Event Horizon

Volume 25, Number 6
April 2018

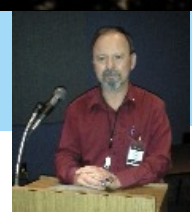
From The Editor

With April here, it's time to wave good-bye to both winter weather and winter constellations, and start saying hello to Spring skies and, hopefully in the not-too-distant future, Spring weather!

Happy Reading!

Bob Christmas,
Editor

editor 'AT'
amateurastronomy.org



Chair's Report by Bernie Venasse

Spring!?

Hello everyone. Welcome to April and spring skies. A lot has been happening and there is much more on the way. It is a great time to be a HAA astronomer!

Our March outreach event was held at the Grimsby Welcome Information Centre. Participation by members was very good with the public getting to view Venus, the Moon, etc. through 4 different types of scopes. There were many oohs and aahs and even a few 'holy cow's. Our visitors included a few participants of BASEF as well.

Our next outreach event is scheduled for April 21st at Bayfront Park in Hamilton. We will gather in the main parking lot. Join us for views of a setting Venus, Orion, and later, a rising Jupiter.

The March HAA meeting was well attended by very enthusiastic members and guests including many first-timers. John Gauvreau presented his portion of the Astro 101 program and I followed with my presentation about note taking and logging.

Our guest speaker in April will be Dr. John Percy from the University of Toronto. His presentation is entitled "Archaeoastronomy: The Astronomy of Civilizations Past". I expect a large audience at this event so arrive early for best seats!

(Continued on page 2)

IN THIS ISSUE:

Chair's Report (continued)

April 7, 2018 is the date for the spring edition of our Scope Clinic and Workshop. This is an event not to be missed! Along with our regular exhibitors, we will be presenting mini workshops that are aimed at the novice astronomer. Each workshop will offer a 10 – 15 minute presentation on a specific aspect of astronomy followed by a question and answer period.

BASEF 2018

There were 322 projects presented this year of which 18 were in the astronomy or physics category.

John gave his presentation, "From Apollo to Space-X" to an enthusiastic group of students while Mike Jefferson, Ann Tekatch and I partook in the judging process.

The winner of the 2018 James Winger Award is Arya Pisharody, a junior from John William Boich Public School in Hamilton for demonstrating an understanding of Gravitational Wave Astronomy. She has been invited to exhibit her presentation at the Scope Clinic on April 7th.

The Hamilton Amateur Astronomers encourage each BASEF exhibitor to continue to fork and follow their dreams.

Binbrook Messier Marathon March 17-18, 2018

The evening was a bit chilly and a bit breezy but that is what layering is for.

There were a dozen or so members and guests either running the marathon, trying their hand at some astrophotography, or were simply enjoying the clear dark skies.

I ended up being there until the early light and managed to see 102 Messier objects using a 15 x 70 bino.

You can try your luck this month at the new moon as well. Let me know how well you fare.

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.

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.

Masthead Photo: *The Moon, Venus and Mercury on March 18, 2018, by Bob Christmas.*

Taken with his Canon 40D DSLR through his Canon 100mm lens, set at f/3.5 & ISO 400, for a 1 second exposure.

The March 2018 General Meeting of the HAA by Matthew Mannering

HAA Chair Bernie Venasse's introduction emphasized that the topics covered that night were directed at those just getting into amateur astronomy.

Club member John Gauvreau was the first of two guest speakers for this month. John's talk "What you will see with your scope" is a part of the Astro 101 course that the club usually runs once per year.

- The solar system:
  - Consists of the sun, planets, moons, asteroids and comets.
  - This will be a great year for observing Mars.
  - When using the any telescope, do not look at the sun until you know how to observe it safely with the proper filtering.

- Deep sky:
  - Is anything beyond our solar system.
  - Single, double and variable stars.
  - Open and globular clusters.
  - Diffuse, planetary, super novae, reflection, emission and dark nebulae.
  - Galaxies, singular or in clusters.

- Example targets by season:
  - *Spring*: the Leo Trio (M65, M66, NGC3628) and M13 (a large globular cluster).
  - *Summer*: the double star Albireo and M8 (the Lagoon nebula).
  - *Autumn*: the Perseus Double Cluster and M31 (the Andromeda galaxy).
  - *Winter*: The Orion nebula (M42) and the Pleiades (M45) open cluster.

- Department stores usually sell junk telescopes.
  - The box cover usually claims unreal maximum magnification (e.g. 675x).
  - Images on the box look nothing like what you will see through the scope.
  - The mounts are rickety and the scope is made of plastic.
  - The eyepieces are junk.

- No matter how good the scope you have, you won't get Hubble like images.

- Scopes make things brighter and bigger.
  - John showed the relative amount of detail visible on the Moon naked eye vs. an 8" scope at high magnification.
  - He also showed the relative scale of the Moon and Saturn in the same field of view.
  - Viewing Jupiter will show the banding on the planet, and its moons.

