Event Horizon

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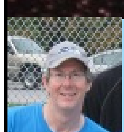
October 2016



From The Editor

Welcome to the month of October, which is always packed with astronomy activities, both up in the sky, and with astronomical observers & imagers down here on Earth.

Enjoy, and Clear Skies!

Bob Christmas, Editor

editor 'AT' amateurastronomy.org

Chair's Report by Bernie Venasse

Astronomy Day … October 8

Officially, Astronomy Day is celebrated "to promote the forerunner of all scientific endeavours and to provide information, resources and encouragement in all facets of astronomy"

But showing that astronomy is FUN is what it is really all about !!!

Astronomy Day was born in California in 1973. Doug Berger, then president of the Astronomical Association of Northern California, decided that rather than try to entice people to travel long distances to visit observatory open houses, they would set up telescopes closer to where the people were - busy locations - urban locations like street corners, shopping malls, parks, etc.

His strategy paid off. Not only did Astronomy Day go over with a bang, not only did the public find out about the astronomy club, they found out about future observatory open houses. Since the public got a chance to look through a portable telescope, they were hooked. They wanted to see what went on at the bigger telescopes, so they turned out in droves at the next observatory open house. *(Continued on page 2)*

IN THIS ISSUE:

Chair's Report (continued)

Astronomy Day also forms part of National Astronomy Week, which begins on the preceding Monday.

Originally, Astronomy Day occurred on a Saturday between mid-April and mid-May, and was scheduled so as to occur at or close to the first quarter Moon. In 2007, an autumn rendition of Astronomy Day was added. It was scheduled to occur on a Saturday between mid-September and mid-October so as to be on or close to the first quarter Moon.

Astronomy Day is a grass roots movement designed to share the joy of astronomy with the general population - "Bringing Astronomy to the People." On Astronomy Day, thousands of people who have never looked through a telescope will have an opportunity to see first-hand what has so many amateur and professional astronomers all excited. Astronomy clubs, science museums, observatories, universities, planetariums, laboratories, libraries, and nature centers host special events and activities to acquaint their population with local astronomical resources and facilities. Many of these events are located at non-astronomical sites; shopping malls, parks, urban centers — truly Bringing Astronomy to the People. It is an astronomical PR event that helps highlight ways the general public can get involved with astronomy - or at least get some of their questions about astronomy answered. Astronomy Week encompasses Astronomy Day starting on the previous Monday and ending on the following Sunday.

Astronomy allows us to see the history of the universe with our own eyes. The stars that twinkle as you look out on a dark, clear night may not exist right now. They existed at whatever point in history they emitted that light, which has taken millions of years to reach Earth.

I invite you to take part in this Astronomy Day. Join us at Bayfront Park. Weather permitting, there will be some solar observing in the afternoon and then observations of the moon and stars in the evening. Bring a friend.

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: *California Nebula (NGC 1499), by Bob Christmas.*
Canon 40D DSLR with Astronomik CLS clip filter, through a Tamron 300mm telephoto lens, tracked on an SP EQ mount, taken September 27, 2016.
Settings: ISO 1600, f/2.8.   Exposures: 21 x 1.5 minutes; 31.5 minutes total.

The Sky This Month for October 2016 by Matthew Mannering

This year, the Black Forest Star Party at Cherry Springs State Park PA was held over the Labour Day weekend. John G., Jim W., Robert S., Janice and I were able to camp as a group and had a great time together. For the first time in the eight years we had clear skies for four nights in a row! Unfortunately there was a high haze every night which limited the number of deep sky targets we could find. The first night had the best seeing and John, Robert and I stayed up till 2:30am doing binocular astronomy. We saw many Messier objects and a few NGCs. The highlight for me was the clear view we had of the **Helix Nebula (NGC 7293)** in Aquarius low in the south. It's about a ¼ degree wide visually (almost ½ degree with filters) but with low surface brightness. I think it's the first time any of us have seen it visually. The Helix goes by far more descriptive and interesting names "The Eye of God" and "The Eye of Sauron". The second reference is of course to "the Lord of the Rings". Here is a Hubble image of the Helix. You can see how it got its more popular names.

