and conducted between individual parties. None of the organizers (the RASC Montreal Centre, John Abbott College and the JAC Space Club) can be held liable for any transactions conducted in this event. All responsibilities lie with the seller and buyer.

Saturday May 30th and Sunday, May 31st,

AstroFest 2026

at the Rio Tinto Alcan Planetarium

In addition to the Planetarium's regular programming and numerous festive activities, more than 30 partners including RASC Montreal will celebrate astronomy at this annual event. The weekend will include activities for all ages with booths, workshops, talks, crafts, demos, solar observing during the day and festive nighttime sky observation.

- **Wednesday April 22nd, Morgan Arboretum,** Lyrids Meteor Shower, public event;
- **Saturday April 25th, John Abbott College,** International Astronomy Day, public event;
- **Wednesday April 29th, I.K. Williamson Library,** Members' Library Night, Observing Double Stars;
- **Saturday May 2nd, Morgan Arboretum,** Members' Informal Clubhouse;
- **Wednesday May 6th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday May 9th, Thompson Park,** Members' Observing / Zoom Clubhouse if NoGo;
- **Wednesday May 13th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday May 16th, Wooly Woods,** Members' Observing;
- **Wednesday May 20th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday May 23rd, Morgan Arboretum,** Members' Informal Clubhouse, Movie Night, Mars Madness;
- **Wednesday May 27th, I.K. Williamson Library,** Members' Library Night;
- **Saturday May 30th -Sunday May 31st, Rio Tinto Planetarium,** Astrofest;
- **Wednesday June 3rd, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday June 6th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Wednesday June 10th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday June 13th, Wooly Woods,** Members' Observing;
- **Wednesday June 17th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday June 20th, Morgan Arboretum,** Star Party, Public Event;
- **Wednesday June 24th, Morgan Arboretum,** Members' Informal Clubhouse;
- **Saturday June 27th, Morgan Arboretum,** Members' Informal Clubhouse.

Watch our website for possible updates at https://rascmontreal.org/our-calendar/.

Explore the Universe: Spring DSO's

***By Nicole Laporte**, Director of Membership Liaison,*

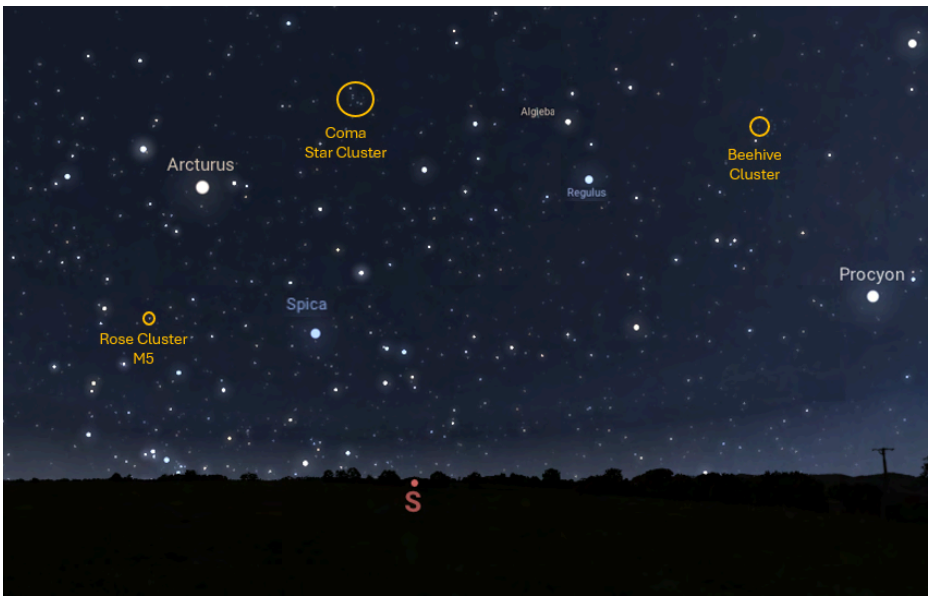


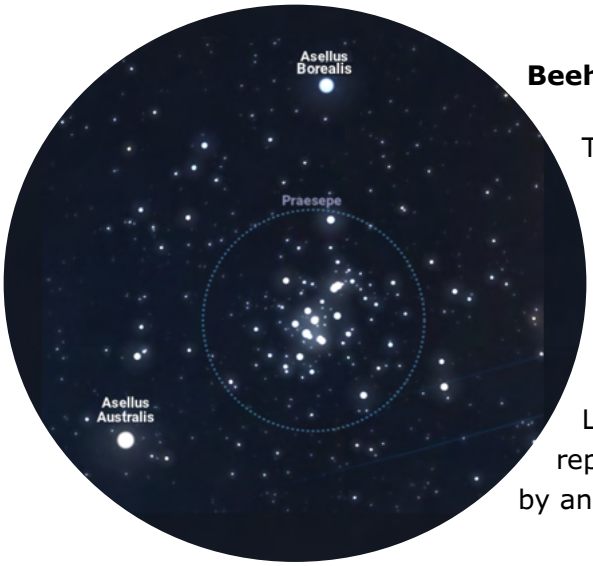
Image source: Stellarium-web.org

The spring season offers warm evenings and a vast variety of deep sky objects for stargazers.

Three of the brightest celestial gems that are visible with binoculars from suburban skies and part of the RASC Explore the Universe Observing Program (ETU)[1] target list consists of:

- Beehive Cluster (M44)
- Coma Star Cluster
- Rose Cluster (M5)

[1] *RASC Explore the Universe Observing Program, https://rasc.ca/explore-universe*



Beehive Cluster
Image source: Stellarium.org

Beehive Cluster

The Beehive Cluster is also known as Praesepe and Messier M44 is visible to the unaided eye in dark skies. The open star cluster is three time the size of the full moon.

The name Beehive is due to the many star that appear as a swarm of bees when viewed through a telescope or binoculars. The older name Praesepe means "manger" in Latin and the stars Asellus Borealis and Asellus Australis represent the Northern and Southern donkeys, as interpreted by ancient stargazers.

Star hopping to the Beehive Cluster

The star Pollux in the constellation Gemini and star Regulus in the Leo constellation are useful signposts for hopping to the Beehive Cluster.

Draw a straight line between Pollux and Regulus and at approximately halfway between them find the dimmer stars Asellus Borealis and Asellus Australis. The Beehive Cluster is between Asellus Borealis and Asellus Australis.

Image source: Stellarium-web.org

Coma Star Cluster

The Coma Star Cluster is found in the Coma Berenices constellation adjacent to the Leo constellation. The open star cluster is bright enough to be seen with unaided eyes and is approximately 4.5 degrees in diameter, which is the equivalent to the diameter of 9 full moons.

Binoculars are well suited for viewing the large cluster. Most telescopes have a field of view that is too narrow, even at low magnification. However, a short focal length telescope, such as 360mm with a 40 mm eyepiece gives a magnification of 9x, which allows for a field of view wide enough to view the entire cluster.

Coma Star Cluster
Image source: Stellarium.org

Queen Berenices lock of hair
Image source: Stellarium.org

Coma Star Cluster

In classic mythology, the star cluster represents a flowing lock of hair from Berenices, a third century BCE, Egyptian Queen. Another interpretation is that the star cluster is the tuft of hair at the end of Leo the lion's tail.

Gamma Berenices is also known as Al Dafirah, which means the braid, is a 4.3 magnitude orange coloured star approximately 170 light-years from Earth. Al Dafirah is in the foreground in relation to the Coma Star Cluster that is approximately 240 light-years away from Earth.

Star hopping to the Coma Star Cluster

The Coma Star Cluster is located above halfway point between the bright stars Arcturus in Boötes and Regulus in Leo.

If the skies are dark enough to see the entire outline of the lion in Leo, the Coma Star Cluster is the tip of the tail.

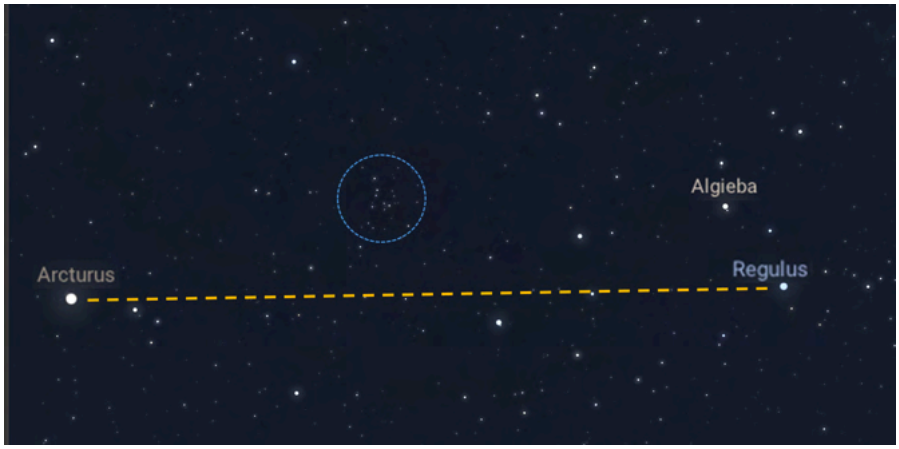


Image source: Stellarium-web.org

Rose Cluster
Image source: Stellarium-web.org

Rose Cluster (M5)

Messier 5 (M5) is a bright magnitude 5.7 globular cluster in the Serpens constellation. The bright cluster is also known as the Rose Cluster due to what appear to be of rose petals radiating outwards. The Rose Cluster is visible to the unaided eye in dark skies and appears as a smudge. In suburban skies a pair of binoculars is required to locate the cluster, and a large telescope will show individual stars.

The Rose Cluster appears to observers on the Earth as approximately half the diameter of the Moon. The actual size is massive, approximately 165 light-years in diameter, however it is also very far,approximately 245 000 light-years away.

Star hopping to the Rose Cluster

The Rose Cluster is located above the star Zubeneschamali (Beta Librae) approximately one fourth of the way toward the star Princeps (Delta Boötes).

At first glance, there appear to be two stars adjacent to each other. However, upon a closer look the top fuzzy star is actually a globular cluster shaped like the petals of a rose.

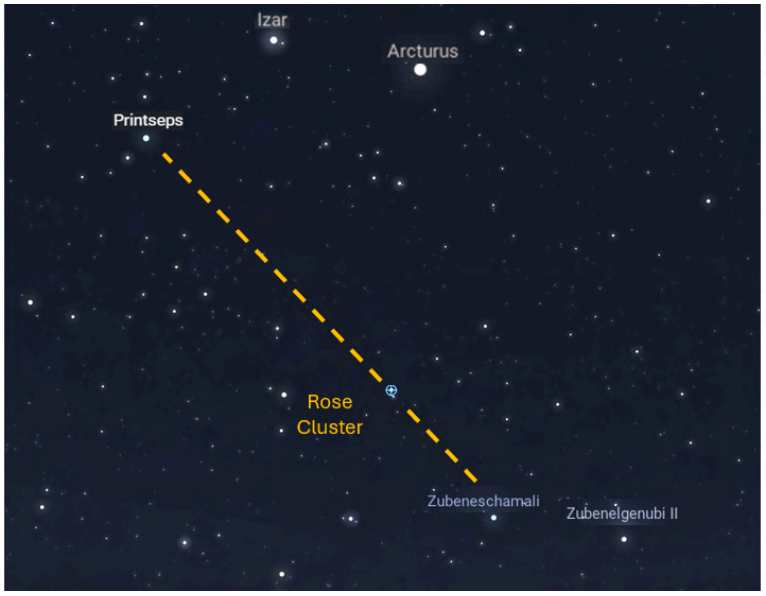


Image source: Stellarium-web.org

Learning the Spring Constellations

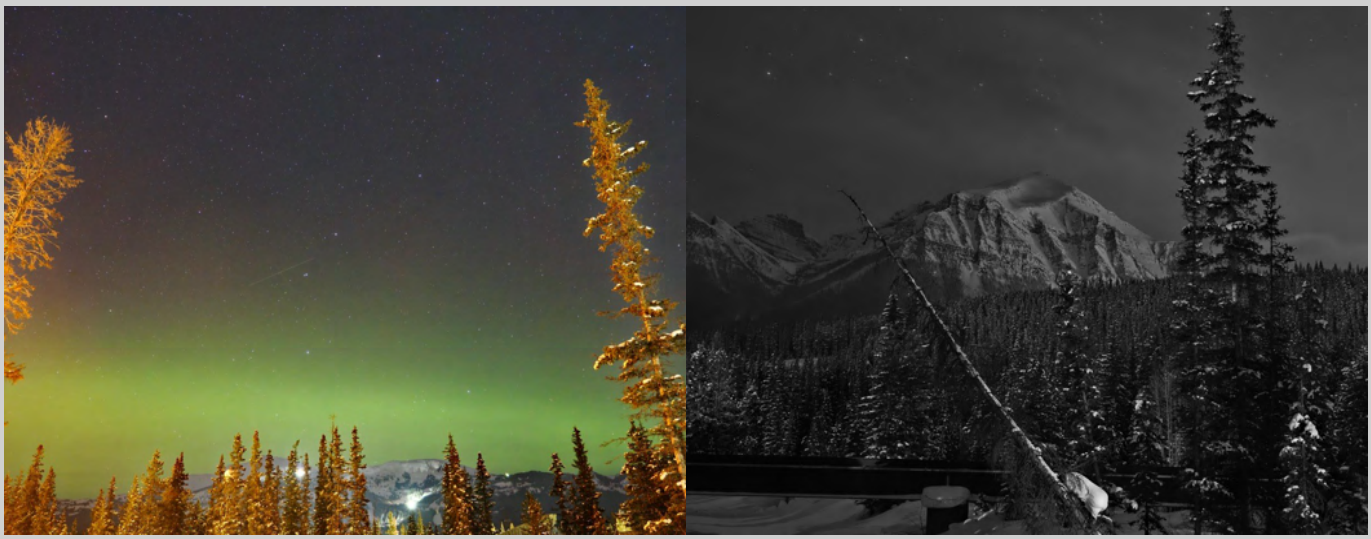
Star hopping to find the three ETU spring deep sky objects, is a good way to learn how to navigate the night sky and learn the constellations.