- Too much magnification equals empty magnification. There is only so much information in the light entering the scope.
- Find the optimal magnification based on the type of scope you have, the viewing conditions and your eyesight.
- Use higher magnifications for galaxies as your eye will process the image better.

- John discussed the human eye:
  - How it is structured.
  - Expansion and contraction of the pupil based on light levels.
  - How dark adaptation improves your observing.
  - Using averted vision allows you to see the target better.

(Continued on page 4)

The March 2018 General Meeting of the HAA (continued)

Bernie then gave a talk on record keeping and why it is important.

- For every observing session record the date and time, location, equipment, weather conditions, limiting magnification and seeing. Record anything else that seems important.
- To determine limiting magnification, use the stars of the Little Dipper.
- Describe in your journal what you see.
- The details will differ based on experience, equipment, weather and sky conditions.
- Record anything else that appears in the field of view other than the primary target.

Why bother?

- Gives you a sense of accomplishment.
- Provides a historical perspective of your observing.
- Others can laugh at your descriptions.
- Badges and awards require documentation.
- You can use a voice recorder at the eyepiece and transcribe them later.
- Logs can be kept in books or in the computer.
- Quoting Isabel K. Williamson; 'Observations not written down are not observations'.

Bernie had a few announcements.

- The scope clinic will be held on April 7th between 1 and 5pm for the general public and between 12 and 6pm for club members.
- A series of talks will be presented at the clinic for beginners.
- We are already accepting pictures for the 2019 club calendar.
- Send pictures to *recorder 'at' amateurastronomy.org*.
- We encourage club members to enter submissions to the club newsletter the Event Horizon.
- If you have astro hardware for sale, send a description of the article to *editor 'at' amateurastronomy.org*.

Bernie had a few announcements.

Denise White encouraged people to donate books to the club library.

Steve presented "The Sky This Month" after the break.

- We were clouded out for the January 31st lunar eclipse.
- The Falcon Heavy rocket launched a Tesla into space.
- Showed a couple of pictures of Mercury and Venus low in the western evening sky.
- Page 97 of the "RASC Observer's Handbook 2018" has a one page chart titled "Right Ascension of the Sun and Planets 2018". The chart shows the morning and evening visibility of the planets for the entire year.
- It also shows the constellation they will appear in and when the planets are in conjunction with the sun.
- Steve talked about the 3 different phases of twilight (civilian, nautical and astronomical) and how the angle of the ecliptic affects the length of time of each phase. Night time occurs once the sun is 18 degrees below the horizon.
- The minor planet Ceres is in the constellation of Cancer at the moment. Use a chart to find it against the field of stars. Observe it over several nights and track its movement.
- Steve was planning to be at the Sydenham Road Lookout the evening of March 30th to photograph the full moon.
- The next astrophysics meeting will be held on Friday March 16th at 7pm.

Meeting closed at around 9:40pm.

Hamilton Amateur Astronomers Astrophysics Group by Mike Jefferson

March 16, 2018

Present at the March 16 meeting were Aidan King, Doug Black, Gary Sutton, Steve Germann and Mike Jefferson. The topic was a programme called “Starlift” and was presented by Steve. It was a fanciful method on how it may be possible to mine hydrogen from and harness power from stars and very large planets in the future. Our sun is a candidate for this as it contains 99.8% of all the material in our solar system.

Starlifting is how we may one day affect stars and not how they might affect us. Such a condition could only be met by a K-2 civilization which would not have to worry about being exterminated by supernovae.

Programmes like this one are done by Isaac Arthur on YouTube every Thursday.

Doug did more presenting of “Distances In And Beyond Our Galaxy”. There are ~36 ways to measure the universe. The Sunyaev-Zel'dovich Effect (where the hot electrons of clusters of galaxies repel the cosmic microwave background photons and thus reveal the galaxies' presence) was reviewed. The SZ Effect is fully independent of redshift and extra-galactic distances.

Inverse Compton Scattering was briefly touched on.

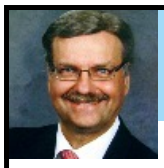
Next month we are set *tentatively* to meet on April 20. The topic for discussion may be “V=HoD” or “Redshift and the Hubble Constant”.

Our thanks to Doug for the hospitality and refreshments.

Treasurer’s Report by Ann Tekatch

Treasurer's Report for March 2018 (Unaudited)

Opening balance:	$9,170.94
Revenue:	
Memberships:	$205.00
50/50 Draw:	$37.00
Expenses:	
Domain renewal:	$206.15
PayPal fees:	$6.61
Closing Balance:	$9,200.18



The Sky This Month for April 2018 by Steve Germann

The Seasons

Now that Spring has arrived, we will see the Sun setting later and later each evening meaning we get a little less time to see the stars in the evening. Fear not, there's still plenty of time all through April for evening stargazing.

On the bright side, so to speak, it will rise more directly, so twilight is shorter, and the night can still be long.

Also, being warmer, it is more likely we will be willing and able to endure outside for a while.