September has been a beautiful month with warm temperatures and lots of observing opportunities. However as September ends, you can definitely feel the nip of autumn in the morning air. It's a great time of year for observing with steady skies and a great selection of constellations available in the evening. We can still see the summer triangle and many of the summer constellations because it gets dark much earlier in the evening. But by 10pm the true fall constellations are wheeling overhead and the harbingers of winter, the Pleiades, Orion and Taurus are coming up in the east before midnight. Take your favourite star chart and binoculars and spend some time cruising the Milky Way. Just for fun, write down the designation for every object you can identify moving from west to east. Then count them up. I bet you'll be surprised at the total! If you don't already have some sort of observing list, then this can be the beginnings of one. I don't keep a detailed list myself but I do record the first time I see an object including the date, location and equipment used. One reason for a log is to keep you from repeatedly going to the same targets and becoming bored. Like most observers, you will start with the brighter easy to find objects. Once those are crossed off your "to do" list, you will move on to more challenging objects which are generally smaller, dimmer or both smaller and dimmer. A log allows you to hunt them down systematically if you so choose.

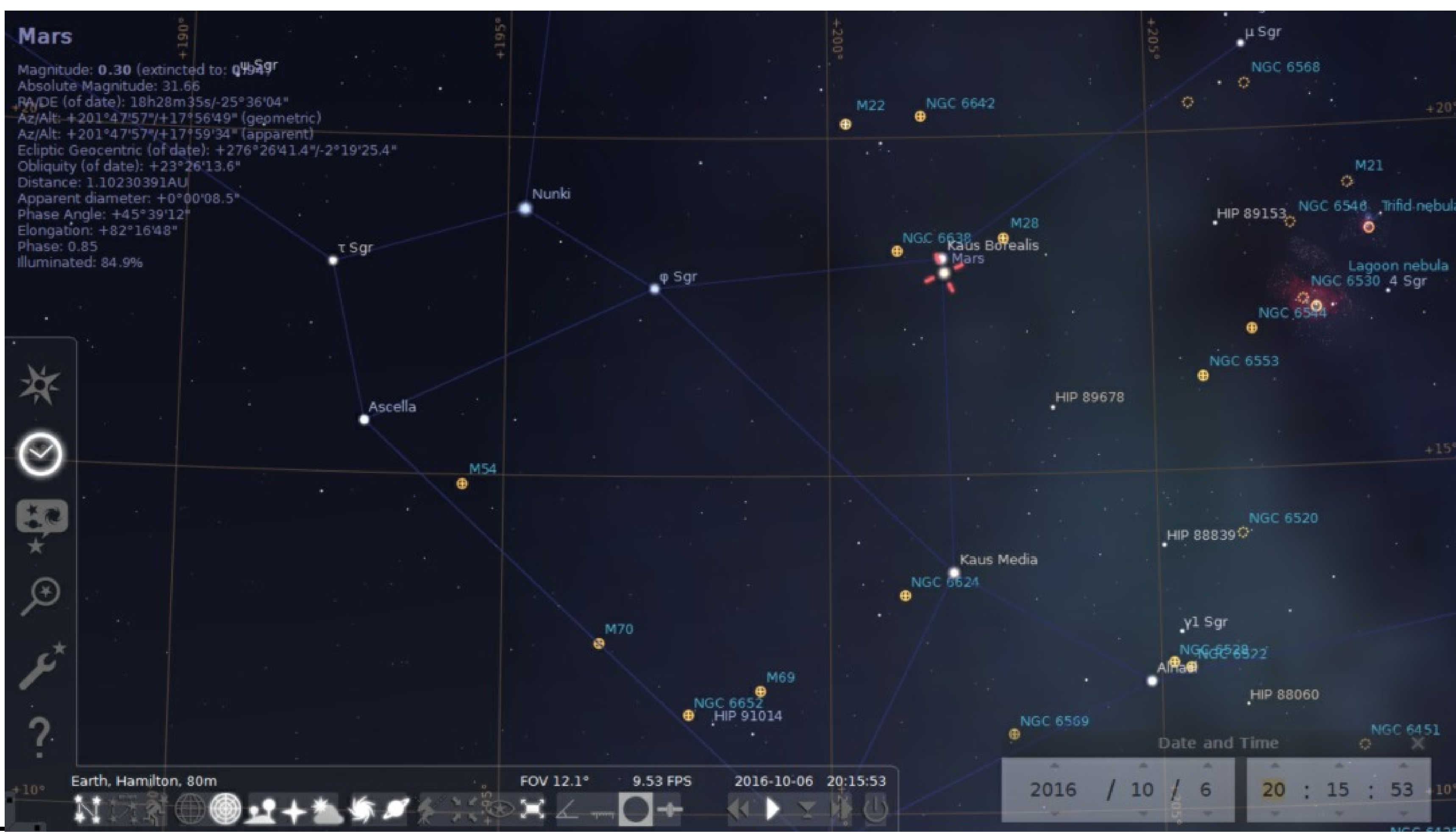
Mid October is a great time to look for two relatively faint constellations, **Pisces** and **Cetus**, otherwise known as "Two Fish" and "A Sea Monster (or Whale)". You will definitely need your binoculars and a clear southern horizon to trace out these constellations as they are faint at the best of times. I have highlighted one fish head and the head of the sea monster in orange (chart is at top of page 4). Notice how both heads are formed from very similar five sided shapes. Start by finding the fish head under the great square of Pegasus (outlined in yellow) and follow the stars east until you come across the three stars of **Aries** (also in yellow). Below Aries is the head of Cetus. Try to follow the stars down from the head and then to the west that form the constellation. I've included a chart showing the constellation art (on page 8). Notice that the second head of Pisces is actually the small triangle just below Andromeda.