Springtime astronomy is often associated with the constellation of Virgo and the many galaxies accessible from dark sky sites. However, the constellations of Leo, Cancer, Boötes, the Serpent, and Libra guide the way toward bright and delightful clusters accessible to stargazers from suburban skies.

As the spring constellations begin to appear in the night sky, take a pair of binoculars and step outside to gaze at the celestial wonders above.

Explore the Universe is open to all. See the program at https://www.rasc.ca/explore-universe

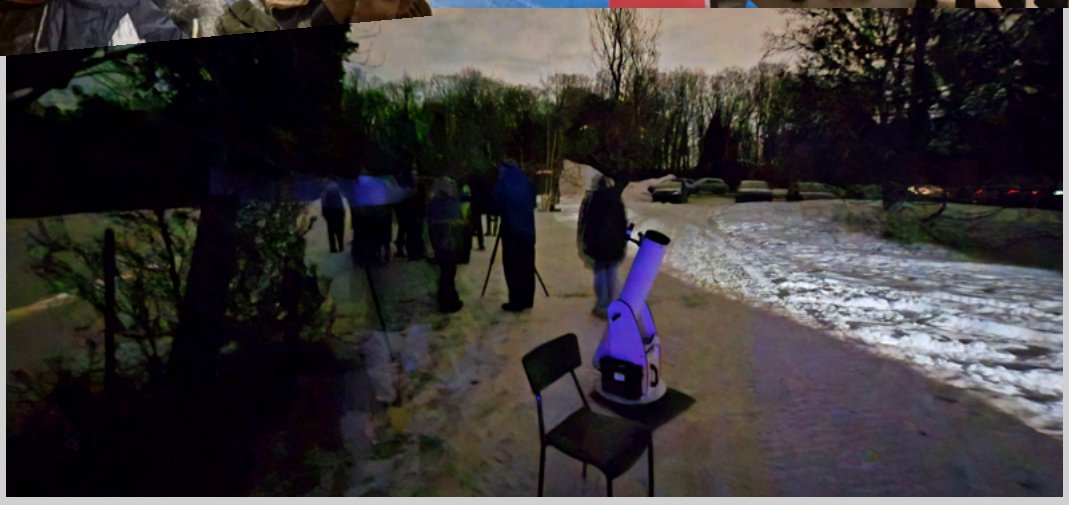
Explore the Moon is an introductory lunar observing program open to RASC members. See the program at https://www.rasc.ca/explore-universe



***By Russell Fralich** in Banff National Park*

Ste-Anne de Bellevue Astronomy event hosted by Nicole Laporte at the Morgan Arboretum.

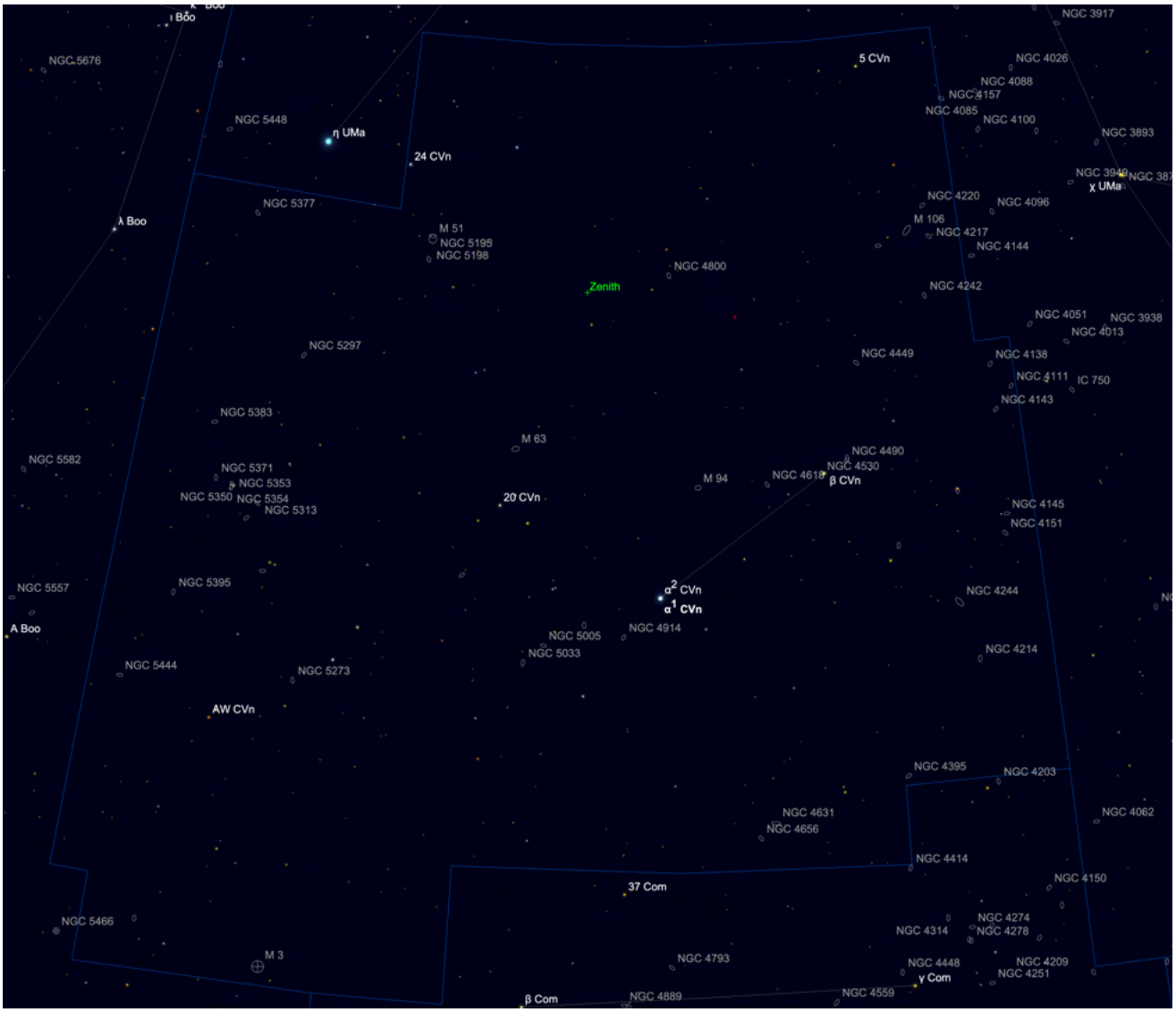
Photos by Frank Tomaras.



Canes Venatici

By: Marc Ricard

This inconspicuous constellation nestled between Ursa Major and Boötes glides high overhead during spring nights. Canes Venatici first appeared in Johannes Hevelius's star atlas, *Firmamentum Sobiescianum*, published posthumously by his second wife in 1690. He depicted the constellation as two dogs, Asterion and Chara, pursuing the great bear. Unbeknownst to them, this little region holds a wide assortment of galaxies of various shapes and sizes within reach of amateur instruments. This tour includes the five objects discovered by Charles Messier and his collaborator Pierre Méchain, as well as 11 of my favourite NGC objects discovered by William and Caroline Herschel.

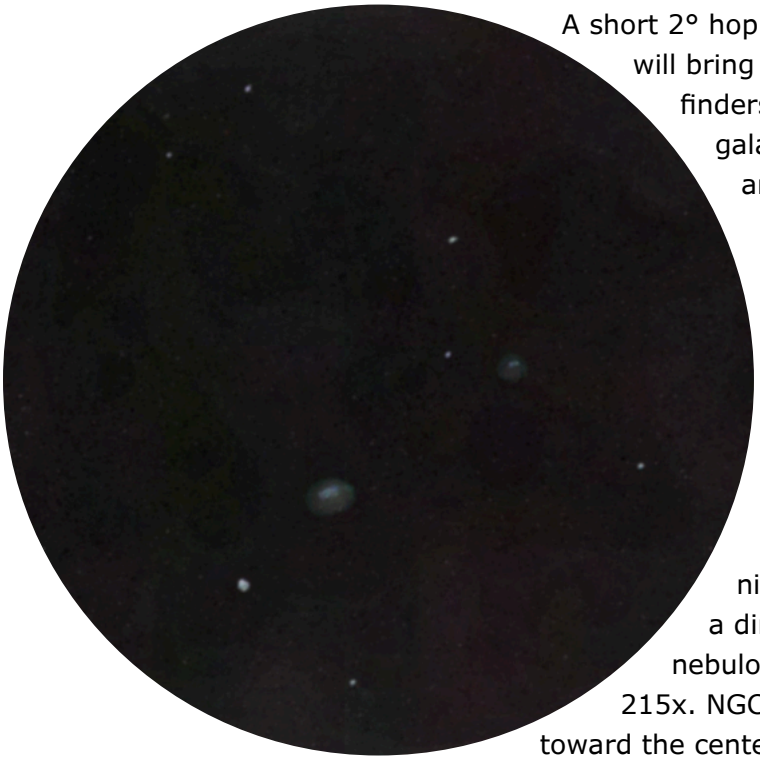


Canes Venatici finder chart courtesy of SkySafari Pro.

M94 From the Digitized Sky Survey, ©CalTech & STScI

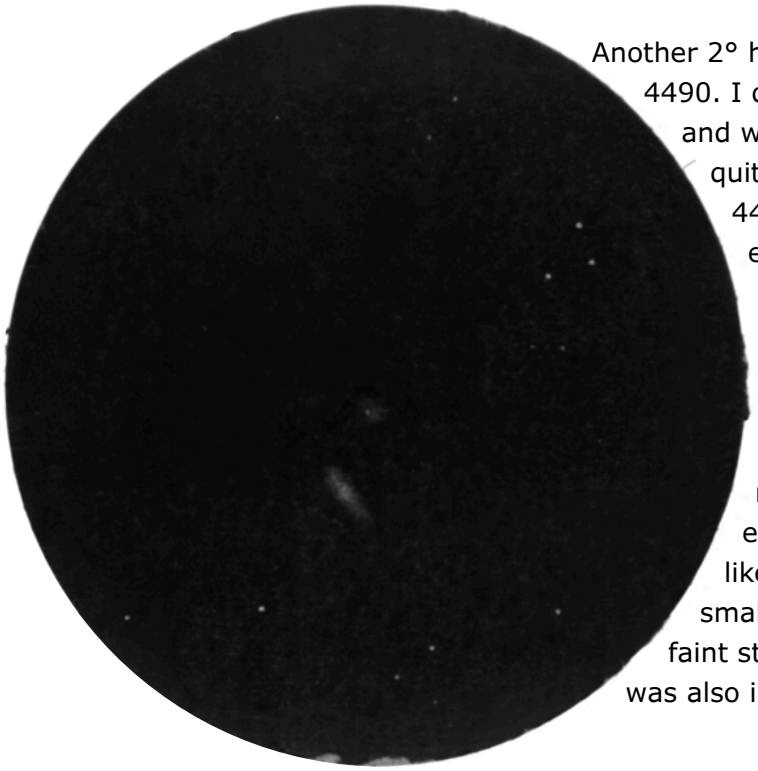
Let's start by locating the magnitude 2.9 α star known as Cor Caroli. Its mag 5.5 pale-yellow companion should be easily split in a small refractor, as it's just visible in my mounted 16x70 mm binoculars. The 8th magnitude galaxy M94 lies roughly 3° north of Cor Caroli. It's a small, slightly elongated fuzzy spot in my 16x70 mm from my home in the Laurentians. In my 15-inch, this face-on spiral has well-defined edges and a bright core at 127x, and I catch glimpses of its nucleus at 217x that is not seen in this 20x20 arcminute Digitized Sky Survey[1] image. It was discovered by Charles Messier's collaborator, Pierre Méchain, on March 22nd, 1781.