Jupiter approaching opposition

Jupiter is almost at opposition, which happens on May 9th. Watch Jupiter for a week approaching conjunction, when it will become somewhat brighter, both due to getting closer to Earth, and all the shadows lining up so that we see slightly more illuminated surface.

Nothing remarkable about Jupiter this month, apart from its brightness. But it's always a treat to see it with optical aid.

Try locating its 4 moons, and make a sketch. We can check it against references to see which moon was which.

Venus - Soon to be the subject of ordinary conversation

Venus is getting more and more prominent in the evening sky this month, and will be within a few degrees of the *Pleiades* on the 25th of April and the days before and after. As Venus becomes more prominent, you will hear people remarking about a slow moving plane, etc, in the evening. Here's your chance to let them know that this happens about 1.5 times per year on average, and that once the US Air Force scrambled jets to go and intercept whatever it was that seemed to be coming towards their location, lights blazing. I think that's a made up story, because I don't know which air base it was, and either way I would not expect them to be publishing every time they take off to shoot down a planet.

Take a look in the western sky a few times this month, and imagine that pilot heading out on his mission. Try not to grin too wide.

I looked around for a decent reference on the Internet, and found plenty of stuff, but none worth quoting. If you can find one, send it to me and I will share it at our monthly meeting on April 13th.

The Moon

The *Full Moon* rises on the 30th of April, and will have an azimuth of 109 degrees which means it will rise along the main streets of Hamilton.

If you live downtown, this is a perfect time to spot the moon near the eastern horizon, along the canyon of one of the wide one-way streets. A word of warning though. By 21:19, when the moon is considered 1.4 degrees above the horizon, it will have drifted south enough that you won't see it along those streets anymore.

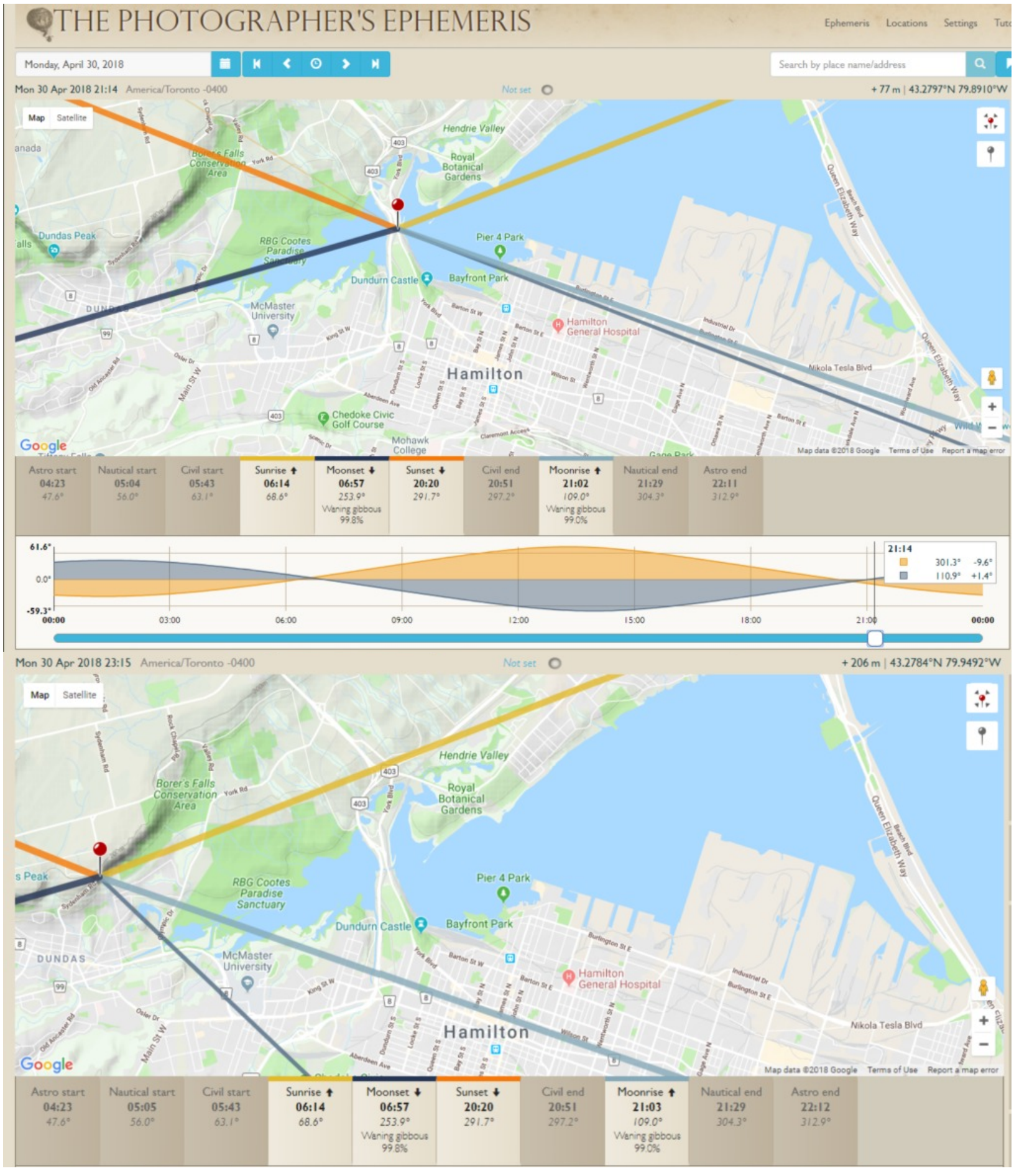
(Continued on page 7)

The Sky This Month for April 2018 (continued)

The darker blue line in the second figure shows the actual azimuth to the Moon as well as it altitude and the time.