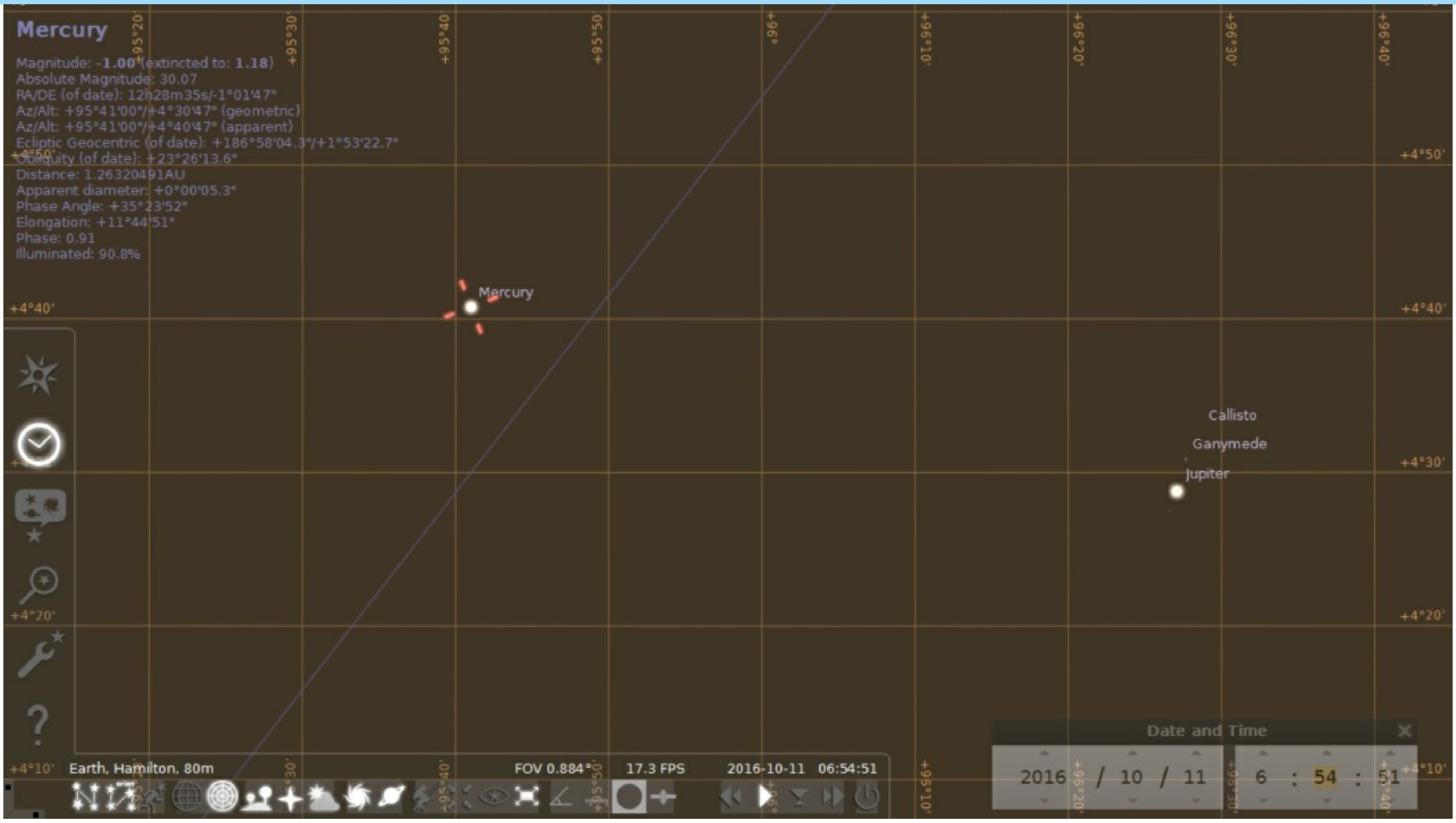
(Continued on page 4)