[1] These images were made using the ESO Online Digitized Sky Survey at https://archive.eso.org/dss/dss. See copyrights at https://archive.eso.org/dss/dss-copyrights.html



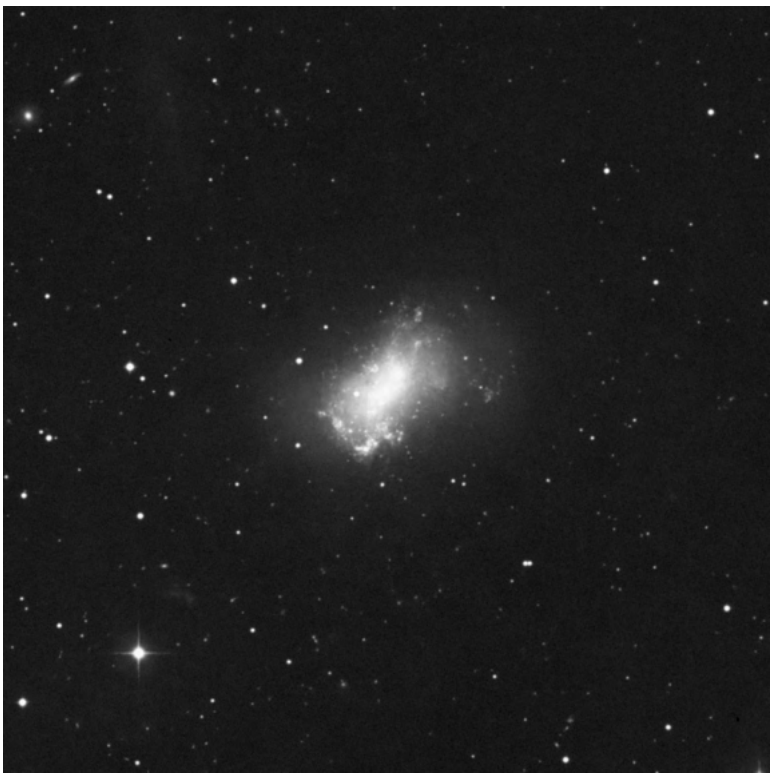
NGC 4618 & NGC 4625

A short 2° hop toward β Canum Venaticorum (β CVn for short) will bring NGC 4618 and NGC 4625 into the field of your finderscope. I first observed this ghostly pair of galaxies from Ormstown on a moon-free but humid and buggy June night in 1994 with fellow members Doug Middleton and Frank Tomaras. I drew the sketch you see here and wrote in my logbook that NGC 4618 was elongated 3 arcminutes NNE-SSW and featured a distinct core and stellar nucleus in my C8 at 146x. Smaller, fainter NGC 4625 was visible with averted vision near a mag 12.5 star. NGC 4618 was an unusual sight when I re-observed it through my 15-inch on a cool, moon-free and bug-free April night in 2021. Its large central bar was encircled by a dim, narrow area and then by a large, faint nebulous ring, prominent along its southeastern side at 215x. NGC 4625 was small, round and gradually brighter toward the center at 135x. William Herschel discovered this galaxy on April 9th, 1787, through his 20-foot reflector with its 18.7-inch aperture, but recorded it as two objects (H1781 and H1791). His description reads: "*Two, the most north considerable or very bright. The most south pretty bright. Their nebulosities run into each other.*" Halton Arp included this one-armed spiral in his "*Atlas of Peculiar Galaxies*", a collection of 338 unusual objects published in 1966.



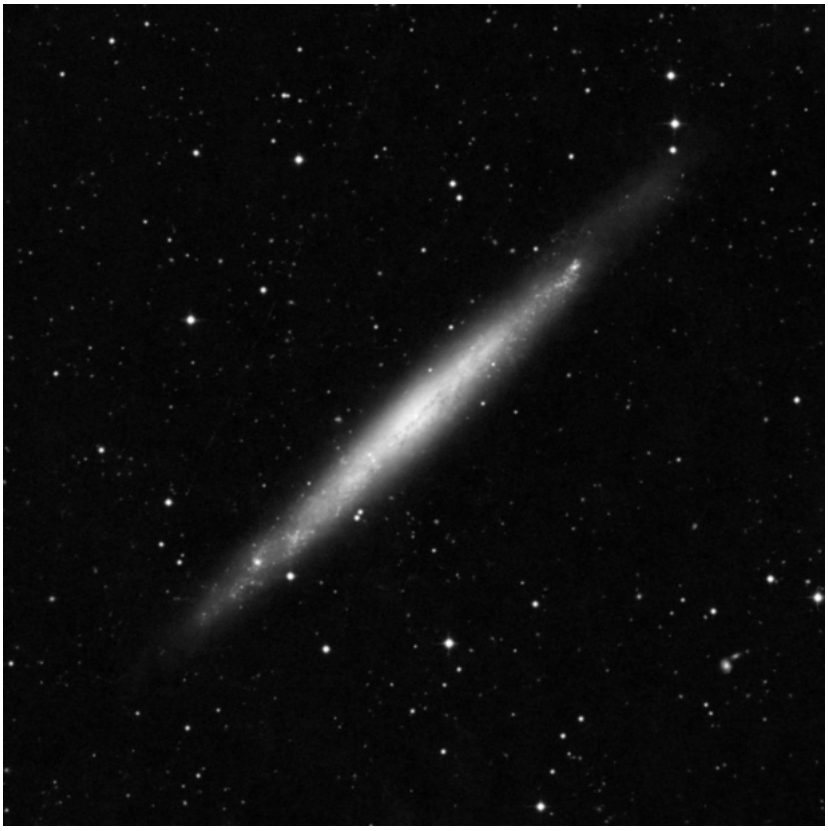
Another 2° hop westward will bring you to NGC 4485 & NGC 4490. I drew this sketch on the same June night in 1994 and wrote: “These two are very attractive at 145x and quite bright; Frank observed them in his 4-inch. NGC 4490, the larger and brighter of the two, is elongated roughly 5 arcminutes E-W. Prolonged viewing reveals a wealth of detail.” I re-observed them through my 15-inch on a June night in 2024 and noted that they’re a stunning sight at 127x. NGC 4490 is a beautiful edge-on spiral with a soft envelope that brightens along its major axis to a round core. The envelope's eastern tip is tapered at 217x, and a small, coma-like appendage is visible at 361x. NGC 4485 is a small, round galaxy that gradually brightens toward a faint stellar nucleus. This interacting pair of galaxies was also included in Halton Arp’s collection.

NGC 4485 & NGC 4490



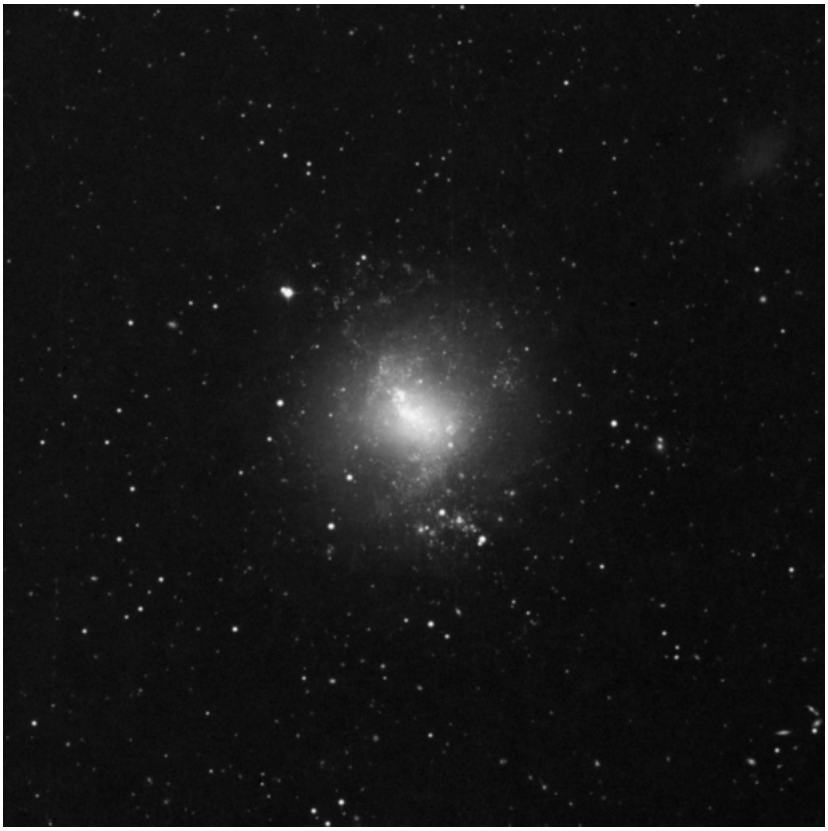
NGC 4449 From the Digitized Sky Survey, ©CalTech & STScI

NGC 4449 is a short 2½ degree hop northward from NGC 4490. Unfortunately, I didn’t sketch this mag 9.6 galaxy on that June night in 1994, but I wrote in my logbook that it measured 3x1 arcminutes in my C8 at 145x, and four brighter regions were visible at 220x. I re-observed it through my 15-inch on a comfortable but windy March night thirty years later and noted that its diffuse envelope measured 5 arcminutes and surrounded a large oval core at 127x. Increasing the magnification to 217x revealed a collection of large clumps, keeping me glued to the eyepiece for 10 minutes. Amateur images of this starburst galaxy reveal several pink HII regions and star clouds. High-resolution wide-field images taken with the 8 m Subaru telescope in 2012 resolved a stream of red giant stars from a massive dwarf galaxy involved in a “stealth” merger with NGC 4449, which may be triggering its current burst of star formation. (*DWARFS GOBBLING DWARFS: A STELLAR TIDAL STREAM AROUND NGC 4449 AND HIERARCHICAL GALAXY FORMATION ON SMALL SCALES, David Martínez-Delgado et. al. The Astrophysical Journal Letters, 748:L24 (6pp), 2012 April 1*).



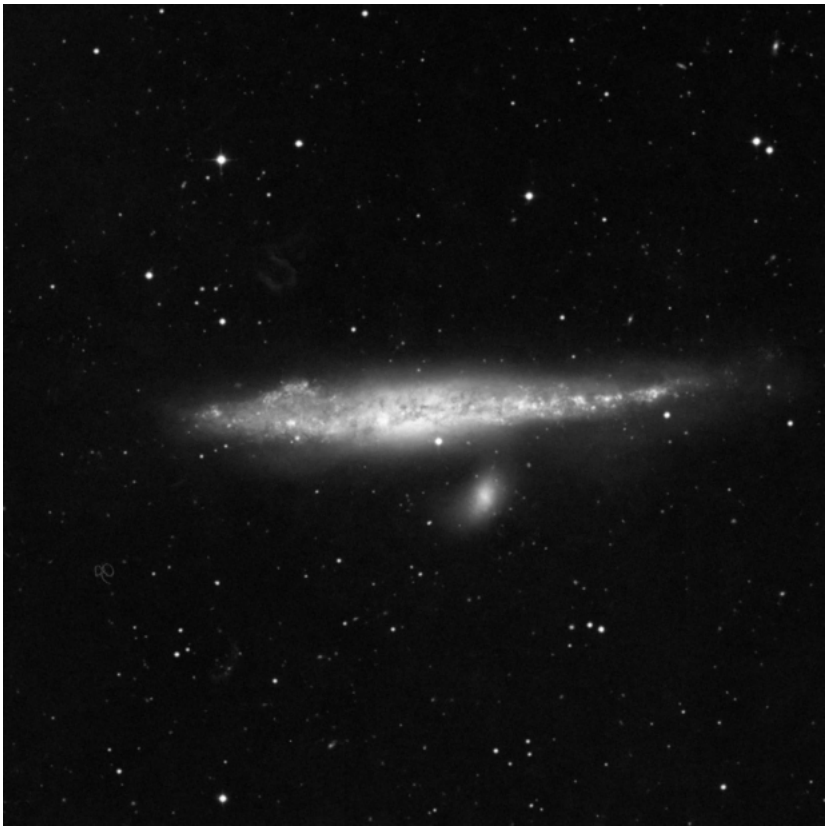
NGC 4244 From the Digitized Sky Survey, ©CalTech & STScI

Five degrees southwest of β Canum Venaticorum, past the 5th magnitude star 6 CVn, lies the Silver Needle galaxy, NGC 4244. When I observed this large mag 10.4 edge-on, on a transparent June night two years ago, it filled half the 27 arcminute field of my eyepiece, resembling a lightning bolt frozen in time. At 217x, its mottled envelope had well-defined edges, and a tapered northeast tip that brightened slightly toward a boxy central bulge measuring ¼ of the galaxy's length. NGC 4244, NGC 4214 (see below), and NGC 4449 belong to the M94 group, which includes 15 galaxies ranging from magnitude 9 to 14.2 and located about 13 million light-years from us.