So it's amazing to me, to see how long it takes (12 minutes) to get to 1.4 degrees altitude and how far diagonally it drifts. It's cool to have this planning tool available.

(Continued on page 8)



Direction Charts for Moonrise & Moonset for April 30 from The Photographer's Ephemeris.

Try getting a vantage point to the Moon, and taking some photos as it rises. You will see the famous 'Hamburger' shape of the moon at the horizon. How low can you see it?

99942 Apophis - A close approach

Well, 11 years from our upcoming April meeting night, 'we' (the astronomers of note) have computed that *99942 Apophis* will make a close approach to earth.

It will actually be worth using a pair of binoculars to watch it go by, probably 4th magnitude.

Its subsequent orbit and possible future collision opportunities depend on its exact position when it gets to its closest point, and our best computers don't really have much to say about the future after 2029 (and 2036) until we get better data.

This asteroid was special because it started out with a 1 in 200 chance of impact, and then after more math, the odds were 1 in 37. Subsequently the odds climbed back to infinity. Let me say a few words about how that can happen.

Suppose we don't know the orbit precisely, and we have a large circular target like a dartboard, and we know the dart will hit the board, but Earth is not at the center of the board and is actually a small target (in this case, about the size of a loonie) a bit off center. Then later, we get more data, and the dartboard gets smaller, more like a dinner plate, and the Earth is still covered. That's when the odds climb to 1 in 37. Then we get even more data, and the dartboard is about the size of a dime, and it's not overlapping Earth anymore. That's when it's known not to hit.

But of course, if you don't know that, you get worried instead of needing more data.

Fortunately, we know it.

Averting Disaster (Dis-aster?)

I expect that a couple of years before close approach (which is currently known to miss the Earth in either case) we will know the orbit much much more precisely. However, a thought experiment on the cost and difficulty of an intercept is in order.

There are 2 kinds of intercept. Those which get the asteroid to miss the earth, and those that just nudge it a bit so it hits a 'keyhole in space' and goes to a harmless orbit after that.

The latter is WAY easier if you have the math and the time. However, it only works if you are far enough in advance that there is still a keyhole to aim at. When an asteroid is not going through any more keyholes (close encounters that change its orbit a lot) then you have to resort to brute force, as shown below.

Disclaimer: This math is not actually rigorous, but I hope it gives you enough confidence to be able to sleep in the daytime. (And stargaze at night)

Being about 270 meters in diameter, 99942 Apophis has a volume of about 10 million cubic meters, and a mass of maybe 20-50 million tons.

(Continued on page 9)

The Sky This Month for April 2018 (continued)

It seems to be in an earth chasing orbit, so its relative velocity is comparatively small. It would still be expected to add about one earth escape velocity (11 km/s) to its speed as it hits.

So the approximate energy content is about 70 gigajoules per ton, for a total energy of 344 million tons of TNT (or rocket fuel if you will). Be at least 20 miles away when it hits... (just kidding. I would recommend 200 miles)

To give an object of that weight, a speed so that it moves roughly 1 Earth diameter per month, would be a speed of 2.5 meters per second, roughly 3 joules per kilogram.

So if you could intercept it a month away, you would need to have a rocket that could add 150 gigajoules of kinetic energy, and to add about 150 giga-Newton-Seconds of thrust. 150 gigajoules is not much. About 50 tons of rocket fuel.

But the momentum is thrust times time. Assuming we have a decent rocket engine with a thrust of about 1 million Newtons, we would have to run it for about 1.5 days. The upper stage of a Falcon 9 rocket produces comparable thrust at takeoff axis for 6 minutes. So we are talking a lot of rocket power.

Now, if you can plan your operation a year in advance, and only get to the half the Earth diameter per year, the numbers go down by a factor of 24 but there is still a need for about 1.5 hours at that thrust. 90 minutes. 15 refueled Falcon 9 upper stages all pushing one way.

Not impossible... not even that hard.

A refueled 'Big Falcon Ship' puts out about 10x that thrust and can do so for probably 10 minutes. So 10 of those for good measure.

Not actually that hard to do. I would say that long term investments are still advisable.

In History

Here is a historical article talking about the math of close approach.

https://deepastronomy.space/article/2/apophis-the-asteroid

Let's see what Heavens Above says about it...