The Sky This Month (continued)

There are several events happening this month that are definitely worth catching. Let's start with the passage of **Mars** through the lid of the **Teapot (Sagittarius)**. From the 5th to the 9th, Mars will travel very close to three different globular clusters. The sequence starts with Mars passing 1.0 degree south of **M28** on the 5th. That is followed by a very close approach to **NGC 6638** on the 7th when Mars will

(Continued on page 5)





come to within 5 arc minutes of the cluster. Lastly on the 9th, Mars will pass 1.5 degrees south of **M22** the biggest and brightest of the three globulars.

Next, on the 11th, **Mercury** and **Jupiter** (above) will appear low in the east, side by side in the morning sky. Look for them at 7am about a half an hour before sunrise. See if you can photograph the pair and catch Jupiter's moons in the image.

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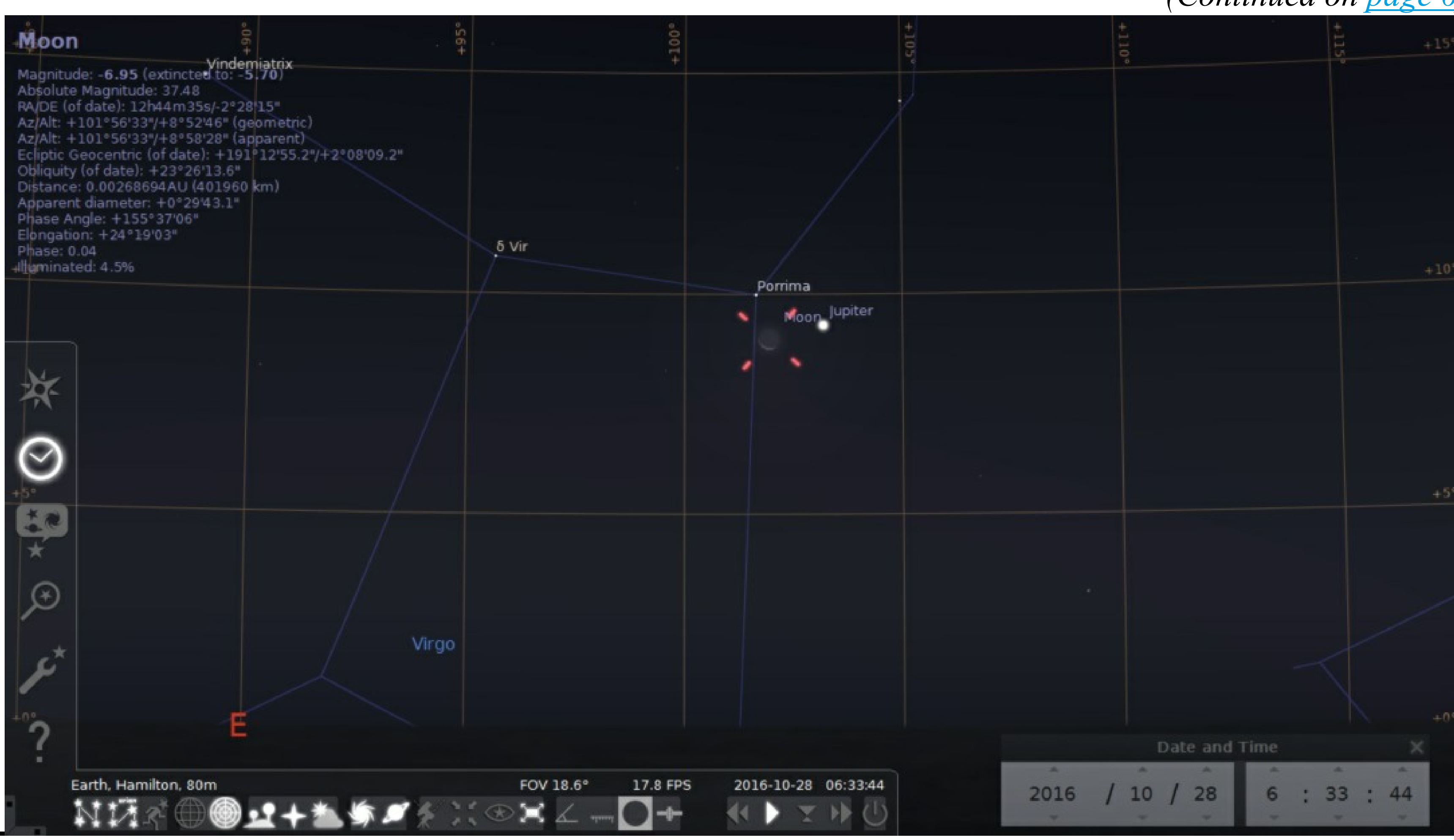


The Sky This Month (continued)

On the 28th, there are two events worth watching. In the morning sky the Moon and Jupiter will appear side by side (previous page, bottom). The Moon will be only two days short of New Moon so most of it should be lit by Earth shine. In the evening sky, **Venus** will pass about 3 degrees below **Saturn**. Notice their relative brightness. Venus will be by far the brighter of the two planets with a 4.5 magnitude difference between them.

Lastly, the star **Aldebaran** in **Taurus** will be *occulted* by the Moon from 1:45am to 2:36am on the 19th. Look for Aldebaran to disappear on the lit side of the Moon and reappear on the night side. Be sure to set up before hand as the times vary slightly by your location.

The Moon

Libration this month is as follows: The Northern limb will be most exposed on the 19th while the Southern limb will be most exposed on the 6th. The Eastern limb will be most exposed on the 23rd and the Western limb on the 11th. Unfortunately, the East and West events occur when that side of the Moon is in shadow.