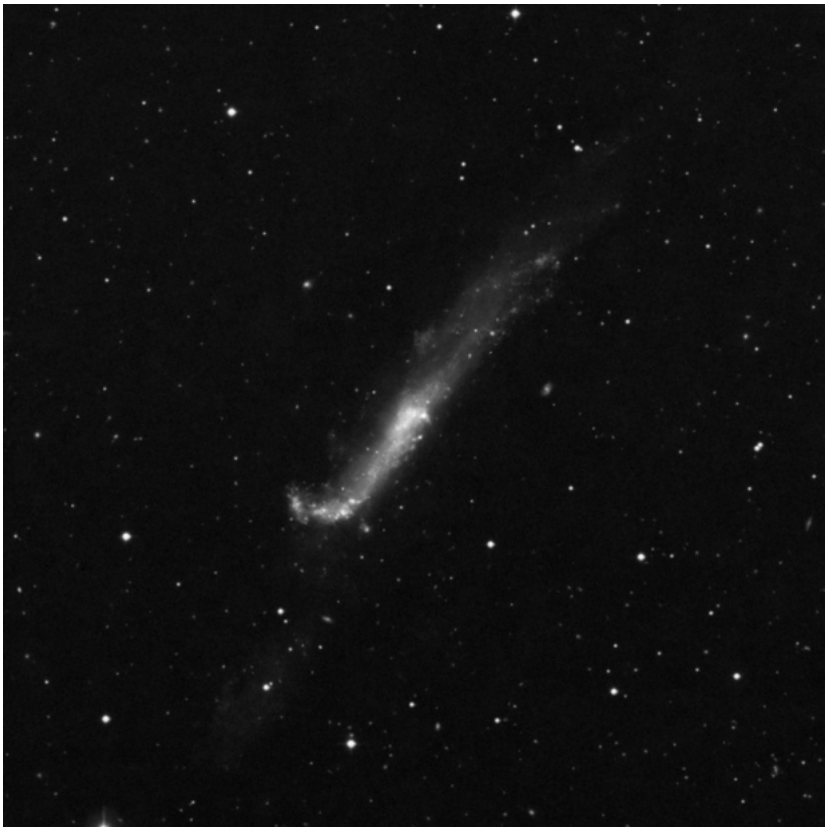
NGC 4214 From the Digitized Sky Survey, ©CalTech & STScI

A short 1½° hop southward will bring NGC 4214 into view. This mag 9.8 galaxy is a fascinating sight in my 15-inch. It's elongated NW-SE, with one end pointing toward a mag 11 star, and the other to a couple of mag 14 stars. The centre of the envelope brightens to a thin, elongated bar, and I catch glimpses of what look like two stellar nuclei but are in fact two star-forming regions near the centre of the galaxy. This is a starburst galaxy like NGC 4449. An image taken with the Hubble Space Telescope in 2011 revealed enormous HII regions in the center of the galaxy with large cavities blown clear of gas.



NGC 4631 From the Digitized Sky Survey, ©CalTech & STScI

NGC 4631, the Whale galaxy, is a fascinating object. It's located midway between Cor Caroli and Melotte 111, the splash of stars that once represented Leo's tail but that was then renamed for Queen Berenice's hair. My 15-inch reveals a bright, braided streak of light, tapered at one end, and broader at the other. Its mottled envelope resembles M82 and measures 14 arcminutes, over half the diameter of my field at 217x. It brightens very slightly toward a small, pale core and a faint stellar nucleus near a 12th mag star. The faint, little elliptical galaxy NGC 4627 lies 3 arcminutes south. This interacting galactic pair is listed as 281 in Halton Arp's collection.

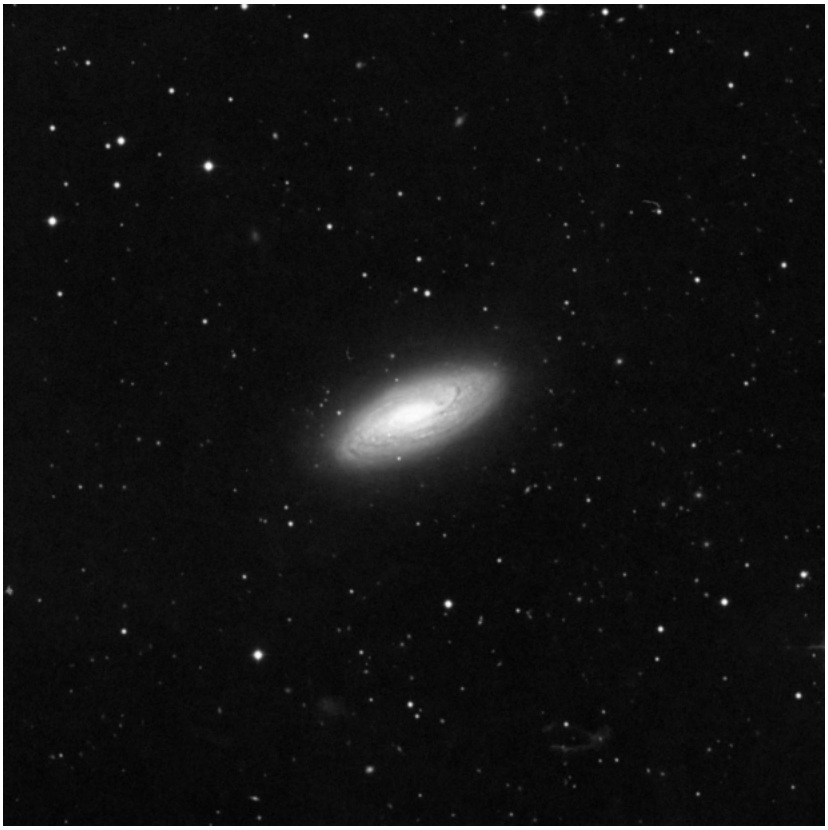


NGC 4656-4657 From the Digitized Sky Survey, ©CalTech & STScI

The Hockey Stick galaxy has two NGC classifications. The longer portion is catalogued as NGC 4656. It resembles a nearly edge-on galaxy with a bright but offset core at 217x, since the fainter portion seen in this DSS image is not visible in my 15-inch.

The small, curved portion is catalogued as NGC 4657. It's a bright patch with a few stellar-like spots that are best seen at 361x.

Current estimates are that NGC 4631 and NGC 4656 are only 225,000 light-years apart. The jury is still out as to whether they are an interacting pair. However, visually, a mere 32 arcminutes separates them, making them a photogenic pair.



NGC 5005 From the Digitized Sky Survey, ©CalTech & STScI

To locate NGC 5005, follow a line starting at β CVn and extend it 3° SE past α CVn. You'll find this mag 9.8 galaxy between two 6th magnitude stars. I observed it on a brisk but steady April night in 2021, accompanied by the drumming of a ruffed grouse. This highly inclined spiral was elongated 4 arcminutes NE-SW with a 2 arcminute bulge and a 12th magnitude stellar nucleus in my 15-inch.

NGC 5033 From the Digitized Sky Survey, ©CalTech & STScI

NGC 5033 lies roughly ¾° southeast of NGC 5005. Only the brighter 4 arcminute central region of this spiral is visible in my 15-inch. It brightens into an elongated core and a stellar nucleus. A 14th magnitude star lies near the NW tip of the core. A mere 40 arcminutes separates NGC 5033 from NGC 5005. The two would make a nice image through an 80-105 mm refractor.

M63 From the Digitized Sky Survey, ©CalTech & STScI

The spiral galaxy M63 lies 5° northeast of α Canum Venaticorum above a small, wide triangle formed by the fourth and fifth magnitude stars 23 CVn, 20 CVn and HR 4997. It's a faint patch in my 16x70 mm with a 9th mag star visible near its western tip. When I observed it through my 15-inch on a cool April night in 2021 with my son Pierre, its bright, oval bulge was surrounded by mottled nebulosity at 135x. The envelope reached the 9th magnitude star at 215x, and its stellar nucleus was obvious. The galaxy's tilt gave it a 3D appearance, making it a stunning sight.

M51 From the Digitized Sky Survey, ©CalTech & STScI

From η Ursa Majoris, the star at the tip of the great bear's tail, slowly descend 3½° SW, and M51 should appear in your finderscope.

In my 16x70 mm, M51's faint glow surrounds its minuscule core, with NGC 5195's faint core lying along the northern edge of M51. Through my C8, NGC 5195 was more condensed and appeared brighter than M51 on a May night in 1992, when a 5-day-old moon in Gemini brightened the sky over Ormstown. The M51 core was surrounded by nebulosity yet only small arcs of the spiral arms were glimpsed. In my 15-inch M51 is an awe-inspiring sight. Two spiral arms wrap around M51's core at 189x. One extends northward to NGC 5195 and the other southward.

M106 From the Digitized Sky Survey, ©CalTech & STScI

M106 is located 6½° NNW of β CVn. This mag 8.4 galaxy is a soft oval glow that brightens to a little core in my 16x70 mm. Through my C8, it's a large, slightly mottled oval with diffuse edges and a very condensed core. A dust lane is suspected along the northwest edge of the envelope.

Through my 15-inch, its core is a thin little streak with a stellar nucleus. A bright patch lies at the end of the northwest spiral arm near a 15th mag star and another bright patch lies at the end of the grainy southeast spiral arm.

Seven NGC galaxies brighter than mag 14.7 lie within 1° of M106 in a field that includes several mag 7-8 stars. This would make a nice image through an 80-105mm refractor.

M3 captured from Pointe-Claire with my QSI 683 & RC-8.

Charles Messier discovered the cluster that we now call M3 on May 3rd, 1764. He described it as round, with a brilliant centre and no stars visible, which is how this 6th magnitude globular appears in my mounted 16x70 mm binoculars. My 6-inch resolves a dozen stars along the edges of the core at 220x. In my 15-inch, it's a tantalizing sight at 217x, with faint pinpricks of light visible along the front of the core and the cluster filling nearly half the 32 arcminute field of view. M3 lies along the southeast edge of the constellation. To locate it, try sweeping your binoculars or the finder of your scope slowly from Arcturus to α Canum Venaticorum. It forms a right-angle triangle with a 6th and a 7th mag star.

Clear skies!

See a table of Marc's targets in Canes Venatici on the next page. Ed.

Name	Magnitude	Diameter / Separation	Class	Distance ly	Right Ascension	Declination
α	2.8 / 5.6	19 arcsec		100	$12^h\ 56^m$	38° 19′
M94	8.2	14.4 x 12.1 arcmin	(R)SA(r)ab	16 million	$12^h\ 51^m$	41° 07′
NGC 4618	10.8	4.2 x 3.4 arcmin	SB(rs)m	21 million	$12^h\ 42^m$	41° 09′
NGC 4625	12.4	1.6 x 1.4 arcmin	SAB(rs)m pec	30 million	$12^h\ 42^m$	41° 17′
NGC 4485	11.9	2.3 x 1.6 arcmin	IB(s)m pec	29 million	$12^h\ 31^m$	41° 42′
NGC 4490	9.8	6.3 x 3.1 arcmin	SB(s)d pec	25 million	$12^h\ 31^m$	41° 39′
NGC 4449	9.6	6.2 x 4.4 arcmin	IBm	13 million	$12^h\ 28^m$	44° 06′
NGC 4244	10.4	16.6 x 1.9 arcmin	SA(s)cd sp:	14 million	$12^h\ 17^m$	37° 49′
NGC 4214	9.8	8 x 6.6 arcmin	IAB(s)m	10 million	$12^h\ 16^m$	36° 20′
NGC 4631	9.2	12.8 x 2.4 arcmin	SB(s)d sp	30 million	$12^h\ 42^m$	32° 32′
NGC 4656	10.5	10.0 x 1.8 arcmin	SB(s)m pec	30 million	$12^h\ 44^m$	32° 09′
M63	8.6	12.6 x 7.2 arcmin	SA(rs)bc	27 million	$13^h\ 16^m$	42° 02′
NGC 5005	9.8	5.8 x 2.8 arcmin	SAB(rs)bc	75 million	$13^h\ 11^m$	37° 03′
NGC 5033	10.2	10.7 x 5.0 arcmin	SA(s)c	40 million	$13^h\ 13^m$	36° 36′
M51	8.4	11.2 x 6.9 arcmin	SA(s)bc pec	31 million	$13^h\ 30^m$	47° 11′
M106	8.4	18.6 x 7.2 arcmin	SAB(s)bc	25 million	$12^h\ 19^m$	47° 18′
M3	6.3	18 arcmin	CC6	10,000	$13^h\ 42^m$	28° 23′

Table of Marc's targets in Canes Venatici

Of Mario Motta, Jean Mueller, Russell Porter, a Lunar Eclipse and Me

By David H. Levy.

