Event Horizon

From The Editor

Here's the 2019 "Summer" edition of the E.H., to usher in the warm-weather season.

The next E.H. after this one will be in September. In the meantime, have a great summer, everyone!

Clear Skies!

Bob Christmas, Editor

editor 'AT' amateurastronomy.org

Chair's Report by John Gauvreau

Our 2018/2019 season will soon be drawing to a close and after this month we look forward to a summer of observing and outreach. And of course we look forward to the next season of talks and meetings. For many, many years we have enjoyed a wonderful relationship with the Hamilton Spectator and enjoyed their spacious and comfortable auditorium for our monthly meetings. But as many of you have heard, the Spectator is due to end printing operations in Hamilton in August. When we reconvene in September, the Hamilton Spectator Building, our home for these many years, will be a very different place, and with such uncertainty for the Spectator's future, so too is there uncertainty for our future there.

Thanks to the keen insight and attentiveness of Bill Tekatch, we were forewarned of this eventuality and for several months now the HAA council has been considering the best path forward. The decision to change venues was not an easy one, as we might have hoped to have several more years at the Spectator before our hand was forced. However, it was felt that being proactive was wiser than being reactive, and council decided to seek a new home now, rather than risk being left homeless. As you know now, this was the correct decision, as the changes at the Spectator came soon after. As a result of Bill's foresight, we were well positioned to cope with this news and already had plans in place to move.

Chair's Report (continued)

We have explored a variety of other venues, evaluating their suitability (covering things like size, acoustics, accessibility, parking and accessories (podium, microphone, projection facilities…)). The Spectator has a large and comfortable room and we definitely didn't want to take a step down. This is a club to be proud of, and we attract first rate speakers and it is entirely appropriate that we host them, and us, in a first rate venue (this month, on June 14th, we will be hosting *Dr. Brian McNamara*, chair of the Department of Physics and Astronomy at the University of Waterloo, who will be speaking on black holes).

We have also considered location; after all, we are the *Hamilton* Amateur Astronomers, and although we draw in many valuable members from other communities, staying in Hamilton seemed prudent, as a central location.

Cost was, of course, another factor that has weighed heavily on us. As a non-profit, registered charity, we operate on a very small budget. The cost of the room rental is one of the biggest expenses of our year (the other large one being insurance so that we can open our doors to the public). There certainly are other very fine venues available, but at a significantly higher cost; indeed, a cost far beyond our means. And although we fully expected the cost of the venue to go up, finding something suitable and affordable was paramount and challenging.

Many options were suggested, and I thank all those that came forward with ideas. In the end, one stood out beyond all others. A thank you goes to Barry Sherman for suggesting McMaster Innovation Park. It is very different from where we are now, but just as suitable, if not more so. The facility is in the same neighbourhood as the Spectator, so we will all have about the same drive to get there. It is easy to reach from the highway for our out-of-town members and on a bus route for those local enough to take advantage of that. There is lots of free parking. It is wheelchair accessible, has all the accessories we need (projection and sound) and is professional, comfortable and welcoming. In all ways, it meets our needs.

The plan in place was to make the move there in November, after our current agreement with the Spectator is fulfilled. It is still our hope to stay in the Spectator building until then, but if we have to move earlier we will let you know. For now, we will see you at the Spectator on June 14th.

At this point I must give a big thank you to Ann Tekatch for orchestrating the move. After an initial meeting between our contact at McMaster Innovation Park and Barry, Ann & myself, Ann has carried us through, making all arrangements for the move. She helped found this club over 25 years ago and has been one of the great unsung people responsible for carrying us forward through the years, often working quietly behind the scenes, striving to make the HAA the large and active club we are today. And again, she has seen us through this challenge. Thank you Ann!

Not surprisingly, the new venue is more expensive than the Spectator. This should not lead you to believe that it is overpriced; it is in keeping with other venues of similar capacity and indeed better priced than many. It really just shows how fortunate we have been over the years to have a room like the Spectator's available to us for such a cheap price. We have been very lucky indeed. The new venue is a fair price for an excellent facility. But, with this increased cost, we have to pay our way. As such, I will be proposing a modest membership fee increase at the upcoming meeting. Our current membership rates are $25 for an individual and $30 for a family. I will propose that the new membership fees be $40 for an individual and $45 for a family (yes, for only an extra $5 you can have your family be part of the HAA!). The increase

Masthead Photo: *Open Star Clusters M35 and NGC 2158, by Bob Christmas.*

Taken on April 28, 2019, from near Barry's Bay, Ontario, with a Canon 40D DSLR through a Tamron 300mm f/2.8 telephoto lens at f/2.8 and ISO 800. Exposures: 10 x 90 seconds, for a total of 15 minutes. Digitally developed using The Gimp and StarTools.

Chair's Report (continued)

will cover the increased cost of the venue and keep the budget balanced. We haven't had a fee increase in almost 20 years (ok, it's been 19 years), so it's not like it's too soon.

This fee increase still keeps us just below other comparable clubs like the Hamilton Naturalists Club, or either the Hamilton or Burlington photographic clubs, and other southern Ontario astronomy clubs, like the Hamilton or Toronto centres of the RASC. The point is, despite being such an active group with much to offer, our membership fees have been well below typical, and the new fees will still be as good as any others around.

And consider this; this club is made up of many people who do an extraordinary amount, not with an exorbitant budget, but through sheer effort and will. The HAA offers 10 monthly meetings, with excellent speakers, door prizes and activities. We run a telescope clinic for both members and public. We hold workshops to introduce new members and the public to the basics of astronomy. We have a library open to all members. Our newsletter is open to everyone to contribute to and enjoy. We have a telescope loaner program, where any member can take home and try out a telescope for a month at a time. Every year we have a beginners group series of seminars, affectionately known as Astro 101. Another mini group within the club that all members are invited to participate in is the Astrophysics group, meeting monthly to discuss all things cosmological. We see our members go out across the city and surrounding area 8 times a year for public observing sessions, bringing the joy of astronomy to our community. We visit schools, libraries, camps and community centres many times each year, offering educational opportunities to all ages. Over the years, thousands and thousands of people have been treated to insights in astronomy and telescopic views they will remember for a lifetime. For our own observers, we have several award programs designed to guide you through the night sky. We have a wonderful arrangement with the Binbrook Conservation Area for access to a darker sky. We publish a wall calendar each year showcasing members' astrophotos. And of course, above all, we are a wonderful group within which I have found much camaraderie over the years, and I hope you have too. As far as I'm concerned, membership in this club is worth every penny. I hope to see you at the June meeting for a great presentation by Dr. Brian McNamara, and to vote on the proposed fee increase to help keep this club going as well as it has for many more years to come.