According to heavens-above.com, it's in the sky now, between Venus and Taurus (see chart on page 10), and it's at magnitude 21.6 which means you could photograph it if you were at Cherry Springs, but not from here.

More useful might be to crash it into the Moon and watch the sparks fly. If it's made of metal, then there will be a lot of valuable minerals in the plume and crater. Changing its course to crash it into the Moon requires a lot more rocket power than mentioned above.

About 60 times more. Still not 'insurmountable'.

If you want to see what they tell non-astronomers, here's a Youtube video as good as any:

https://www.youtube.com/watch?v=LmVpx8P4GHM

(Continued on page 10)

The Sky This Month for April 2018 (continued)

Seeing an asteroid

If you want to see an Asteroid that's actually visible, how about checking out *Ceres*. It's still in the sky, between Gemini and Cancer, and you can put your date and time and get a star chart with this link.

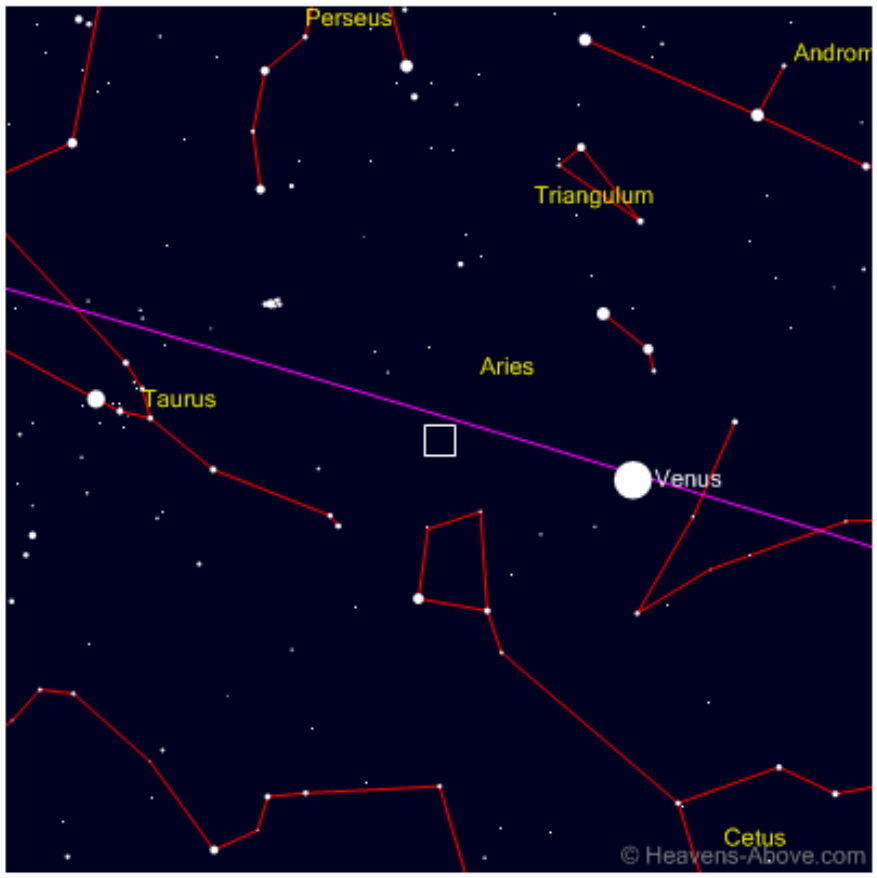
http://heavens-above.com/MinorPlanet.aspx?desig=1&

Putting in 99942 instead of 1 gets you Apophis.

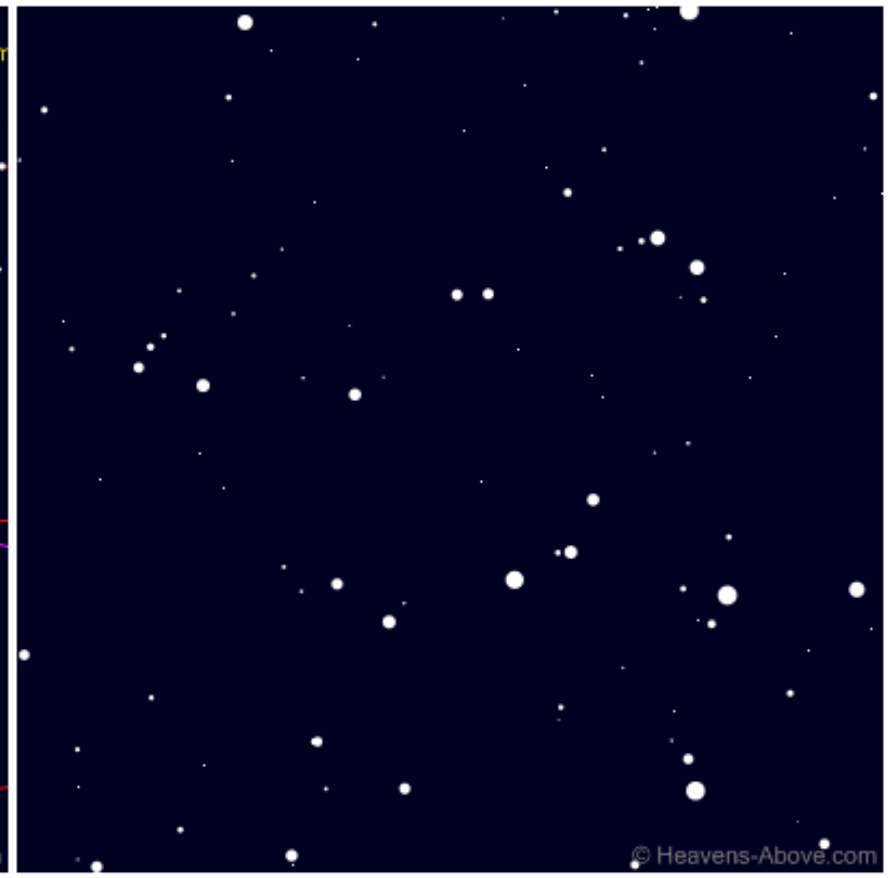
In the meantime, Clear Skies!