On the morning of March 3rd, 2026, a total eclipse of the Moon further darkened the sky over all of the world that was in night. The eclipse was fabulous. During its total phase, the Moon was not really its usual coppery red colour but more of a greyish-brown. On the Danjon luminosity scale, I gave it about a 1.5 on the scale of 0 to 5. I was lucky to view this eclipse during the inaugural session at the San Diego Astronomical Association's newest acquisition. I do not recall an eclipse that was more fun than this one. And I have viewed 104 eclipses ranging from penumbral lunar to total solar.

On March 1st of this year, Dr. Mario Motta, a nationally known cardiologist and an expert on the history of Stellafane and light pollution, and I, travelled to San Diego, in order to view the total lunar eclipse and to meet Jean Mueller. We wanted to see it from the American west coast, where we could view the entire predawn affair with the Moon well above the horizon. We were viewing it with Jean, world renowned as an observer at Palomar Mountain Observatory. She has discovered 15 comets, 13 asteroids, and 107 supernovae in far-off galaxies. The combined accomplishments of these two viewers of the night sky are truly spectacular. But what was even better were her stories about life at Palomar, her work there at the Samuel Oschin 48-inch on the Second Palomar Observatory Sky Survey, and later at the 200-inch. She spoke to a group that was unequivocally spellbound. Jean was delightful. Mario built and uses a wonderful 32-inch f/6 telescope which peeks far into the Universe from the sky above the eastern United States.

Mario is an accomplished deep-sky observer, and has spent a lifetime learning about and living the history of his beloved Stellafane. In fact, during the drive westward we were also driving back in time and there, was Russell Porter, sitting in the back seat, sharing tales and laughing with us.

As we waited for the first penumbral tinge of Earth shadow to touch the Moon, Mario admitted that he "hates" the Moon because it prevents him from more enjoyment of his cherished remote galaxies, clusters, and other deep sky objects. He and I enjoyed a verbal joust about the Moon right during the eclipse! I love the Moon, but he appeared to be winning until I offered a comeback. It was from Leslie Peltier's *Starlight Nights,* where Leslie introduced me to a nursery rhyme. We ended up turning this into a standing joke to which we laughed all the way back to my Arizona home.

"Lady Moon, Lady Moon, where are you roving?"
"Over the sea, over the sea."
"Lady Moon, Lady Moon, whom are you loving?"
"All that love me, all that love me."

As joyous as the total eclipse was, our visit to Palomar the afternoon before the eclipse was truly magical. Again, Russell Porter was right with us. Jean recalled her many years there, first as an observer for the Second Palomar Observatory Sky Survey, then operating the mighty 200-inch telescope.

While there I finally got to complete a dream. In my 77 years I have delivered more than 3150 lectures. I like to imagine that the very first lecture was at the opening of the great telescope. Mueller, as versed in the history of Palomar as Motta is with Stellafane, told us that the telescope was dedicated on June 3rd 1948. Was my first lecture (Lecture zero) delivered that day? I was twelve days old. On this day, 77 years later, I finally turned that into a reality. I gave a brief lecture near the wonderful 200-inch mirror, and another lecture at the visitor centre near the 18-inch Schmidt camera which I used with Gene and Carolyn Shoemaker for seven wondrous years.

Enter Russell Porter, who seemed to accompany us throughout this visit. We got to have a really special visit with the person who designed the telescope and whose sketches are among the finest in the world. Even though Russell Porter died before Mario was born, and when I was but a year old, it felt as though he had been recalled to life for us. Had he been alive I would have asked him, "In Berton Willard's biography of your life, he explained how you accepted Hale's offer of a position designing the 200-inch telescope. How many seconds did it take you to accept this life-changing proposition?"

"Less than 3.14159 seconds," Porter might have replied with his trademark wide grin.

Porter's original sketched design needed revision. I envisage the meeting where that design was turned down, and what the other committee members said about it. "We reject this design, but we love your sketches; they are splendid, magnificent!" Porter's later design was accepted. In a stroke of genius, he took his now-famous design of a small garden telescope with its split-ring mounting, and upgraded it to the horseshoe mount we know and love.

What might have surprised the Palomar engineers in Porters time was the elegance of the 200-inch design. It was and still is simplicity itself. The split-ring of its design descends directly from the split-ring he used in his wonderful garden telescope; I love to think of the mighty 200-inch as being the largest

Porter garden telescope ever built. Finally, in the hallway surrounding the telescope are mounted many of Porter's sketches, among the finest artistry I have ever seen. But according to Jean, Russell Porter did much more than design the Hale telescope. He also chose the locations of the buildings that dot the Palomar mountaintop, from observatories to the offices and the houses. This mountain belongs to Russell Porter.

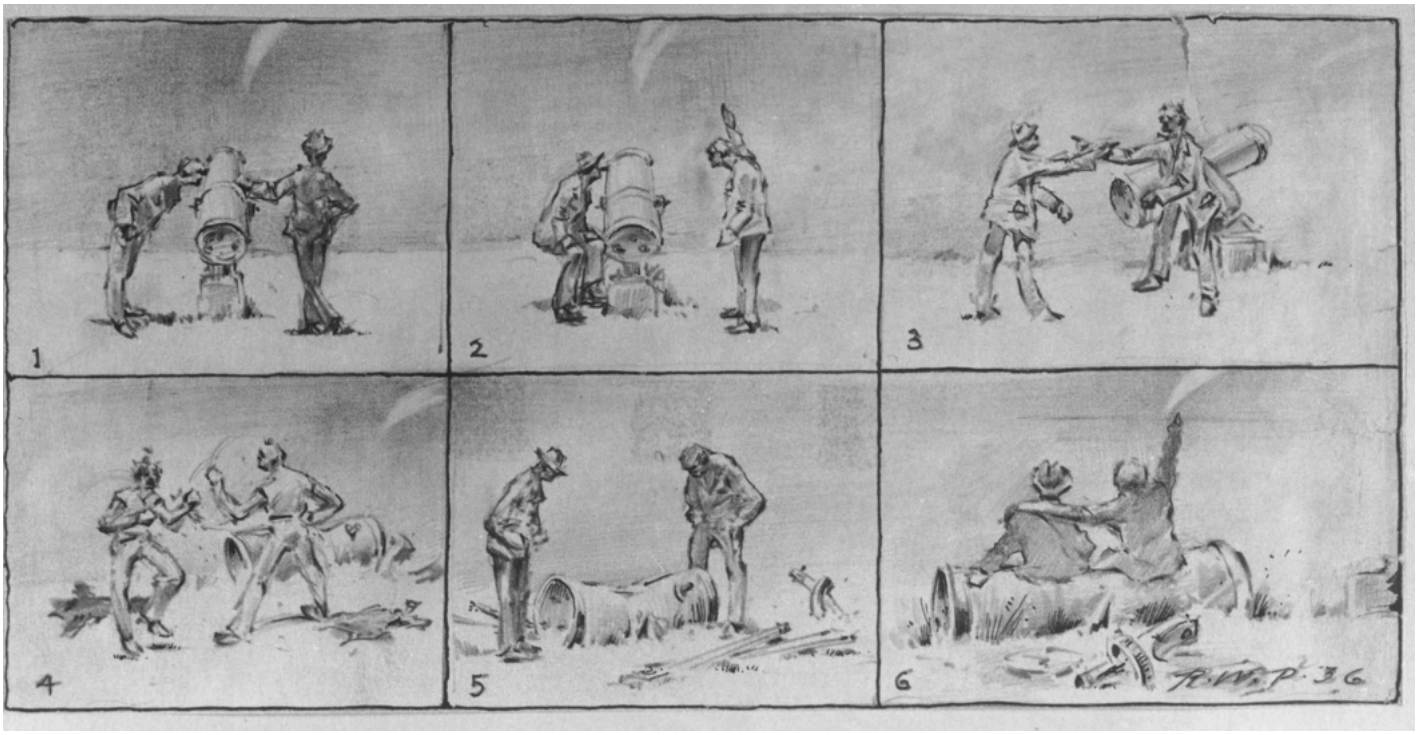
The only negative aspect of Porter's move to Palomar was the possible loss of his close friends at Stellafane, the amateur telescope makers event he founded in 1925. But according to Mario, Porter managed to return to his cherished Stellafane every summer. In my lifetime, I have been privileged to

visit Stellafane many times, and once a month for seven years, I considered Palomar my second home. On this visit, the place displayed its rich times past like a brilliant full Moon, after the eclipse, lighting up the sky. The precious words he inscribed on the front gables of Stellafane's pink clubhouse inspire us to this day and this night: From the first line of Psalm 19:

"The heavens declare the glory of God."

The first picture (previous page) shows the Russell Porter-designed pink clubhouse with its inscription. The second (below) is a Porter series of sketches about a fight over a comet. Notice the shape of the telescope in the fifth sketch. Pictures used with the kind permission of Dr. Mario Motta.

RASC Montreal Centre proudly owns a Russell Porter Sketch from his Arctic adventures. (Ed.)



***By Olivier Habay**. April 12. Here is the Pinwheel galaxy (M101) taken last night from Thompson park. It was the first time for me using the 135 mm Rokinon lens (on my Canon T7i camera). And I'm super happy about the optical quality of this lens and the resulting pictures (it lives up to its reputation). Despite the modest focal length, I'm amazed by the level of details. It may not show on the Facebook picture, but there are also multiple smaller galaxies in this picture.*
Details: 95 lights @45 sec, 30 darks and 23 biases (no flats)

Spring Equinox at the Abo Clubhouse

Presented & Organized by
Tim Bird

The Saturday Night Clubhouse was used to recognize and celebrate the spring equinox.

We brought out the fine glassware and sipped black tea from it. We will do this for special occasions henceforth.

Twice a year, the Earth reaches a point of perfect balance, when day and night are equal in length: The Spring Equinox, a time of renewal, rebirth, and the official start of longer, warmer days.

The Spring Equinox (or Vernal Equinox) occurs when the Sun crosses the celestial equator, making day and night nearly equal across the globe. This astronomical event signals the end of winter and the start of spring in the Northern Hemisphere (autumn in the Southern Hemisphere). In simple terms, at this moment the Earth's axis is tilted neither toward nor away from the Sun, but rather perpendicular to the Sun's rays.

For farmers, gardeners, and all who rely on the rhythms of nature, the equinox marks a pivotal turning point—longer daylight hours mean more warmth, more planting, and the promise of abundance in the months ahead.

Ancient civilizations recognized the equinox as a powerful celestial event and so did we, Saturday night at the Arbo.

For me, the ancient astronomers form a big part of my interest in astronomy. Much more so than processing data from the JWST, for example. The concept of tracking celestial events dates back thousands of years. Early civilizations closely observed the skies, and evidence suggests that humans have been marking the equinox for at least 5,000 years. Here are some of the earliest known equinox celebrations:

– Ancient Egypt: The Great Sphinx of Giza is believed to align with the rising sun on the equinox, connecting the event to the Egyptian gods and the renewal of life.

– Mesopotamia: The Babylonians used the equinox to determine their new year, a tradition that later influenced the Persian festival of Nowruz, still celebrated today.

– Europe: Neolithic structures like Stonehenge are believed to have been used for tracking solar events, including the equinoxes.

Throughout history civilizations have developed unique traditions to honor the balance between light and dark:

Nowruz (Persian New Year): Celebrated across Central Asia and Iran (maybe not this year), this 13-day festival involves spring cleaning, jumping over bonfires, and setting a "Haft-Seen" table with seven symbolic items.

Holi (India & Nepal): Known as the Festival of Colors, this Hindu celebration marks the arrival of spring and the victory of good over evil by throwing colored powders.

Japan (Shunbun no Hi): A national holiday, people visit family graves to honor ancestors and appreciate the changing of seasons.

Mexico (Teotihuacan/Chichen Itza): Thousands gather at ancient pyramids dressed in white, raising their hands to receive energy from the sun. At Chichen Itza, the light creates a "serpent" on the stairs.

Ostara (Pagan/Wiccan): Celebrated as a time of balance and rebirth, often involving the painting of eggs and planting seeds to honor the goddess of dawn.