As always, feel free to get in touch (council emails are on the last page of the newsletter) and see you out there.

HAA Helps Hamilton

To support our community, we collect non-perishable food items and cash for local food banks at our general meetings. Please bring a non-perishable food item to the meeting or a donation of cash and help us help others.

Our donations go to Hamilton Food Share, which delivers them to various food banks around the Hamilton area.

If you would like to help or have any questions about this initiative, please contact the H.A.A.

May Astrophysics Group Meeting Summary by Mike Jefferson

May 17/2019:

The Astrophysics Group met at Doug Black's home on this date and Doug Currie and Doug Black were our presenters. Besides both Dougs, members also present were as follows: Ian Rabenda, Gary Sutton, Mike Jefferson and new member, Peter Hui.

The topics under investigation were Doug Currie's continued PowerPoint investigation of black holes and Doug Black's continued PowerPoint investigation into ways to acquire equipment to pursue some projects in spectroscopy.

Some of the topics that Doug Currie touched on were as follows: - opened with the 'imaging' of Sagittarius A or S2 and the use of its properties to investigate other black holes. It was recently imaged by many observatories called the Event Horizon Telescope, at radio wavelengths. ALMA detected molecular clouds 26,000 light years wide and 60 million light years away. The Event Horizon collection of radio observatories announced its acquisition of a black hole 'picture' on October 31, 2018.

The GRAVITY Telescope assisted with its findings that agreed with General Relativity.

The detection of Hawking radiation (matter becoming antimatter) is seen as evidence for the existence of wormholes.

Stars are orbiting around Sagittarius A. It has shown non-central red and blue shifting of material around it.

Doug Black's Powerpoint presentations suggested some ways to undertake various spectroscopy projects, such as contributing to the BeSS, or emitting B-stars, database. His presentation outlined how the HAA might be able to undertake such activities, if it wished to do so.

Our sincere thanks go to the Blacks for their hospitality and refreshments and to other group members for their refreshments. The group will likely meet again for the last time this HAA year on Friday evening, June 21/19. Stay tuned for any cancellations or changes.

H.A.A.'s Loaner Scope Program

We at the HAA are proud of our Loaner Scope Program.

If you don't have a telescope of your own and want to make use of one for a month or so, you can borrow one of our fine loaner scopes.

Please contact Jim Wamsley, at: 905-627-4323

or e-mail Jim at: *secretary 'AT' amateurastronomy.org*

and we'll gladly get one signed out for you.

Skyscapers, a Group for Women Astronomers by Ann Tekatch

The first meeting of *Skyscapers*, a newly-formed group for female club members, took place on April 25 at Williams Fresh Cafe on the Hamilton waterfront. The evening was cloudy, so no observing took place, but we had a great time getting to know new friends and discuss plans for future outings.

The purpose of this new group is to provide opportunities for the women in the club to make new friends, find observing buddies and gain confidence in operating telescopes and observing.

Our next meeting is Monday June 10, 8:00 pm at McQuesten Park, Hamilton. (South of the Linc on Upper Wentworth Street.)

Bring your telescope or come and learn about ours.

We hope Brenda can bring her telescope so we can all help her set it up! (Yes - that's a hint, Brenda!)

Contact me to get added to the Skyscapers' email list.
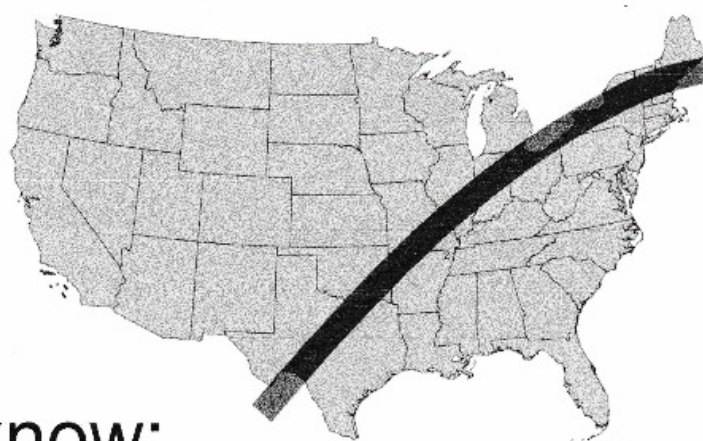

Ann Tekatch

treasurer 'AT' amateurastronomy.org

The first meeting of Skyscapers, April 25, 2019.

What are your plans

for viewing the

2024 Solar Eclipse?

Let me know:

eclipse@amateurastronomy.org

The Sky For Summer 2019 by Bob Christmas

As I mentioned last month, for personal reasons, Steve is taking a break from his duties as Observing Director. So I am doubling as author of *The Sky* once again.

Since the E.H. will be taking a break until September, I will be covering events in the sky for the months of June, July and August.

The Sky at a Glance

Here's an all-sky chart for *July 7, 2019, at 11:30 pm EDT*. It shows the summer constellations and the positions of the Moon, Jupiter and Saturn on July 7. This chart was generated, using the Heavens Above website.