The Planets

(Rise and set times are given for when the planet reaches 5 degrees above the horizon)

- ***Mercury*** appears low in the eastern morning sky for the first half of the month.
- ***Venus*** shines brightly in the western evening sky all month.
- ***Mars*** appears low in the SSW after sunset all month. It will be setting by about 10:30 every night.
- ***Jupiter*** moves away from the rising Sun by midmonth. Look for it low in the east by about 6:45am.
- ***Saturn*** is low in the SW evening sky and sets by 9:30pm at the beginning of the month and 7:30pm by months end.
- ***Uranus*** comes to opposition on the 15th and is visible all night. At that time it will be 18.95 AU (Astronomical Units) or 2.6 light hours from Earth. At mag 5.7 it should be visible naked eye from a dark site. It's a nice blue/green colour and should resolve into a disk at high magnification through a telescope.
- ***Neptune*** sits another 10 AU further out from us at this time. Using 8.3 minutes per AU travel time for light means that we are seeing Neptune as it appeared a little over four hours ago (29.2 AU x 8.3 = 242.4 minutes = 4 hours). It's also visible most of the night but about 45 degrees further west along the ecliptic in Aquarius.

Events for October (highlight events are marked "!!")

-October 3rd: — The Moon passes Venus in the evening sky.

-October 5th: — Venus passes ¾ degree below Zubenelgenubi in Libra. That in itself isn't very important. I just like the name "Zubenelgenubi".
— **!!** Mars passes 1.0 degree south of globular M28.

(Continued on page 7)

The Sky This Month (continued)

-*October 7th:* — ‼ Mars will passes within 5 arc minutes (1/12 of a degree) of another globular NGC 6638.

-*October 9th:* — First Quarter Moon.
— ‼ Mars passes 1.5 degrees south of globular M22.

-*October 11th:* — Mercury and Jupiter are separated by about 0.8 of a degree at 6:55am low in the east.

-*October 13th:* — The Moon passes less than ½ degree west of Neptune at 2am.

-*October 15th:* — Uranus is at opposition.

-*October 16th:* — Full Moon.

-*October 18th-19th:* — ‼ Aldebaran is occulted by the Moon from 1:45am to 2:36am on the 19th.

-*October 21st:* — Orionid meteors peak in the a.m.

-*October 22nd:* — Last Quarter Moon.

-*October 28th:* — ‼ Jupiter 1.0 degree south (to the right) of the Moon at 6:15am. The Moon will be only 4.5% lit as new Moon follows in two days. Also on the 28th, Venus passes less than 3 degrees below Saturn in the evening sky. Look for them at about 7:00pm.

-*October 30th:* — New Moon.

(See Pisces-Aries Constellation Art on page 8)

Treasurer's Report by Steve Germann

Treasurer's Report for September 2016 (unaudited)

Opening balance:	$8,497.80
Revenue:	$879.00
Expenses:	$408.78
Closing Balance:	$8,968.02

Revenue consisted of 50/50 $49; Memberships for the coming year, $830.

Expenses consisted of PO box rental for the coming year, $176.28; Our annual donations to the Clear Sky Chart, $50; Niagara Peninsula Conservation Authority, $100; and the International Dark Sky Association, $50 US ($68 Canadian), and purchase of a supply of blank membership cards $14.50.

There are no more anticipated expenses for the 2015-2016 year, but I expect we will soon be paying the annual Insurance, Hall rental, and printing cost for the calendars. Those add up to about $4150 but the calendar revenue offsets much of that amount.