Photos by: Morrie Portnoff

Christianity/Judaism (Easter/Passover): While dates vary, these holidays are linked to the equinox. Easter is on the first Sunday after the first full moon following the equinox, celebrating resurrection, while Passover celebrates freedom.

Thailand (Songkran): While sometimes aligning later in April, the water festival is a major "astrological passage" marking the New Year and renewal (including water “fights” in the streets).

Indigenous Traditions: Many, such as the Anishinaabeg, mark this time with the gathering of maple sap and community celebrations of the new season.

You can dress in white, throw colored powder, fire-jump or bring eggs. Do all three at once and assimilate as many cultures as you can.

Moonrise

By David H. Levy,

> **Moonrise**
>
> I awoke in the Midsummer not-to-call night, in the white and the walk of the morning:
> The moon, dwindled and thinned to the fringe of a finger-nail held to the candle,
> Or paring of paradisaïcal fruit, lovely in waning but lustreless,
> Stepped from the stool, drew back from the barrow, of dark Maenefa the mountain;
> A cusp still clasped him, a fluke yet fanged him, entangled him, not quit utterly.
> This was the prized, the desirable sight, unsought, presented so easily,
> Parted me leaf and leaf, divided me, eyelid and eyelid of slumber.
>
> --Gerard Manley Hopkins, circa 1876.

The Moon is so much more than an object in the sky. *Moonrise* is a poem that echoes the cosmic thoughts of Hopkins, who was an experienced and passionate observer of the night sky.

The Moon is also a place. Twelve people have walked along its surface, some of whom saw mountains close by.

On the morning of July 20, 1969, 57 years ago, I was the astronomy teacher at Camp Minnowbrook on the west shore of New York's Lake Placid. The entire camp was in the auditorium as the Eagle spacecraft made its way to the surface of the Moon. The landing seemed normal enough although I sensed that Neil Armstrong and Buzz Aldrin were having some difficulty finding a flat landing site free of small craters. But we all heard the precious words, "Tranquillity base. The Eagle has landed."

The rest of that day went normally, until dinner when the head counsellor announced an evening program of "free play." I approached him and suggested that the camp might want to watch the moon walk scheduled for that evening. "Mind your own business and do your job," he barked back at me. Sadly, I returned to our table.

Apparently the camp director, Lothar Eppstein, had overheard that conversation. He quickly rose and called for our attention. "Evening program is cancelled," he said. "We will all proceed directly to the auditorium from here. History is being made tonight and we all have a duty to witness it and be a part of it."

That evening, as we sat on our folding chairs, we watched a small, perhaps 12-inch black and white TV mounted on the auditorium stage. Walter Cronkite was in charge. He interviewed some interesting people, including a young Gene Shoemaker; it would be nineteen years before I would get the chance to meet him, and his wife Carolyn, in person. Some of it was quite serious; a lot of it was just fun.

Then after a few hours the picture suddenly changed to the"porch" of the lunar module. Armstrong was standing on it. The auditorium, filled with children as young as six or seven years old, went suddenly silent. Slowly, step by step, Armstrong descended the ladder and set one foot, then the other, on the Moon.

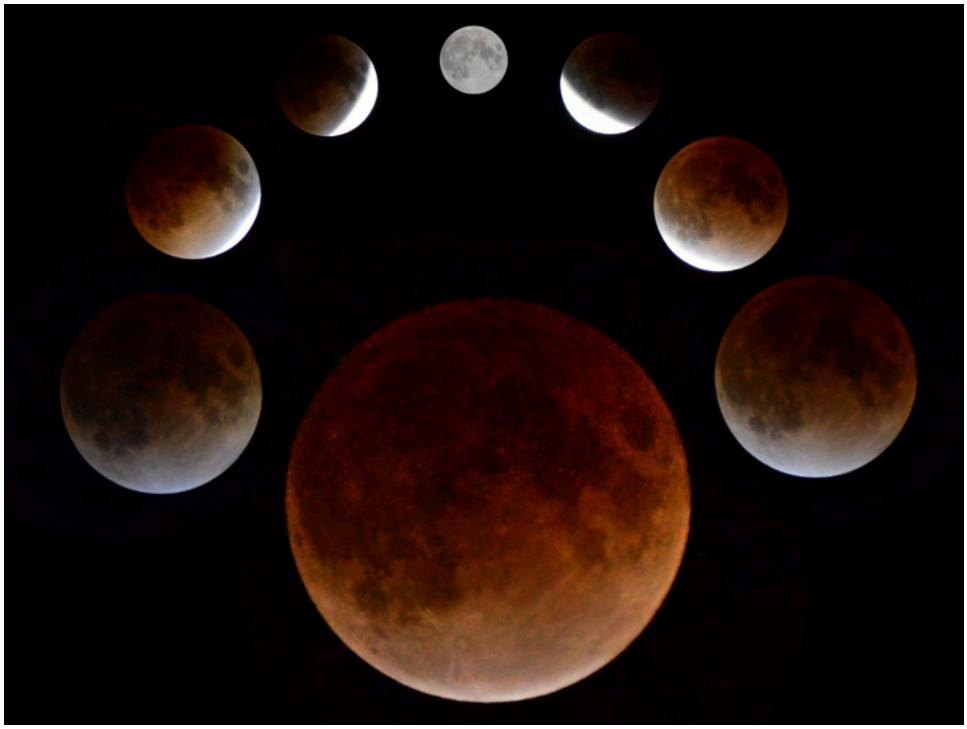
> "That's one small step for a man,
> One giant leap for mankind."

It was more than a major time in history. This was one of the pivotal, defining moments in the history of human civilization. I will never forget that night.

There have been other, more personal, defining moments in my own lifetime. The discovery of my first comet, on 13 November 1984, was one. And the discovery by the Shoemakers and me of the comet that would strike Jupiter was another. Those two times were private. Watching the moon walk was a joy I shared with 150 young children, and our whole world.

On Wednesday, 1 April 2026, Artemis II began its journey to the Moon. Its four astronauts represented different aspects of American society, including one Canadian. The mission commander was Reid Wiseman, its pilot Victor Glover. The two other mission specialists were Christina Koch and Canadian Jeremy Hansen. I met Jeremy in 2016 at the London general assembly of the Royal Astronomical Society of Canada, and have never forgotten him. Seeing him emerge from Integrity just a few moments ago was ecstatic.

Our world is going through trying times. But the continuing story of the travels we take to the Moon offers a rare moment of unity. No red countries, no green countries, just one gorgeous world. The other news shows us the world as it is. The Moon journeys show our world's possibilities. They show the world as it can be.



Montage of the March 3 2026 total eclipse of the Moon. Used by permission of Mario Motta.

Unveiling Stellar Secrets: Part 2

A Guide to Amateur Stellar Spectroscopy and OBAFGKM Classification

***By Nader Daou**, Director of Outreach*

(This is part two of a two-part article. If you missed Part 1, it covers the foundations of spectroscopy, emission and absorption lines, and the OBAFGKM classification sequence.)

The Amateur Spectroscopy Setup: From Light Bucket to Spectrograph

In amateur astronomy, you can always go as basic or as advanced as you are comfortable with, and the good news is that you don't need a professional observatory to dabble in stellar spectroscopy. Advancement in consumer-grade equipment had made astronomy, in all its different flavours, a very accessible hobby or vocation for amateur astronomers such as you and myself.

Let us walk through each essential component and how they all fit together.

The Essential Components

- **Your Telescope:** You will need a stable amateur telescope mounted on either an equatorial or alt-azimuth mount capable of tracking. For longer exposures, mount alignment and tracking are essential to prevent smeared spectral images. Refractors, Schmidt-Cassegrains (SCTs), and Newtonians are all suitable. Bigger aperture is always better for collecting more light, but even a 100 mm refractor can produce good spectra of brighter stars. A focal reducer is also useful to make the system faster (i.e. shorter exposures), collecting more light over a broader field. So basically, if you ever used your telescope to take reasonably good photos of anything in the night sky, you're good to go.
- **Your Camera:** You will need a dedicated astronomical camera: a CCD or CMOS camera is ideal. Mono cameras are generally preferred over colour because they capture more light and don't require de-mosaicing, which can smear fine spectral features, so your ASI120MM guiding camera is good enough, although with some trade-offs that we will talk about later. Nevertheless, a good DSLR (with raw image capability) can certainly get you started. Planetary cameras (such as the ASI585MC, though the MM mono, is preferred) can also be used for brighter targets, particularly those with good signal-to-noise ratio.
- **The Diffraction Grating (The Heart of the Spectrograph):** This is the crucial component that splits the starlight into its spectrum. For amateur spectroscopy, we use transmission gratings.
  - **Star Analyser (SA-100, SA-200):** These are perhaps the most popular and accessible gratings for amateurs. They are typically designed to screw at the end of 1.25" or 2" threaded cells (eyepieces or spacer rings) containing a precision optical element with either 100 or 200 lines per millimetre (l/mm).
    - **SA-100 (100 l/mm):** Offers narrower dispersion but lower spectral resolution. However, it performs better with fainter objects.

    - **SA-200 (200 l/mm):** Offers wider dispersion (the spectrum is more spread out) potentially offering higher resolution. However, it may not improve spectral lines much, due to optical constraints. It is only offered as an alternative when telescope design restricts placement of the SA-100 far enough from the camera to achieve good spread.
- **Placement:** The grating is typically threaded onto the nosepiece of your camera, or into a filter wheel if you have one. It should be positioned in the optical path before the camera sensor, effectively making your camera a "slit-less spectrograph."
    - **Spacer Rings (crucial for dispersion control):** The distance between the diffraction grating and the camera sensor directly influences the dispersion (how spread out the spectrum is) and the resolution (how fine the details are). Using standard T-rings, extender tubes, or variable spacers allows you to adjust this distance. Longer distances lead to more spread-out spectra, which can be beneficial for resolution but make the spectrum dimmer and more susceptible to tracking errors. Shorter distances give a more compact, brighter spectrum but with less detail. This is where the ASI120MM has a trade-off. It's small sensor will define how spread out the spectrum can be before it's cut-off. Experimentation is key. You want to be able to capture a full spectrum with enough definition that the software can detect absorption lines.
    - **Focusing System:** Precise focus is of utmost importance. An electric focuser with fine control is highly recommended. But a good, dual speed, focuser will work perfectly well. The diffraction grating can shift the focal point slightly, so refocusing will be necessary after installation.
    - **Mount and Guiding:** As mentioned earlier, accurate tracking is essential, especially for longer exposures needed to capture fainter spectral features. Autoguiding is highly useful, but not necessary for brighter stars. For slitless spectroscopy, the "slit" is effectively the star itself, so a sharp, star image with no trailing is critical.

Putting It All Together

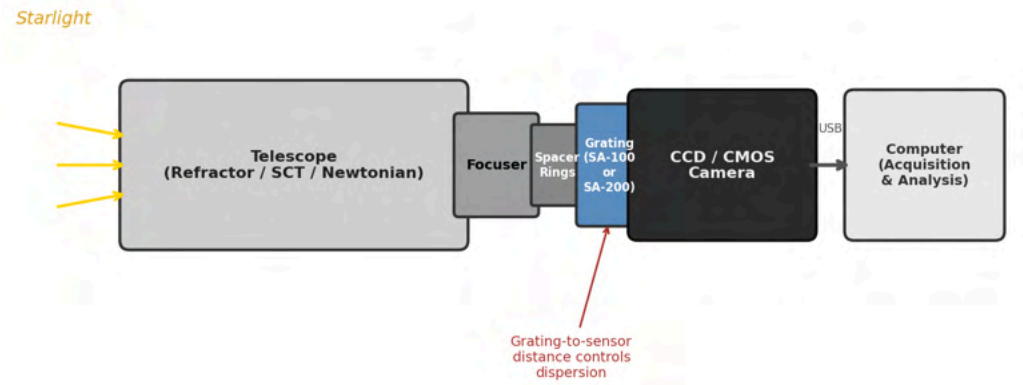


***Figure 1**: Schematic of a typical amateur slitless spectroscopy setup. Starlight enters the telescope, passes through the focuser and spacer rings, is dispersed by the diffraction grating, and is recorded by the camera sensor. The computer controls acquisition and performs analysis.*

- **Attach the Grating:** Thread your Star Analyser on the nosepiece of your camera (or the extension ring if one is necessary). I personally prefer to use the grating in a filter drawer, so that I can rotate the camera to align the spectrum with the sensor diagonal in order to get as much "real estate" as possible on the sensor. There is a little caveat here though, the distance between the grating and the camera sensor need to be just right.
- **Attach Camera to Telescope:** Insert the camera (with grating attached, whether directly or in a filter drawer) into your telescope's focuser, just as you would for normal imaging.