Don't forget that this will be the sky an hour earlier every half month later. On July 23, this will be the sky at 10:30 pm; on August 7, this will be the sky at 9:30 pm, etc.
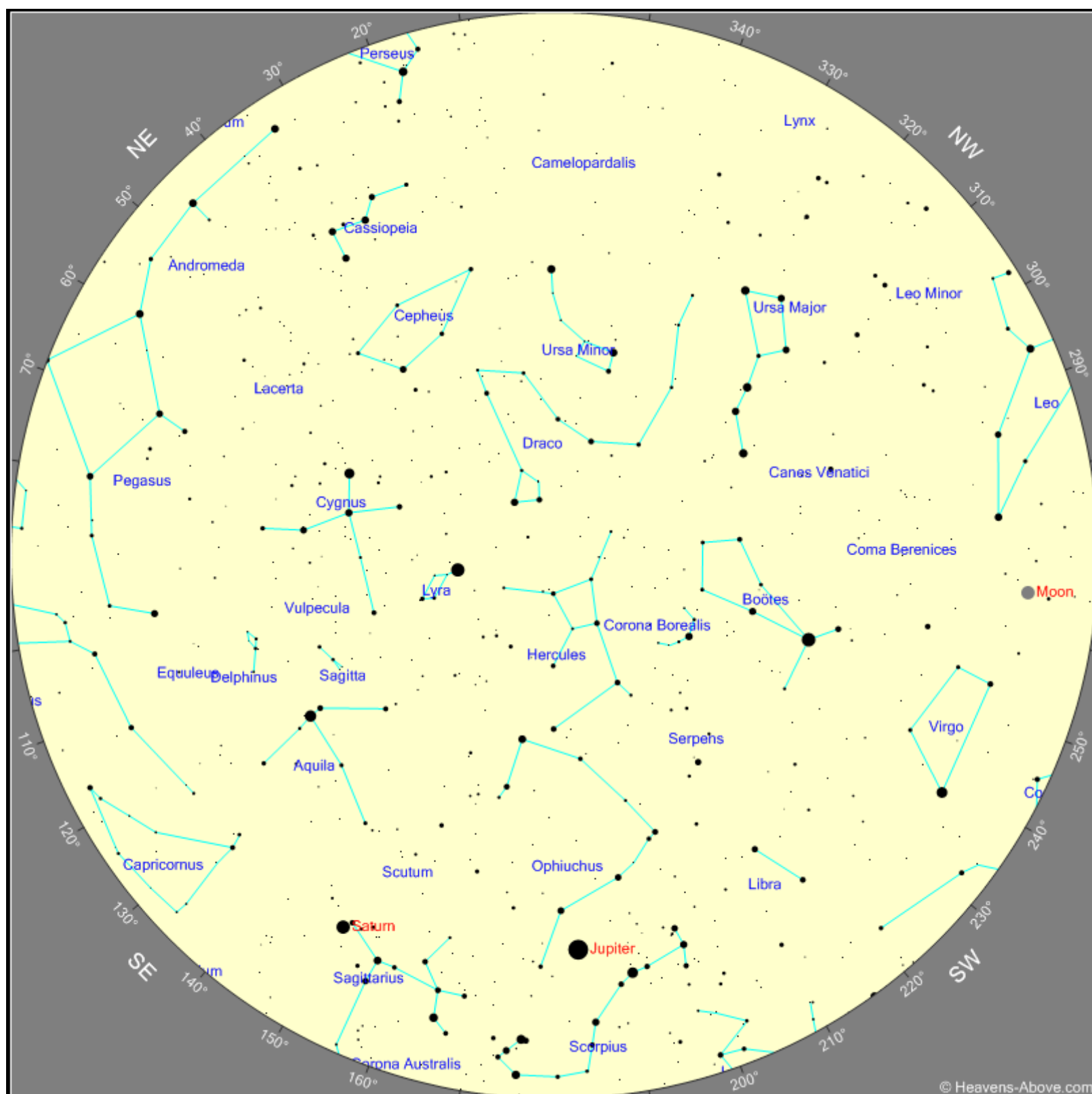
© Heavens-Above.com

The Sky For Summer 2019 (continued)

The Moon

Phases this summer:

- June 3   10:02 UT — New Moon
- June 10   05:59 UT — 1st Quarter
- June 17   08:31 UT — Full Moon
- June 25   09:46 UT — Last Quarter
- July 2   19:16 UT — New Moon
- July 9   10:55 UT — 1st Quarter
- July 16   21:38 UT — Full Moon
- July 25   01:18 UT — Last Quarter
- August 1   03:12 UT — New Moon
- August 7   17:31 UT — 1st Quarter
- August 15 12:29 UT — Full Moon
- August 23 14:56 UT — Last Quarter
- August 30 10:37 UT — New Moon

The Planets

- *Mercury* is in the evening sky in June, with a very close conjunction with Mars on June 17-18, and a very favourable maximum elongation of 25 degs on June 23.   It becomes more difficult to see in the evening in July before reaching inferior conjunction on July 21, after which it is in the morning sky until the end of August.

- *Venus* is in morning twilight and getting increasing difficult to see, becoming unobservable in early July as it enters the Sun's glare, before reaching superior conjunction on August 14.

- *Mars* is in evening twilight, with a very close conjunction with Mercury on June 17-18. It becomes increasingly difficult to see after sunset in June and becomes too close to the Sun to safely observe as July progresses, lost in the Sun's glare after that. It reaches superior conjunction on September 2.

- *Jupiter* reaches opposition on June 10. It will be visible most of the night all summer, very prominent in the southern sky in southern Ophiuchus and northwestern Scorpius.

- *Saturn* rises progressively earlier in the southern sky in Sagittarius, just east of Jupiter. Saturn reaches opposition on July 9. It remains prominent in the southern sky most of the night all summer.

- *Uranus* re-appears in morning twilight in June, becoming easier to observe in the morning sky in Aries.

- *Neptune* rises progressively earlier in Aquarius, becoming stationary on June 22 before beginning a slow retrograde loop that lasts all summer and into the fall. It remains well placed for most of the night.

Minor Planets

- *(1) Ceres* is in ideal position in the summer evening sky this year, in Scorpius, NNW of the bright star Antares, and just to the right of Jupiter. It passed opposition on May 28. It will be at about magnitude 7 in early June, dimming to about magnitude 8.7 by the end of August, but still visible in binoculars.

- *(15) Eunomia* is in the constellation Aquarius. It will be at about magnitude 9.8 to begin June, but it will brighten to magnitude 8.3 on August 10, and should be visible in binoculars.

Comets

Unfortunately, no bright comets are visible right now; nothing brighter than magnitude 12.5. But I don't completely rule out the possibility that a previously undiscovered comet could surprise us this summer, or anytime, really. You can keep track of comets currently in the sky, using 2 very useful websites:

Weekly Information about Bright Comets:
http://www.aerith.net/comet/weekly/current.html

Heavens Above's Comet Page:
https://www.heavens-above.com/Comets.aspx

Summer Messier Objects

The summer sky offers up some of the best showpiece deep sky objects from the Messier catalogue. Here is a selection:

- *M13* — (globular cluster) the great Hercules Cluster, visible to the naked eye under a dark sky in the "keystone" of the constellation Hercules. Its visual magnitude is 5.7
- *M6* — (open cluster) the "Butterfly Cluster", in Scorpius; magnitude 4.2; low in the southern sky though.
- *M7* — (open cluster) "Ptolemy's Cluster", in Scorpius; magnitude 3.3, but also low in the southern sky.
- *M16* — (emission nebula with open cluster) the "Eagle Nebula", in Serpens; contains the "Pillars of Hercules", made famous by a Hubble image.
- *M17* — (emission nebula) the "Swan Nebula", in Sagittarius, just below M16.
- *M8* — (emission nebula) the "Lagoon Nebula", in Sagittarius; naked eye under a dark sky; fabulous in binoculars or a low-power telescope.
- *M20* — (emission/reflection nebula) the "Trifid Nebula", in Sagittarius, just above M8.
- *M22* — (globular cluster) bright cluster in Sagittarius; magnitude 5.1; naked eye under a dark sky.
- *M57* — (planetary nebula) the "Ring Nebula", in Lyra; magnitude 8.8; looks like a smoke ring; use averted vision at the telescope eyepiece to see well.
- *M27* — (planetary nebula) the "Dumbbell Nebula", in Vulpecula; magnitude 7.3.