Asteroid 99942 Apophis

Year 2018 Month April Day 2 Time 00:52:53 Update Reset to now



Coarse finder chart
(Field of view=60°, Limiting magnitude=5)



Fine finder chart
(Field of view=2°, Limiting magnitude=12)

Position	
Right ascension	2^h 56.3^m
Declination	15° 2'
Constellation	Aries
Magnitude	21.6
Distance from Earth	1.604 AU

Orbit	
Distance from Sun	0.955 AU
Perihelion	0.746 AU (11/01/2018)
Aphelion	1.099 AU
Period	0.89 years
Eccentricity	0.191472
Inclination to ecliptic	3.3°
Epoch	23/03/2018

Finder Charts for Apophis, as generated from Heavens-Above.com.

Find the Girl in the Nebula by Peter Wolsley

Below is the Iris Nebula (NGC 7023).

This is a stack of 24 images. Each image is a 200 second exposure at ISO 1600. Taken with my Nikon D5300 and my Celestron 8" EdgeHD SCT at F10. Processed using Deep Sky Stacker and Startools.

I think the Iris Nebula should be renamed the "Angel" Nebula because at its centre there is a silhouette of a little girl that I imagine as being an angel.

Included is an image of a little girl. Can you see this little girl outlined in the Iris Nebula?

I named the astrophoto "*RGGB2x2BilinearGS32Max.jpg*", meaning:

RGGB2x2 - RAW images were binned 2x2 using the RAW RGGB values in the bayer matrix…using my own custom program.
Bilinear - The calibrated images were debayered using a bilinear method
GS32 - Stacked using a Gamma Sigma Clipping method Gamma = 3 # of interations = 2.
Max - Calibrated images were saved as unsigned 16 bit TIFFs with the values upscaled to use the full 65,535 count range.

NGC 7023 in Cepheus. Credit: Peter Wolsley

This article is provided by NASA Space Place.

With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.

Visit spaceplace.nasa.gov to explore space and Earth science!

Measuring the Movement of Water on Earth

By Teagan Wall

As far as we know, water is essential for every form of life. It's a simple molecule, and we know a lot about it. Water has two hydrogen atoms and one oxygen atom. It boils at 212° Fahrenheit (100° Celsius) and freezes at 32° Fahrenheit (0° Celsius). The Earth's surface is more than 70 percent covered in water.

On our planet, we find water at every stage: liquid, solid (ice), and gas (steam and vapor). Our bodies are mostly water. We use it to drink, bathe, clean, grow crops, make energy, and more. With everything it does, measuring where the water on Earth is, and how it moves, is no easy task.

The world's oceans, lakes, rivers and streams are water. However, there's also water frozen in the ice caps, glaciers, and icebergs. There's water held in the tiny spaces between rocks and soils deep underground. With so much water all over the planet—including some of it hidden where we can't see—NASA scientists have to get creative to study it all. One way that NASA will measure where all that water is and how it moves, is by launching a set of spacecraft this spring called GRACE-FO.

GRACE-FO stands for the "Gravity Recovery and Climate Experiment Follow-on." "Follow-on" means it's the second satellite mission like this—a follow-up to the original GRACE mission. GRACE-FO will use two satellites. One satellite will be about 137 miles (220 km) behind the other as they orbit the Earth. As the satellites move, the gravity of the Earth will pull on them.