- **Rough Focus:** Use a bright star to achieve a rough focus. You will initially see the star (the "zero-order" image) and a rainbow-like streak to one side (the "first-order" spectrum). There might also be a fainter spectrum on the opposite side (the "minus-first-order" spectrum), which we generally ignore. So you want to see the star image to one side, close to the edge of the sensor, so that the first order spectrum will be fully visible in the frame (see figure 2 below).

***Figure 2**: Illustration of what you see on the camera sensor after installing the diffraction grating. The bright zero-order image (the star itself) appears alongside the first-order spectrum, which shows the dispersed light with visible absorption lines (Balmer series in this case). The faint minus-first-order spectrum on the opposite side, if observed, is typically ignored.*

- **Orient the Grating:** Rotate the grating (or your camera/focuser if it allows rotation) so that the spectrum is aligned diagonally on your sensor. I prefer to use the diagonal because it gives me a bit more room, then rotate the spectrum back into horizontal in post processing, because most amateur spectrum analyser software require a horizontal spectrum. This might require some trial and error, taking short exposures and rotating until desired orientation is achieved.
- **Fine Focus:** This is critical. Focus not only on the star (zero-order) but also on the sharpest possible spectral lines within the first-order spectrum. This often requires adjusting the focuser in very small increments. Zooming in on your camera's live view or taking short test exposures and reviewing them may be necessary.

Software for Spectrum Acquisition and Analysis: The Digital Darkroom

Once you have your hardware set up, the real work happens in the software. You will need two main categories of tools: camera control/acquisition software, and spectroscopy analysis software.

Camera Control and Acquisition Software

This is what you use to capture your images. If you are already an astrophotographer, then you already have a system to acquire photos. This could be ASIAIR dedicated hardware, a camera software such as SharpCap or NINA, or any other ASCOM-compatible program on a portable computer.

For stacking multiple raw spectral images to improve the signal-to-noise ratio (SNR), tools like DeepSkyStacker (DSS), PixInsight, or Siril are an absolute must. Siril is particularly versatile as it can

also perform some basic spectral extraction, not to mention that it is a free, Open Source Software. Can we really ask for more?

Spectroscopy Analysis Software

This is where you transform your raw spectral images into meaningful scientific data. The table below compares the most popular options available to amateur spectroscopists.

Software	Cost	Difficulty	Best For
Rspec	Paid	Beginner	Live viewing, outreach, quick analysis
BASS Project	Free	Intermediate	Detailed analysis, calibration
ISIS	Free	Advanced	Hi-Res scientific work
Siril	Free	Beginner-intermediate	Stacking, per-processing, basic extraction

***Table 1**: Comparison of popular amateur spectroscopy software packages. Each tool occupies a different niche in terms of cost, learning curve, and capability.*

- **RSpec** (Paid, ~CA$150, https://www.rspec-astro.com)
  RSpec is the recommended software by the manufacturer of the SA-100 grating. It offers a user-friendly interface with real-time display of the spectrum as you capture it, making adjustments easy. It has a live rotate feature that allows you to rotate the spectrum to a horizontal position as you capture it. It includes a library of reference spectra for comparison. The typical workflow involves capturing an image in FITS format, loading it into RSpec, defining a region of interest around your spectrum, and then calibrating and overlaying reference lines. The downside is that it is not free and may lack some advanced features of more specialized scientific tools. Moreover, the live features work only with cameras that have a DirectX drivers (such as ZWO ASI120MM). Note: it offers a full feature 30 day trial
- **BASS Project** (Free, Open Source, https://groups.io/g/BassSpectro)
  BASS is powerful and flexible, with a large community and robust tools for wavelength calibration, flat-fielding, and atmospheric extinction correction. Its workflow involves capturing raw frames (light, dark, flat), stacking them (in Siril, for example), loading the stacked spectrum into BASS, performing wavelength calibration using known spectral lines, then extracting and analysing the spectrum. The interface has a steeper learning curve than RSpec.
- **ISIS** (Free, Advanced, http://www.astrosurf.com/buil/isis-software.html)
  ISIS is often considered the gold standard for amateur scientific spectroscopy. It is extremely powerful and precise, capable of very high-resolution work. However, it has a very steep learning curve and requires a solid understanding of spectroscopy principles. It is not recommended for beginners. However, I include it in the list because I am sure there are more capable amateur astronomers out there that can and will use it to its full capabilities!
- **Siril** (Free, Image Pre-processing and Basic Analysis, https://siril.org)
  Siril excels at stacking, calibrating (dark, flat, bias), and aligning raw spectral images. It includes some basic 1D spectral extraction tools. However, its spectroscopic analysis features are not as comprehensive as dedicated spectroscopy software, so it is best used as a pre-processing step before moving to BASS or ISIS for detailed analysis.

The Spectroscopic Workflow: From Image to Classification

Here is a general step-by-step workflow for acquiring and analysing stellar spectra. The following flowchart summarizes the entire process from initial setup through to final classification.

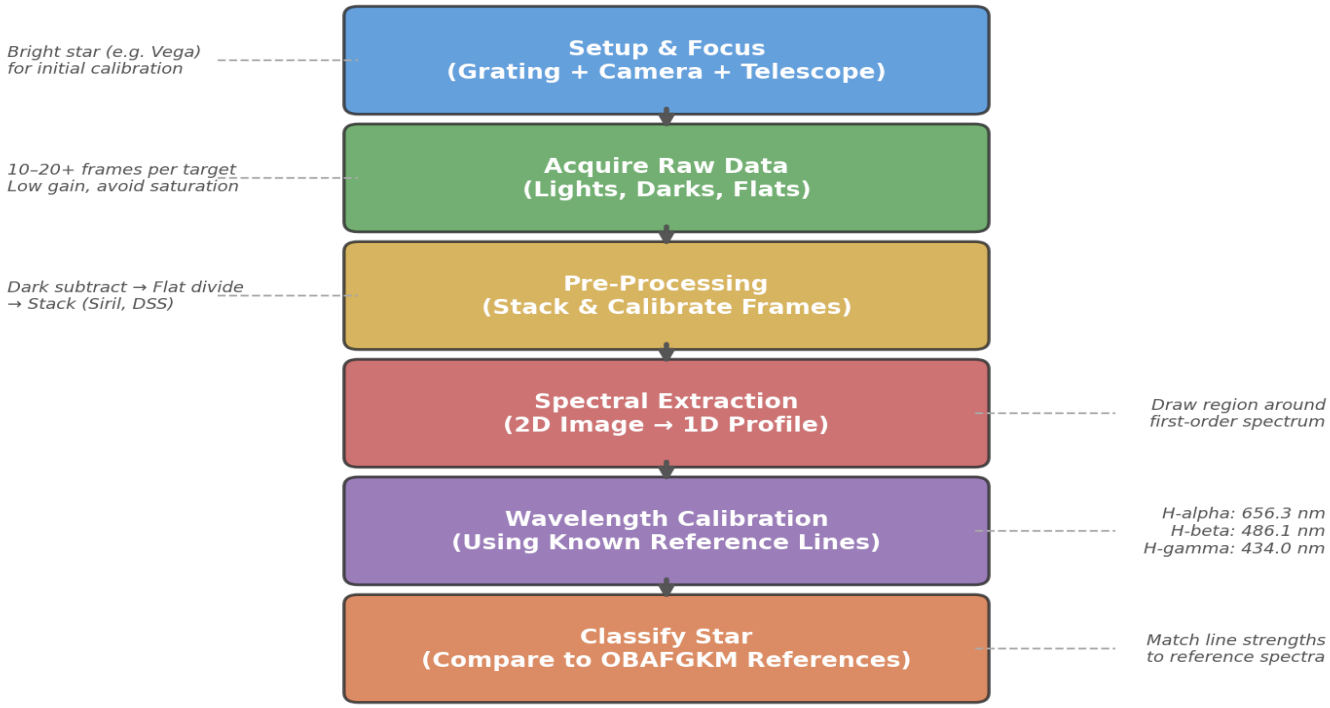


Figure 3: *The complete spectroscopic workflow, from initial hardware setup and focus through raw data acquisition, pre-processing, spectral extraction, wavelength calibration, and finally stellar classification against OBAFGKM reference spectra.*

Step 1: Setup and Focus

- Install grating on camera, attach to telescope.
- Aim at a bright, well-known star (e.g. Vega, Sirius). These A-type stars are excellent calibration targets due to their strong, easily identifiable Hydrogen Balmer lines (Figure 2 above).
- Rough focus, then orient the spectrum horizontally on your sensor.
- **CRITICAL**: Achieve precise focus on both the zero-order star and the spectral lines in the first-order spectrum. This might be the most challenging part.
- Adjust the grating-to-sensor distance with spacers to get a good balance of dispersion and brightness for your chosen targets, as well as rotation to get the most of your camera sensor. If you are taking multiple exposures with a good tracking mount, then dispersion is much more important since brighter image will be achieved through stacking.

Step 2: Acquisition of Raw Data (Lights, Darks, Flats)

Light Frames

Capture multiple exposures of your target star. Experiment with exposure time: you want the brightest parts of your spectrum to be well-exposed without saturating the sensor. Start with a few seconds and

adjust. Keep gain/ISO as low as possible while still getting good signal, since high gain increases noise. Take at least 10–20 frames (more for fainter targets) to stack later, improving the SNR.

Dark Frames

Take dark frames immediately after your light frames, with the same exposure time and temperature, but with the telescope cap on. These remove thermal noise from the sensor.

Flat Frames

Flat frames are important in spectroscopy, but they are extremely nuanced. Unlike regular astrophotography where dust spots are "merely" cosmetic blemishes, in spectroscopy a dust spot on the sensor or optical element creates an absorption feature that can be mistaken for a real spectral line. The flat SNR must be adequate at the *dust-affected wavelength*, and if it is not, applying the flat actively degrades the spectrum at that wavelength. Hence, the best remedy is to be thorough in cleaning the optical path and make sure it is dust and blemish free, and avoid potentially misleading flats.

Step 3: Pre-processing (Stacking and Calibration)

Use software like Siril to stack the calibrated light frames. The output will be a single, high-quality master spectral image (ideally a FITS file). The actual process of stacking is outside the scope of this article.

Step 4: Spectral Extraction (2D to 1D)

Load your master spectral image into your chosen spectroscopy software (RSpec, BASS, etc.). The software will typically prompt you to draw a "box" or "profile" around your first-order spectrum. This defines the region from which the light intensity will be integrated along the dispersion axis. The software then converts this 2D image into a 1D graph (figure 4, below), plotting intensity (Y-axis) against pixel position or wavelength (X-axis). This 1D graph is the actual spectrum we analyse.

Step 5: Wavelength Calibration

This is crucial for accurately identifying spectral lines. Your software needs to know which pixel corresponds to which wavelength. There are two main methods, but practically, for an amateur astronomer, the first is the only one that is feasible.

- **Method 1: Known Star Calibration (most common for amateurs):** Use a star with a well-known spectrum (like Vega, an A0V star with very strong Hydrogen Balmer lines). Identify prominent features (e.g. the Hα, Hβ, Hγ lines of hydrogen at 656.3 nm, 486.1 nm, 434.0 nm respectively). Tell the software the exact known wavelengths of these identified features. The software then calculates a dispersion solution (e.g. Ångströms/pixel), allowing it to assign a wavelength to every point on your spectrum.
- **Method 2: Reference Lamp (more advanced):** Using a gas discharge lamp (e.g. Argon-Neon) whose emission lines are precisely known. You capture its spectrum and use it for calibration. This is a more precise and standardised method but requires additional equipment. It is often used in labs and advanced scientific research and is not necessary for amateur spectroscopy. The "software" provided calibration templates are more than adequate.

Classifying Your Stars: Reading the Fingerprints

Now, with a calibrated 1D spectrum in hand, you can begin the exciting process of classifying stars. The key is to identify characteristic absorption features and compare them against known reference spectra.

Identify Key Absorption Lines

- **Hydrogen Balmer Series:** Look for the characteristic dip pattern (Hα in the red at 656.3 nm, Hβ in the blue-green at 486.1 nm, Hγ in the blue at 434.0 nm, and so on). Their strength is a primary indicator of spectral type.
- **Calcium II H & K Lines:** These are two very strong lines in the violet part of the spectrum (Ca II H at 396.8 nm, Ca II K at 393.4 nm). They become dominant in F, G, and K type stars.
- **Neutral Metal Lines:** Look for absorption features caused by neutral iron, titanium, and other metals. These become increasingly prominent in cooler stars.
- **Molecular Bands:** In the coolest stars (K and M types), look for broad, often jagged absorption bands caused by molecules like titanium oxide (TiO).

Compare to Reference Spectra

Most spectroscopy software (like RSpec) comes with a built-in library of professionally obtained OBAFGKM reference spectra. Overlay your target star's spectrum with these references and visually compare the strength and presence of the key absorption lines. Which reference spectrum does yours most closely resemble?