Timeline of Significant Events

- June 5 — Mars 1.6 degrees north of the crescent Moon.
- June 7 — Moon in Beehive Cluster (M44).
- June 10 — Jupiter at opposition.
- June 15 — Ceres 0.9 degrees south of the Moon.
- June 18 — Mercury 0.2 degrees north of Mars (see charts in NASA Night Sky Notes on page 16).
- June 21 — Summer Solstice.
- June 23 — Mercury at greatest elongation in evening sky; 25 degrees.
- July 2 — Total Solar Eclipse visible in Chile and Argentina.
- July 4 — Thin waxing crescent Moon in Beehive Cluster (M44).
- July 9 — Saturn at opposition.
- July 13 — Jupiter 2 degrees south of the Moon
- July 20 — 50th anniversary of Apollo 11, the first manned Moon landing.
- July 28 — S Delta-Aquariid meteors peak.

The Sky For Summer 2019 (continued)

Timeline of Significant Events (continued)

- August 9 — Jupiter 2 degrees south of the Moon; Mercury at greatest elongation in morning sky; 19 degs
- August 12 — Saturn 0.04 degrees north of the Moon; Pluto 0.1 degrees south of the Moon.
- August 13 (early morning) — Perseid meteors peak.
- August 28 — Thin waning crescent Moon 0.3 degrees north of the Beehive Cluster (M44).

Have fun observing everyone, and let's hope for lots of clear night skies.

Sources

- The Royal Astronomical Society of Canada. *Observer's Handbook 2019.* Editor: James S. Edgar. Toronto, ON, 2018.

- The Heavens Above website; https://www.heavens-above.com

Eye Candy the Members' Image Gallery

Sylvie L Gionet

Waning Gibbous Moons by **Sylvie Gionet**

(*left:* May 21, 2019 — illumination: 92%; *right:* May 24, 2019 — illumination: 70%)

Both were taken with her Canon Rebel T6i through her Canon EF-S 55-250mm zoom lens, set at 250mm.

Oh wow! It's so Obvious How the Universe Works by Bill Tekatch

OK, maybe it is not very obvious, but I hope that when you get to the end you will say "oh wow it's so obvious."

Current cosmology seems to explain a lot. The standard model (Lambda-CDM model) with inflation is very compelling and convincing until we get to dark energy and dark matter. This leaves us in the dark.

In 1911 a paper titled "On the Influence of Gravitation on the Propagation of Light" by Albert Einstein was published in Annalen der Physik 35 (1911): 898-908. Einstein was made famous to the general public by this paper because he calculated that light travelling past the Sun would undergo a deflection of 0.83 seconds of arc. This was confirmed to great acclaim when the next solar eclipse occurred.

The paper mentions how a clock runs $(1+ \Phi/c^2)$ times slower when moved to a stronger gravitational field. This is called gravitational time dilation. In the paper, equation (3), $c=c_o(1+(\Phi/c^2))$ is then given where c_o is the speed of light at the first location and c is the speed of light at the higher gravitational potential Φ (yh where the acceleration due to gravity is y and the vertical distance is h). Then he states,

"The principle of the constancy of the velocity of light does not hold in this theory in the formulation in which it is used as the basis of the ordinary theory of relativity. From the proposition just proved, that the velocity of light in the gravitational field is a function of place, one can easily deduce, via Huygens' principle, that light rays propagated across a gravitational field must undergo deflection."

He essentially said that the speed of light can change, but says it can't be true because the speed of light can't change, and then he uses the changing speed of light to make his correct calculation. Due to the acceptance of the speed of light as being constant, it is mass which has been seen as the variable quantity. I will show that the speed of light is not the same everywhere and yet is always exactly the same value in a vacuum wherever it is measured, and mass is not as variable as it was thought to be.

Recent observations of gravity waves from neutron stars and black hole mergers have proven that gravity waves travel at the speed of light. This confirmation made me realize that this fact can change how we think about the structure of the observable or visible universe.

Let us set out some basic principles that are required.
1. The speed of light in a vacuum is the same everywhere in the universe.
2. Energy is conserved, and cannot be created or destroyed, only changed in form.
3. Every point in the universe is the center of its own observable universe.

The equations that I will use may not be exact; they are just to demonstrate the concept.

The cosmological redshift when combined with distance was used to determine an implied recessional velocity known as the Hubble constant H_o. It is now known not to be constant and is called the Hubble parameter H. The most recent measurements are giving two different values. A significantly higher value of about 74 (km/s)/Mpc and a lower value of about 68 (km/s)/Mpc. The lower values are based on measurements of the observable universe over 5 billion years ago, and the higher values are based on the universe less than 5 billion years ago. This is why it is thought that the universe is expanding at an accelerating rate. Here is the not so obvious property of the Hubble parameter. The units end up at 1/second. But because units normally cancel out, the actual units may be second/(second)^2 which is time acceleration. So, we may actually be measuring the rate at which time is accelerating.

Time dilation $\Delta t=\Delta t_o/(1-(v^2/c^2))^{1/2}$ is the slowing down of time (as would be seen on a clock) when travelling, and is most apparent at high speeds especially near the speed of light. It can also occur in a gravitational field. The stronger the gravity the slower time passes. This has become very apparent and

Oh wow! It's so Obvious How the Universe Works (continued)

requires time dilation correction for Global Positioning System (GPS) satellites. Now that very high precision atomic clocks are available, we can actually measure gravitational time dilation on Earth's surface with height differences as little as one metre.