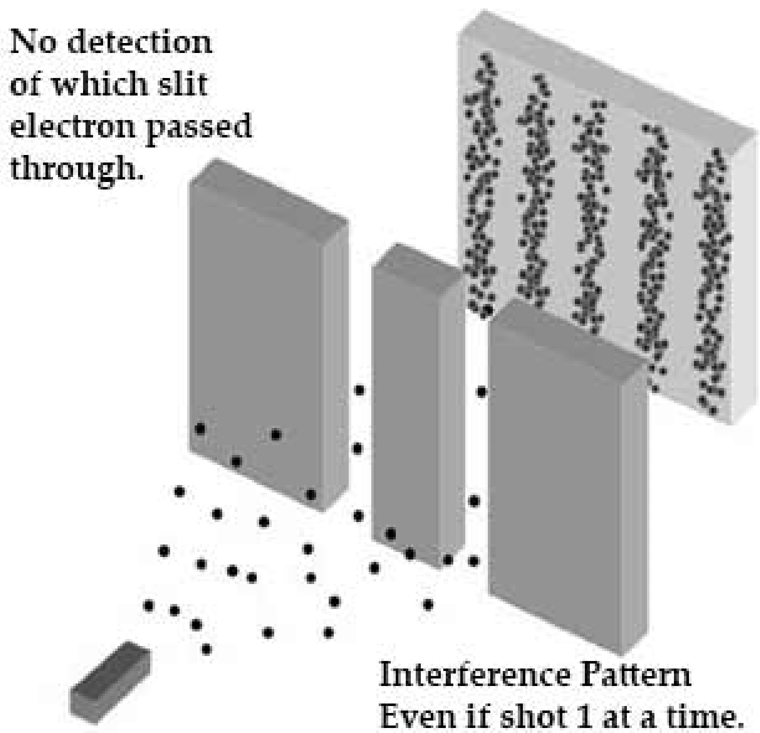
Thanks to your support, our club is financially strong. A full financial report will be presented at the October Annual General Meeting and published in the Event Horizon November 2016 Issue.

Constellation Artwork of Pisces-Cetus Area

Wanted --- Dead and Alive by Bruce Pawlett

Schrödinger's Cat - Wanted: Dead and Alive
The Double Slit Experiment and the Multiverse (Part I)

In 1803, Thomas Young conducted an experiment that would eventually lead to modern day quantum confusion and profound implications on our interpretation of reality (Part II). Of course I am referring to the famous double slit experiment. Young was convinced the current prominent corpuscular (particle) theory of light was incorrect and used double slit (in his case, hole) experiment to demonstrate his viewpoint. Beaming light through two slits demonstrated the interference pattern expected from the wave-like nature of light.



To provide some additional historical context for the development of quantum theory, fast forward ~125 years. As with all scientific discoveries many scientists over a large time span contributed to the development of quantum theory. The following very brief summary does not do it justice but provides the essential information. In 1923 Louis de Broglie introduced his theory of matter waves (particles can exhibit both particle and wave characteristics). In 1925 German physicist Werner Heisenberg (and others) developed matrix mechanics while Erwin Schrödinger developed wave mechanics. The Schrödinger equation provided a mathematical representation of de Broglie's wave-particles. Schrödinger showed that his equation and the matrix mechanics were equivalent and since his equation was much easier to use than the matrices, it persisted. In 1928 Paul Dirac unified quantum mechanics with special relativity specifically for the electron in the Dirac equation. Heisenberg developed the Heisenberg uncertainty principle where only one of complementary variables could be known accurately (e.g. the more precisely position is known, the less precisely momentum can be determined). Even today, the Schrödinger wavefunction equation is considered to be the heart of quantum theory.

Since the original double slit experiment variations evolved, single photons one at a time are fired through a double slit. Eventually, after many repeats, the formation of the same interference pattern seemingly confirmed the wave nature of light. Experimentation with electrons, atoms and even 60 carbon atom molecules (buckyballs) all produced similar results. The implication being that a waviness nature is not confined to light and is consistent with de Broglie's matter waves and Schrödinger's wavefunction equation that describes the extent to which the particle is simultaneously in different places. For instance, an electron is considered to be in all possible positions in an atom at once. The "superposition principle" is used to refer to the simultaneous existence of a particle in different places. (Hot off the press. Stanford University, Glowia et al pre-released a paper in August 2016 that describes their creation of a x-ray movie showing Iodine molecules in superposition for just a few trillionths of a second).