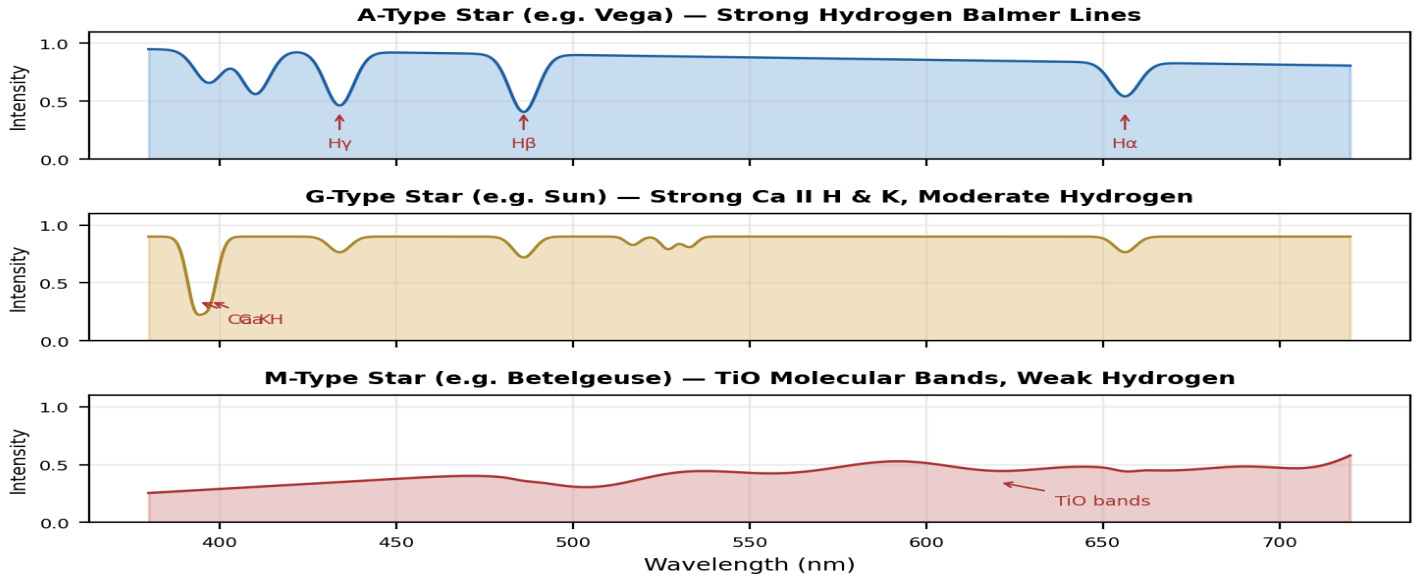


Figure 4: *Simplified spectral profiles for three key OBAFGKM classes. Top: an A-type star (e.g. Vega) showing strong Hydrogen Balmer absorption lines. Middle: a G-type star (e.g. the Sun) showing dominant Ca II H & K lines with moderate Hydrogen. Bottom: an M-type star (e.g. Betelgeuse) showing broad TiO molecular absorption bands and very weak Hydrogen lines.*

For a quick reference, you can consult the **Harvard CfA Spectral Atlas (https://lweb.cfa.harvard.edu/~pberlind/atlas/htmls/note.html)** or for a slightly deeper dive, **R.O. Gray's Digital Spectral Classification Atlas of the department of astronomy at Appalachian State University (https://ned.ipac.caltech.edu/level5/Gray/frames.html)**

Example Walkthrough (Figure 4 above)

- **Example 1:** You observe a star and its spectrum shows very strong Hydrogen Balmer lines, weak Ca II lines, and no noticeable molecular bands. Conclusion: This is indicative of an A-type star.
- **Example 2:** You observe another star and its spectrum shows weak Hydrogen lines, extremely strong Ca II H and K lines, and a few strong neutral metal lines, with no obvious molecular bands. Conclusion: This points to a G-type star.
- **Example 3:** You observe a third star and its spectrum shows almost no Hydrogen lines, very strong neutral metal lines, and prominent broad absorption bands due to TiO. Conclusion: This is a clear indicator of an M-type star.

Conclusion: Your Telescope as a Precision Instrument

The journey into stellar spectroscopy as an amateur astronomer is incredibly rewarding. It transforms your view of the night sky, moving beyond visual appreciation to quantitative scientific analysis. With a modest investment in a diffraction grating and a commitment to learning the software, you can perform real scientific work, measuring the physical properties of distant suns.

You will gain not just images, but data. You will not only see the stars but measure their temperature, their composition, and their place in the stellar classification system. This pursuit bridges the gap between the visual beauty of the universe and the rigorous principles of physics, empowering you to classify the OBAFGKM sequence one photon at a time.

By Daniel Biron. *NGC2264 (Christmas Tree cluster)*

The "top" of the tree is pointing downward, where the Cone Nebula is visible; also, the Fox Fur Nebula is located just at the right of the brightest star in the field of view (S Monocerotis, mag. 4.7);

- *Seestar S30 in altaz mode;*
- *90 minutes integration (540*10s);*
- *Bortle 7 location;*
- *Moon at 0%;*
- *Image enhancement done with the Seestar smartphone app.*

New Members

Please join us in welcoming these new members:

Eric Siblin

Felipe Mena

Manon Bouchard

Jean-Bruno Desrosiers

Hiba Bayazid

Renée Declay

Sarah Ducharme

David Silva

Next Issue

Got something to publish in the next issue of Skyward? We welcome contributions from Montreal Centre members. Send them to editor@rascmontreal.org before *June 1st.* A reminder will be mailed *May 20th.* Publication will be in the last week of *June*.

We are always looking for:

- Articles
- Pictures of recent events
- Reviews of Books, equipment, videos, etc.
- Astro-images or drawings
- Observation logs
- Items for sale/wanted

Guidelines:

- Text should preferably be in Word with images shown where they go. However, send separate copies of images since Word tends to reduce resolution.
- Aim for image resolution of at least 300dpi at the size the image will be used on the letter sized page.
- Send a head shot to include with your article.
- Unless you instruct me otherwise, I will use images posted on our Facebook Group.
- Be aware that if you send a PDF I will not have your fonts.
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Being a RASC Montreal Centre Member has its

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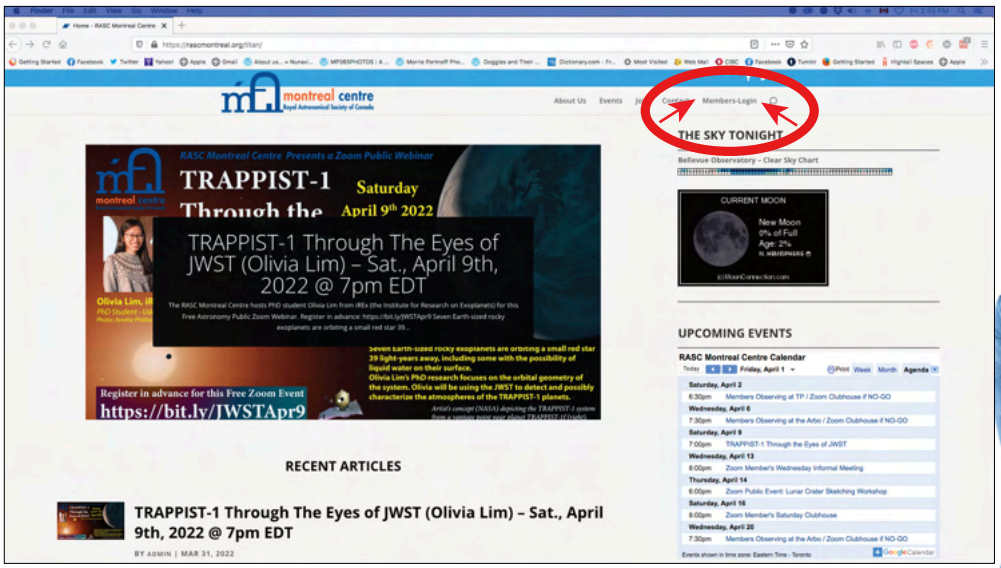

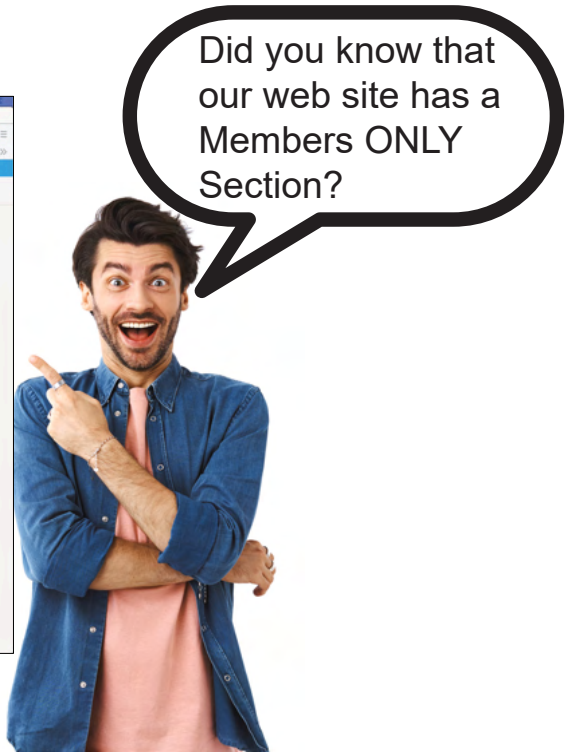

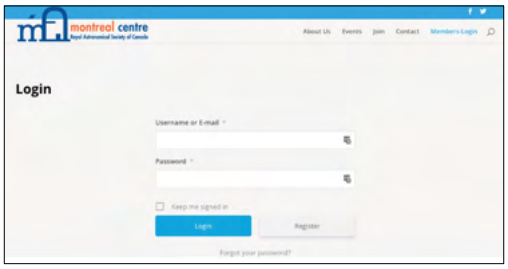

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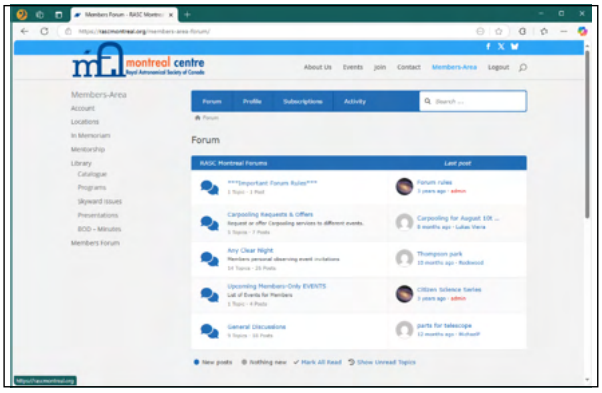

Don’t have a telescope? Borrow one from the Centre.

If you are a RASC Montreal member, telescopes are available to borrow for FREE. (Donation of any amount is encouraged!) A $50 deposit is required for each borrowing, it will be returned in full upon return in good condition. To make a borrowing request, please send an email to: telescope@rascmontreal.org.

By Andrew Maenz March 25

Morgan Arboretum

Welcome to the Morgan Arboretum!

Live, breathe, and enjoy 245 hectares of Saint-Anne-De-Bellevue forest, meadow, and wetland trails inviting you to connect with nature. Our nearly 25 kilometres of all-season paths offer you the chance to explore one of Montreal's most precious nature reserves. Come for a picnic with family or friends in summer, watch in awe at the leaves in fall, ski our groomed trails in winter, and rejoice in the new warmth of spring. Open all seasons, with activities for all ages.

The Morgan Arboretum specialises in 4 main areas; conservation, research, education and leisure. Numerous recreational programs are available for all ages, such as Shinrin Yoku (guided forest bathing), summer camp programs, ecological workshops, scavenger hunts, and holiday events! As protecting and conserving our land is at the forefront of our mission, a combination of youth educational programming and a land maintenance team ensures that our community is well taken care of. The forest also provides fantastic research space for student projects, as it provides a consistent, untouched environment for scientific study.

Did you know that the Arboretum is home to over 500 species of plants, animals, insects, and fungi? It is home to many unique species, such as monarch butterflies, jack-in-the-pulpit flowering plants, Cooper's hawks, and giant puffball mushrooms.

The Morgan Arboretum is open to the public and members every day of the week from 9:00 AM to 4:00 PM. Our membership program offers daily access based on a yearly fee, and is available for purchase now! To purchase a membership, please refer to our website's "membership" section below.

For more information, call 514-398-7811, email gatekeeper.morganarboretum@mcgill.ca, or visit our webpage at www.mcgill.ca/morganarboretum