Length contraction $L=L_o(1-(v^2/c^2))^{1/2}$ as with time dilation occurs with motion and is due to gravity. The other way to interpret this is that the weaker gravity becomes the greater the amount of space there will be. As the density of the universe becomes lower the more space there will be. Less mass equals more space.

The relative speed of light $c=c_o(1+(\Phi/c^2))$ as Einstein wrote can be explained this way. Gravitational potential energy $E_p=mgh$,   where potential energy (E_p) equals the objects mass (m) times the acceleration due to Earth's gravity (g) times the height (h) that an object is lifted. If the energy of the object at the original lower position is $E=mc^2$ and E_p is added, then energy at the higher position is $E=mc^2+mgh$.   Without increasing the mass we can state $E=m(c^2+gh)$ and therefore the relative speed of light at the higher position is $c=c_o+gh$. Let's put some real numbers in to show how small that is. The Earth's gravity gives an acceleration of about 9.8 m/sec^2, so lifting the object one metre, makes gh equal to 9.8 m^2/sec^2. Take the square root to get the speed and the answer is about 3.1 metres per second. This is very small compared to the speed of light at 300 million metres per second. As we move away from the Earth the speed of light is faster. Why is it always exactly the same speed in a vacuum when measured? The answer is that the speed of light is different as time and space are too. Using Einstein's approximate equation $(1+(\Phi/c^2))$,   time is faster in the higher position exactly matching the faster speed of light. The result is that the measured speed of light is constant. This is what happens everywhere and why even though the relative speed of light is different, the speed of time always
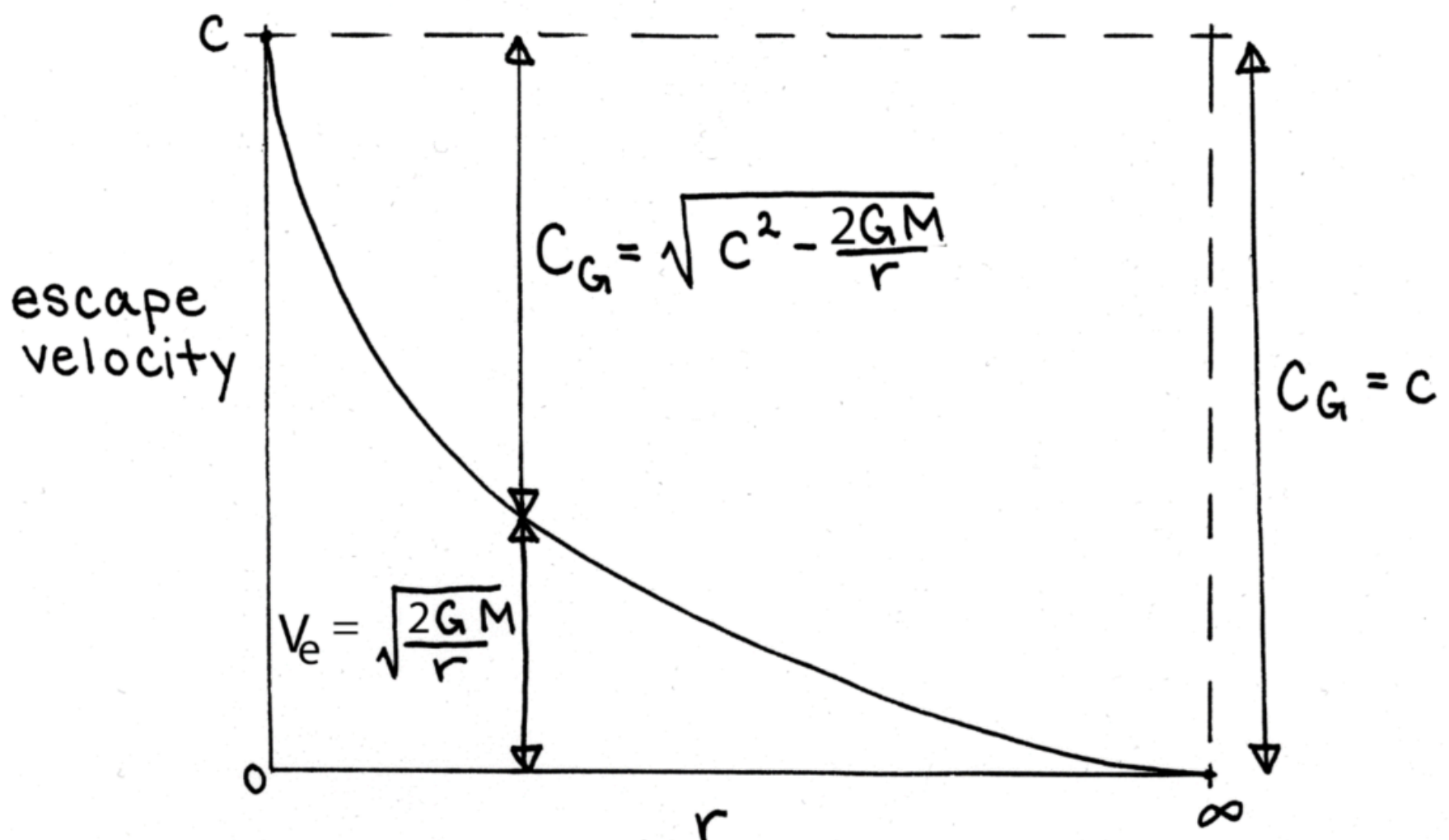
Gravitational speed of light C_G and escape velocity V_e versus distance from center of mass r