Gravity isn't the same everywhere on Earth. Areas with more mass—like big mountains—have a stronger gravitational pull than areas with less mass. When the GRACE-FO satellites fly towards an area with stronger gravitational pull, the first satellite will be pulled a little

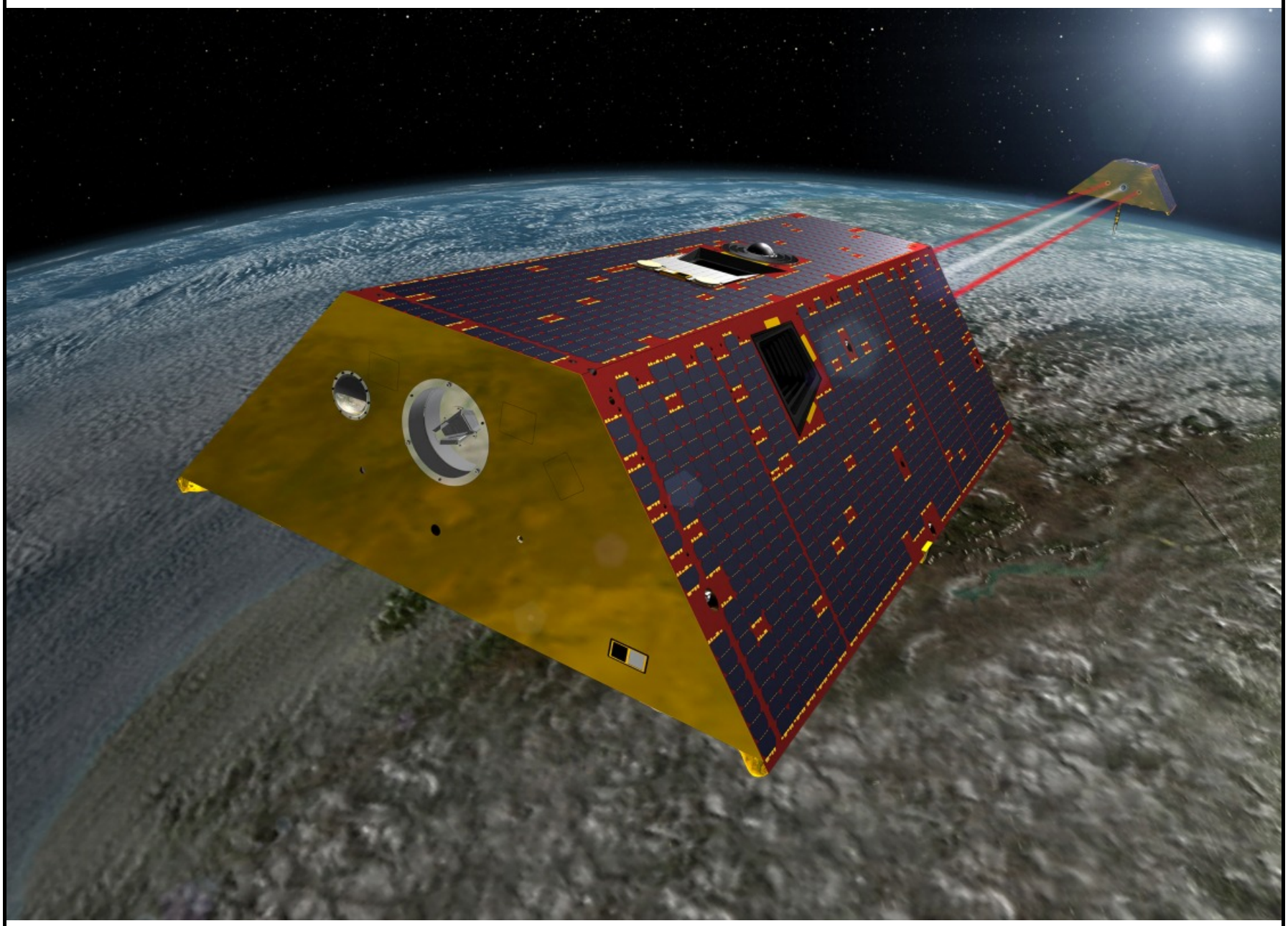
(Continued on page 13)

faster. When the second GRACE-FO satellite reaches the stronger gravity area, it will be pulled faster, and catch up.

Scientists combine this distance between the two satellites with lots of other information to create a map of Earth's gravity field each month. The changes in that map will tell them how land and water move on our planet. For example, a melting glacier will have less water, and so less mass, as it melts. Less mass means less gravitational pull, so the GRACE-FO satellites will have less distance between them. That data can be used to help scientists figure out if the glacier is melting.

GRACE-FO will also be able to look at how Earth's overall weather changes from year to year. For example, the satellite can monitor certain regions to help us figure out how severe a drought is. These satellites will help us keep track of one of the most important things to all life on this planet: water.