$$C_K = \frac{C_0}{\sqrt{1 - v^2/c^2}} - C_0$$
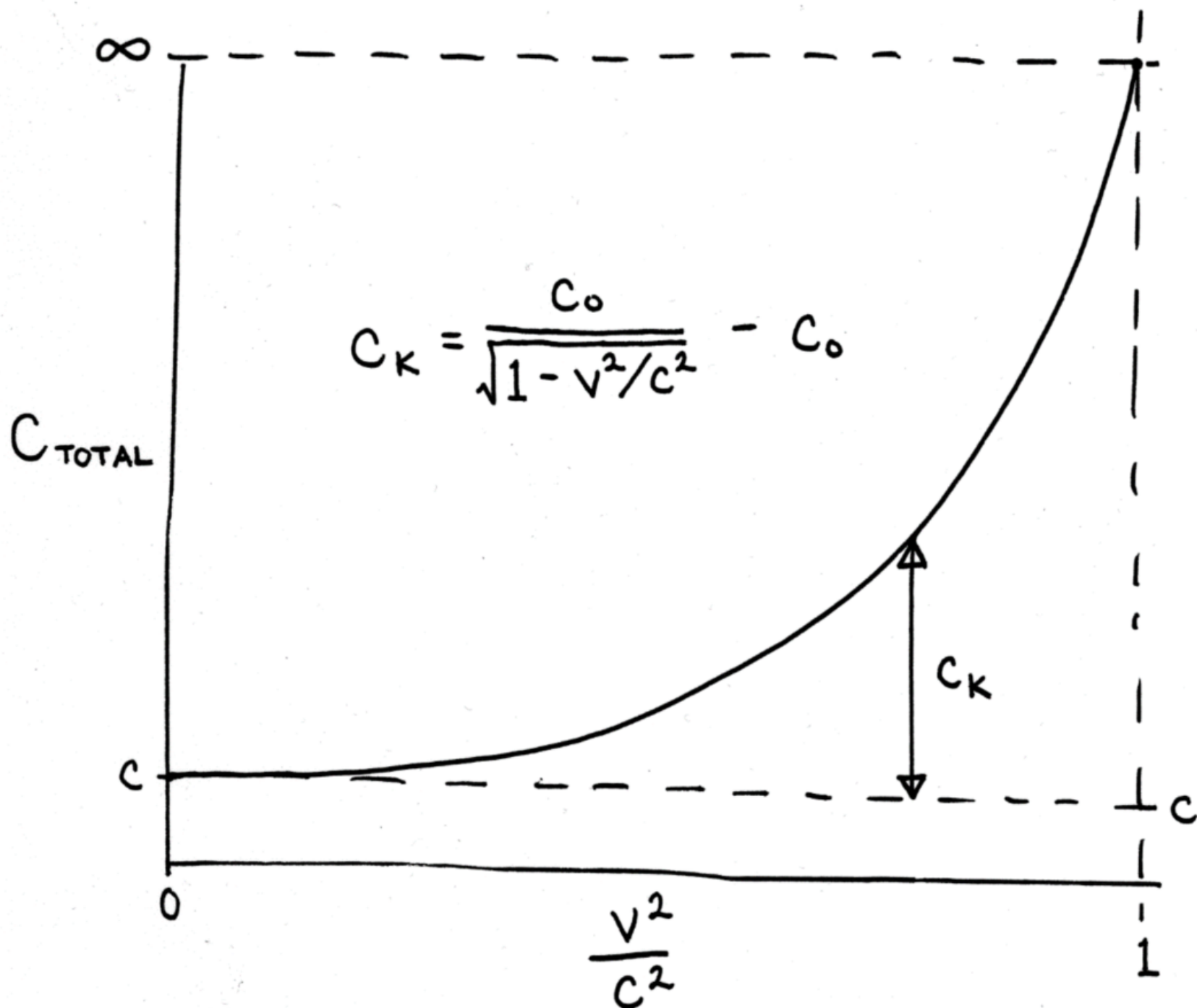
Kinetic speed of light C_k versus Velocity v^2/c^2

exactly matches it, resulting in a constant universal speed of light. This makes the relative speed of light an implied property that can not be directly measured.

Distance versus time. We usually measure distance with a ruler or measuring stick. Here is my two cities analogy. There are two cities, city A and city B. They are one hour apart. You drive at 50 Km/h and it takes one hour to get from city A to city B. They must be 50 Km apart. Now you travel at 100 Km/h and it takes one hour. They must be 100 Km apart. You travel at 200 Km/h and again it takes one hour to go from city A to city B. They must be 200 Km apart. If we go slower, much slower, zero Km/h, and it takes one hour to go from city A to city B are they zero distance apart? The point is that when objects are separated by time, you determine the distance between them by measuring the speed to travel from one to the other.

Oh wow! It's so Obvious How the Universe Works (continued)

We can convert all distance measurements to time if we use the speed of light as our ruler. Now think of all objects in the Universe fixed in three-dimensional time. Just like the city analogy, as the relative speed of light increases, distance between objects appears to increase. We are very attuned to interpreting our world in terms of distance. It would be difficult to accept that the time for light to travel between objects had not changed.

This means that while the Sun is about 8 light minutes from us today, it will still be 8 light minutes from us tomorrow. But, because the relative speed of light is increasing, it will be farther away from us tomorrow. Not to worry. Even though the Sun will be farther away, it will shine brighter because $E=mc^2$ tells us that it will produce more energy. The drop in light intensity due to increased distance is exactly cancelled by increased energy production. Another consequence is that black holes would shrink.

Of course, there are more consequences due to a constantly increasing relative speed of light. It means that there is no Dark Energy. No energy is required to push apart everything in the Universe. Because nothing is being pushed apart.

Here is a parting thought. If you had an infinite Universe of uniform density, and in this Universe, there were two points separated by infinite time, what is the physical distance between these two places if the relative speed of light is zero? It would be zero. So, this infinitely old Universe, that is of infinite size in time, but zero size in space would change instantly if the relative speed of light assumed any value greater than zero. That is how the Universe works.

The Universe

Time	Relative Speed of Light	Density	Time Rate
Zero	Zero	Infinite	Zero
> Zero	> Zero	High	> Zero
Now	c	0.2-0.25 Hydrogen atoms/m^3	1
Future	> c	Low	Faster
Far Future	Infinite	2 or More Particles left in the Universe	Infinite
End	Zero	<2 Particles left in the Universe	Zero
Zero	Zero	Infinite	Zero

This article is distributed by NASA Night Sky Network.

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach.

Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Jupiter Shines in June

By David Prosper

Jupiter stakes its claim as the king of the planets in June, shining bright all night. **Saturn** trails behind Jupiter, and the **Moon** passes by both planets mid-month. **Mercury** puts on its best evening appearance in 2019 late in the month, outshining nearby **Mars** at sunset.

Jupiter is visible almost the entire evening this month. Earth will be between Jupiter and the Sun on June 10, meaning Jupiter is at **opposition**. On that date, Jupiter rises in the east as the Sun sets in the west, remaining visible the entire night. Jupiter will be one of the brightest objects in the night sky, shining at magnitude -2.6. Its four largest moons and cloud bands are easily spotted with even a small telescope.