You can learn more about our planet's most important molecule here:
https://spaceplace.nasa.gov/water

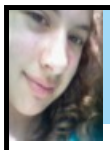


An artist's rendering of the twin GRACE-FO spacecraft in orbit around Earth. Credit: NASA

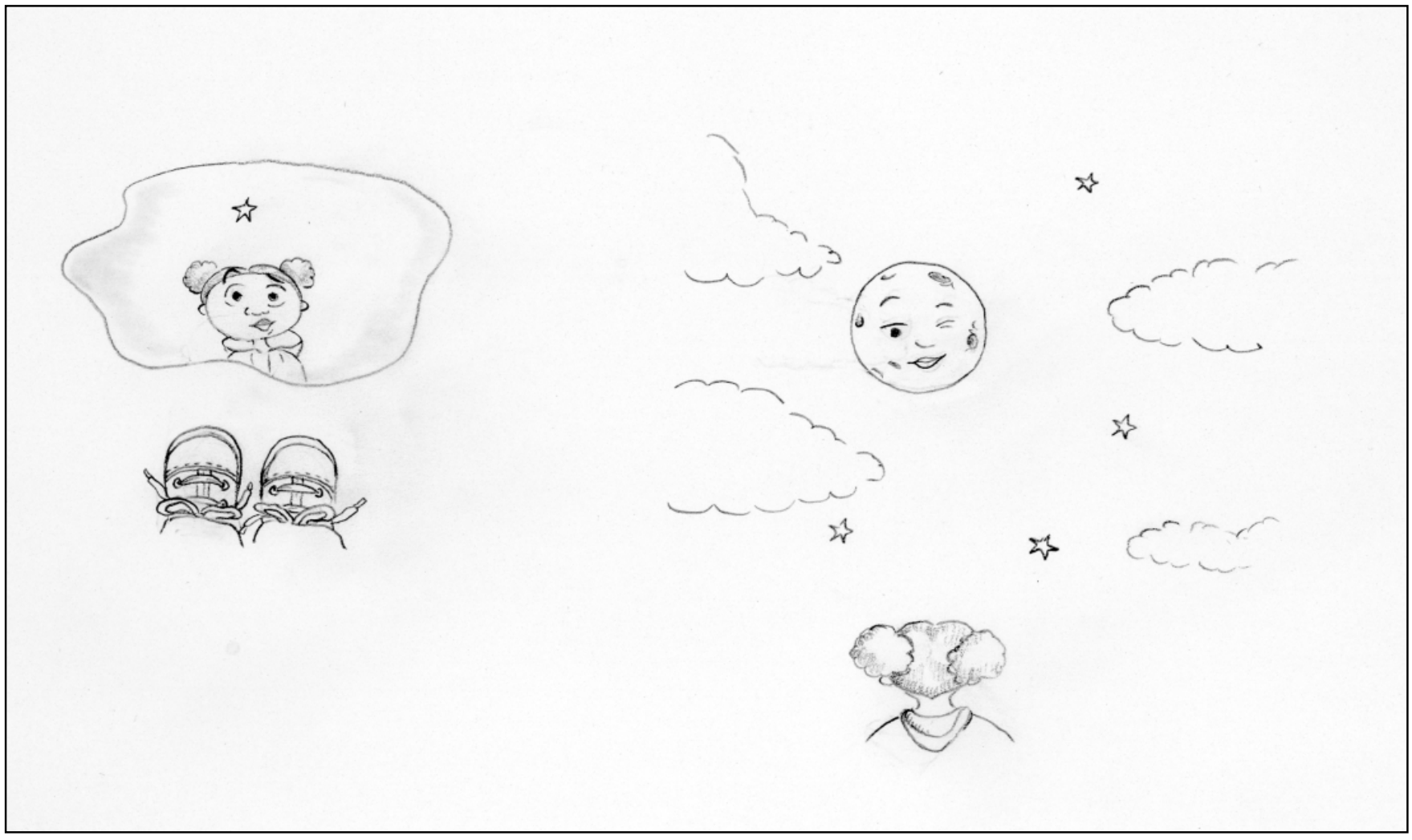
Eye Candy the Members' Image Gallery

Venus and Mercury on March 3, 2018 from Brantford, ON, by **Matthew & Janice Mannering**

The Moon, Venus and Mercury on March 18, 2018 from Brantford, ON, by **Matthew Mannering**



Cartoon Corner by Alexandra Tekatch



“Remember to look up at the stars and not down at your feet.”

Stephen Hawking

(1942-2018)

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:
  - Apr 4: Introductory Astronomy for Kids — Galaxies
  - Apr 11: Rust and Stardust
  - Apr 18: Space Explosions
  - Apr 25: Carl Sagan's Universe
- For more details, visit www.physics.mcmaster.ca/planetarium

UPCOMING EVENTS

April 7, 2018 - 1 pm - 5 pm — *Spring Telescope Clinic* at the Hamilton Spectator Auditorium. Many types of telescopes will be on display, and experts will be on hand for various workshops and to answer questions.

April 13, 2018 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium. Our main speaker will be ***Dr. John Percy***, whose talk is entitled "Archaeoastronomy: The Astronomy of Civilizations Past"

April 28, 2018 - 7:30 pm - 11:00 pm — *Public Stargazing Night* at Bayfront Park, Hamilton, ON.

May 11, 2018 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium.

2017-2018 Council

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Second Chair	Mike Jefferson
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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

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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 out-door function.
Please consider purchasing a season's pass for $79 to help support the park.
http://www.npca.ca/conservation-areas/binbrook/
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E-mail: haalibrarybooks@gmail.com