What if your sky is cloudy or you don't have a telescope? See far more of Jupiter than we can observe from Earth with NASA's **Juno** mission! Juno has been orbiting Jupiter since 2016, swooping mere thousands of miles above its cloud tops in its extremely elliptical polar orbits, which take the probe over 5 million miles away at its furthest point! These extreme orbits minimize Juno's exposure to Jupiter's powerful radiation as it studies the gas giant's internal structure, especially its intense magnetic fields. Juno's hardy JunoCam instrument takes incredible photos of Jupiter's raging storms during its flybys. All of the images are available to the public, and citizen scientists are doing amazing things with them. You can too! Find out more at bit.ly/JunoCam

Saturn rises about two hours after Jupiter and is visible before midnight. The ringed planet rises earlier each evening as its own opposition approaches in July. The **Moon** appears near both gas giants mid-month. The Moon's tour begins on June 16 as it approaches Jupiter, and its visit ends on June 19 after swinging past Saturn.

Mercury is back in evening skies and will be highest after sunset on June 23, just two days after the summer solstice! Spot it low in the western horizon, close to the much dimmer and redder **Mars**. This is your best chance this year to spot Mercury in the evening, and nearly your last chance to see Mars, too! The two smallest planets of our solar system pass close to each other the evenings of June 17-18, coming within just ¼ degree, or half the width of a full Moon, making for a potentially great landscape photo at twilight.
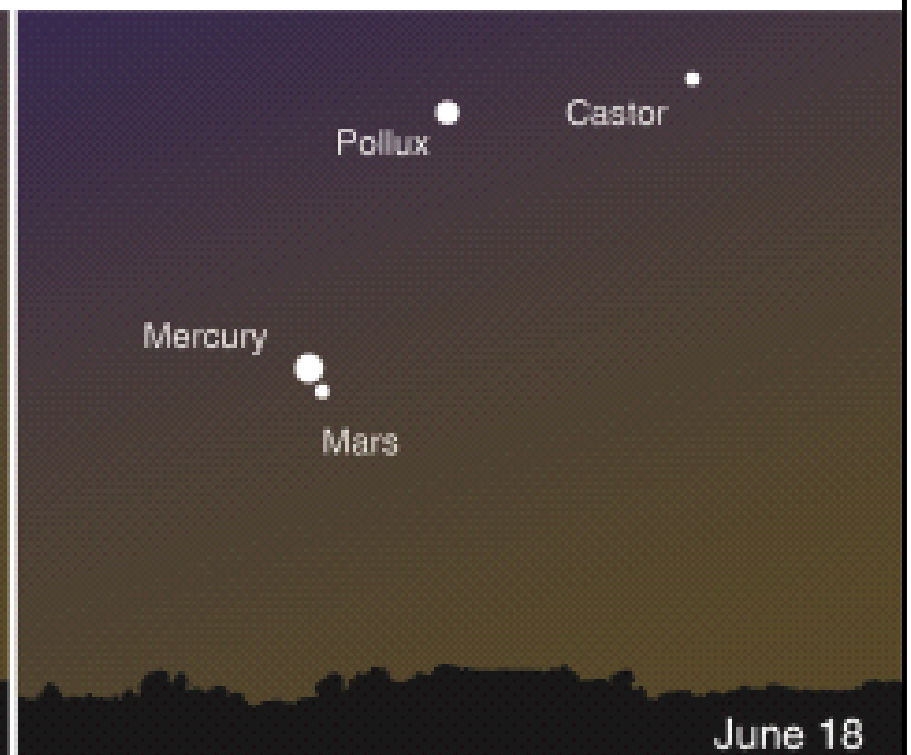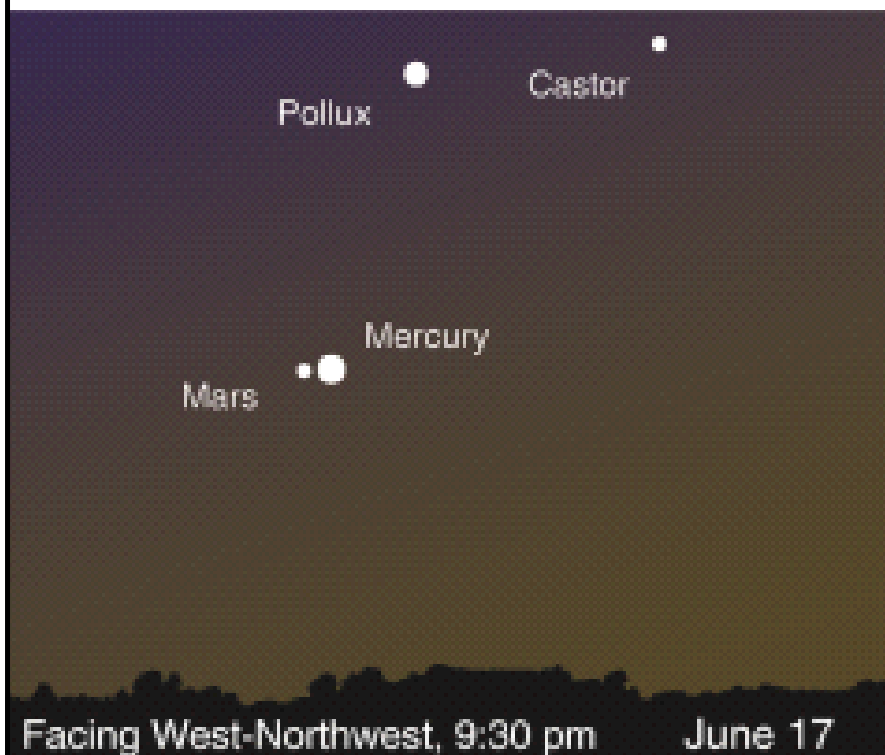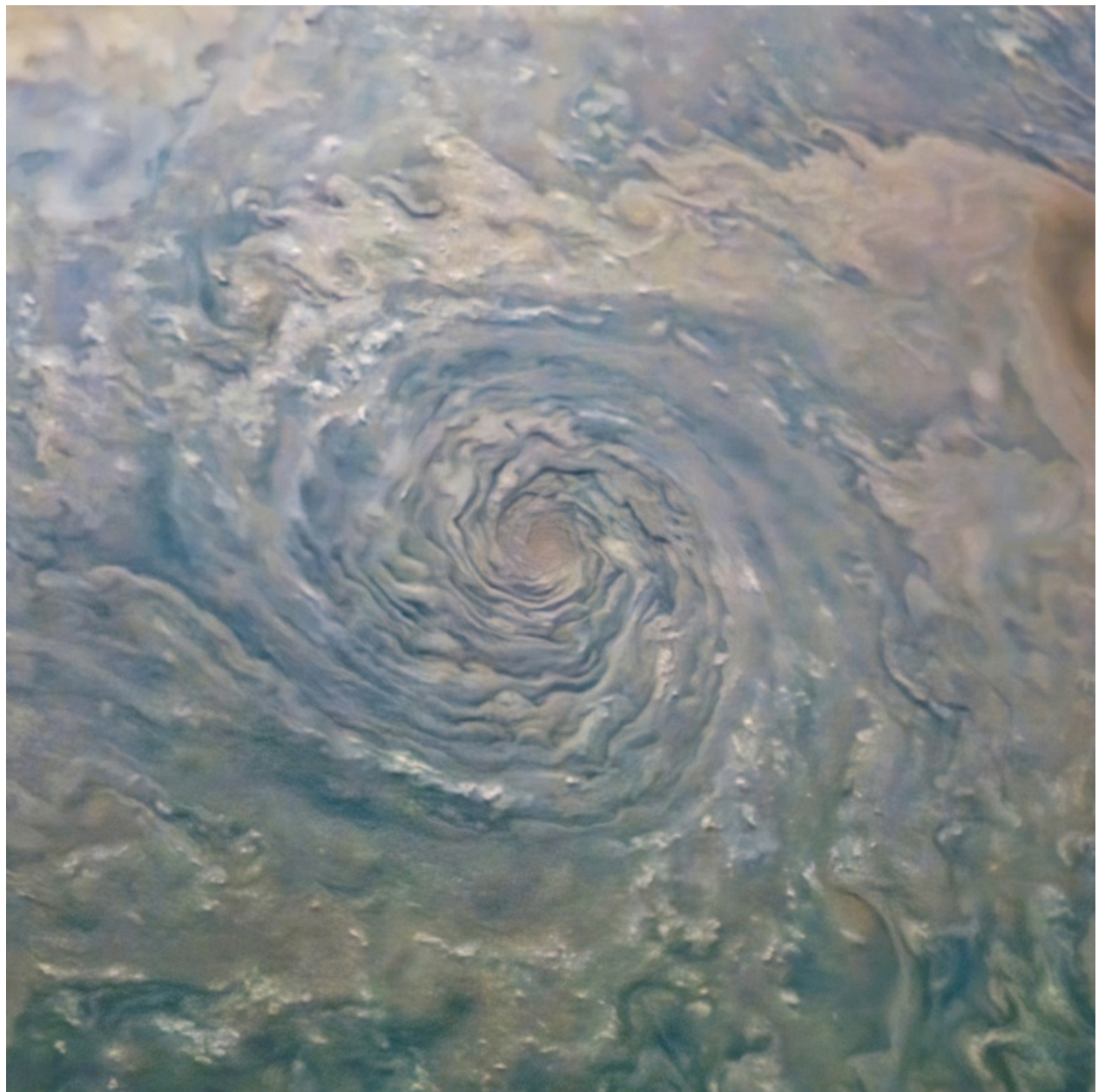
NASA Night Sky Notes (continued)

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Right: A giant storm in Jupiter's north polar region, captured by JunoCam on February 4, 2019. Image processing performed by citizen scientists Gerald Eichstädt and Seán Doran.

Photo Credit: NASA

Source:
http://bit.ly/JupiterSpiral

Mars and Mercury after sunset the evenings of June 17-18, 2019. Image created with assistance from Stellarium.

William J. McCallion
Planetarium
McMASTER UNIVERSITY, HAMILTON, ONTARIO

- **Public shows every Wednesday (7:00pm)**

- **Public transit available directly to McMaster campus**

- **Tickets $7 per person; private group bookings $150**

- **Different shows every week**

- **Upcoming shows include:**

    - **June 5:   Introductory Astronomy for Kids — Galaxies**
    - **June 12: The Search for Life: Are We Alone?**
    - **June 19: Stories of the Sky**
    - **June 26: The Celestial Bear: The Six Nations' Night Sky**

- **For more details, visit www.physics.mcmaster.ca/planetarium**

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  - **July 3: Introductory Astronomy for Kids — Solar System**
  - **July 10: Dammit Jim, I'm an Astronomer**
  - **July 17: The Golden Dance of Death**
  - **July 24: Next Generation Telescopes for Cutting Edge Science**
  - **July 31: Astronomy for Muggles**

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  - **Aug 7: Introductory Astronomy for Kids — Galaxies**

  - **Aug 14: Oumuamua and Other Eccentric Objects**

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UPCOMING EVENTS

June 14, 2019 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium. Our featured speaker will be **Dr. Brian McNamara** of the University of Waterloo. His talk is entitled *"1919-2019: A Century of Black Holes"*.

June 22 and August 24, 2019 - 2:00 pm - 5:00 pm (solar); 8:00 pm - 11:00 pm (evening) — *Public Solar & Stargazing Events* at Van Wagners Beach (near Hutch's & The Lakeview), Hamilton, ON.

July 20, 2019 - 8:00 pm - 11:00 pm — *Public Stargazing Night* at McQuesten Park, 1199 Upper Wentworth St, Hamilton, ON.

August 10, 2019 — *Perseids Meteor Shower Public Night* at Binbrook Conservation Area. Stay tuned for more details.

Sept 7, 2019 - 8:00 pm - 11:00 pm — *Public Stargazing Night* at Bayfront Park, Hamilton, ON.

Sept 13, 2019 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium.

2018-2019 Council

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Check out the H.A.A. **Website**
www.amateurastronomy.org

Contact Us
Hamilton Amateur Astronomers
PO Box 65578
Dundas, ON
L9H 6Y6

www.amateurastronomy.org

General Inquiries:
secretary@amateurastronomy.org

Membership:
membership@amateurastronomy.org

Meeting Inquiries:
chair@amateurastronomy.org

Public Events:
publicity@amateurastronomy.org

Observing Inquiries:
observing@amateurastronomy.org

Education:
education@amateurastronomy.org

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Observing site for the HAA provided with the generous support of the
Binbrook Conservation Area
Come observing with the HAA and see what a great location this is for stargazing, a family day or an outdoor function.
Please consider purchasing a season's pass for $79 to help support the park.
http://www.npca.ca/conservation-areas/binbrook/
905-692-3228

The Harvey Garden HAA Portable Library

Contact Information

E-mail: library@amateurastronomy.org