The next iteration of the double slit experiment provided unexpected results. An instrument was set up to determine which slit the particle went through. (If the detector is prior to the slits it is called a "which way" experiment but if it is after it is called " which way-delayed choice" experiment). It was soon discovered that any attempt to make this observation resulted in a clumping pattern rather than the interference pattern. This is often referred to as the "measurement problem". Although now fall-

(Continued on page 10)

Wanted --- Dead and Alive (continued)

ing out of favour with some physicists the "Copenhagen Interpretation" proposed by Werner Heisenberg and Neil Bohr is still the typical textbook explanation for this strange phenomenon.

The photon is more particle like at the beginning and end of its journey but more wavelike in between. "The wave holds the information about all the possible final positions of the particle but also about its possible positions at every stage in its journey. In fact, the wave must map out all possible paths the particle could take. For some reason when the wave reaches the screen it chooses a final location and that implies choosing from these possible paths. According to the Copenhagen interpretation, "physical systems generally do not have definite properties prior to being measured, and quantum mechanics can only predict the probabilities that measurements will produce certain results. The act of measurement affects the system, causing the set of probabilities to reduce to one of the possible values immediately after the measurement. The future state will be based on the state of the system when the measurement was made." This feature is known as "wavefunction collapse." When we make an observation in the double slit experiment the wavefunction collapses and particle behaviour is exhibited (clumping pattern).

Schrödinger's famous cat thought experiment exemplifies the concept and provides linkage from the quantum world to our perceived macro reality. A cat is trapped in a box with cyanide canister that is opened if a present radioactive atom decays. The radioactive atom will eventually be in superposition of being decayed and not decayed meaning the cat will be dead and alive. However, once you open the box to observe the cat it will be either dead or alive. (I promise; no cats were harmed in the writing of this article!)

The Copenhagen interpretation has been very successful. Predictions using wave function collapse work extremely well, it has facilitated great technological advancements and it rationalizes our perceived macro reality where we observe objects in one place at a time. However, not everyone was so accepting of the interpretation including Einstein. This led to his famous remark "I can't believe that God plays dice" due to the somewhat random aspect of the outcome of the wavefunction collapse. The interpretation is criticised for lack of mathematical rigor, lack of a mechanism that results in the transition of a wave into a particle, lack of a definition of what constituted an observation etc. Again Einstein, "does the Moon exist because a mouse looks at it?" (Einstein's comment is likely based on the von Neumann-Wigner interpretation that consciousness awareness causes the collapse).

This phenomenon continues to occupy the scientific community. John Wheeler's 1978 "Delayed Choice" gedanken (thought) experiment showed that a photon could choose to behave as a particle or a photon even after entered into an interferometer. In 1982 Scully & Drühl (Max-Planck Institute) proposed the "delayed choice quantum eraser" experiment to further investigate. The point of the experiment was to determine the paths of the particles without disturbing their wavefunction. The interference pattern is dependent on maintaining coherence of the two waveforms emerging through the slits. Decoherence occurs when the quantum system is not isolated and it interacts with its environment (e.g. detector, conscious awareness?). "Entangled photons" were utilized to preserve coherence. Scully & Kim et al (University of Maryland) built the apparatus and carried out the experiment in 1999.

To create the entangled photons a crystal beam splitter is used to split photon beams into 2 pairs of photons. In this case the resultant photons have correlated polarizations (same polarization is Type I, perpendicular polarizations is Type II). Subsequently, if an action causes the alteration of the polarization of one of the entangled photons the other is also instantaneously altered regardless of distance between them (hence Einstein's phrase "spooky action at a distance"). It is noted that although the

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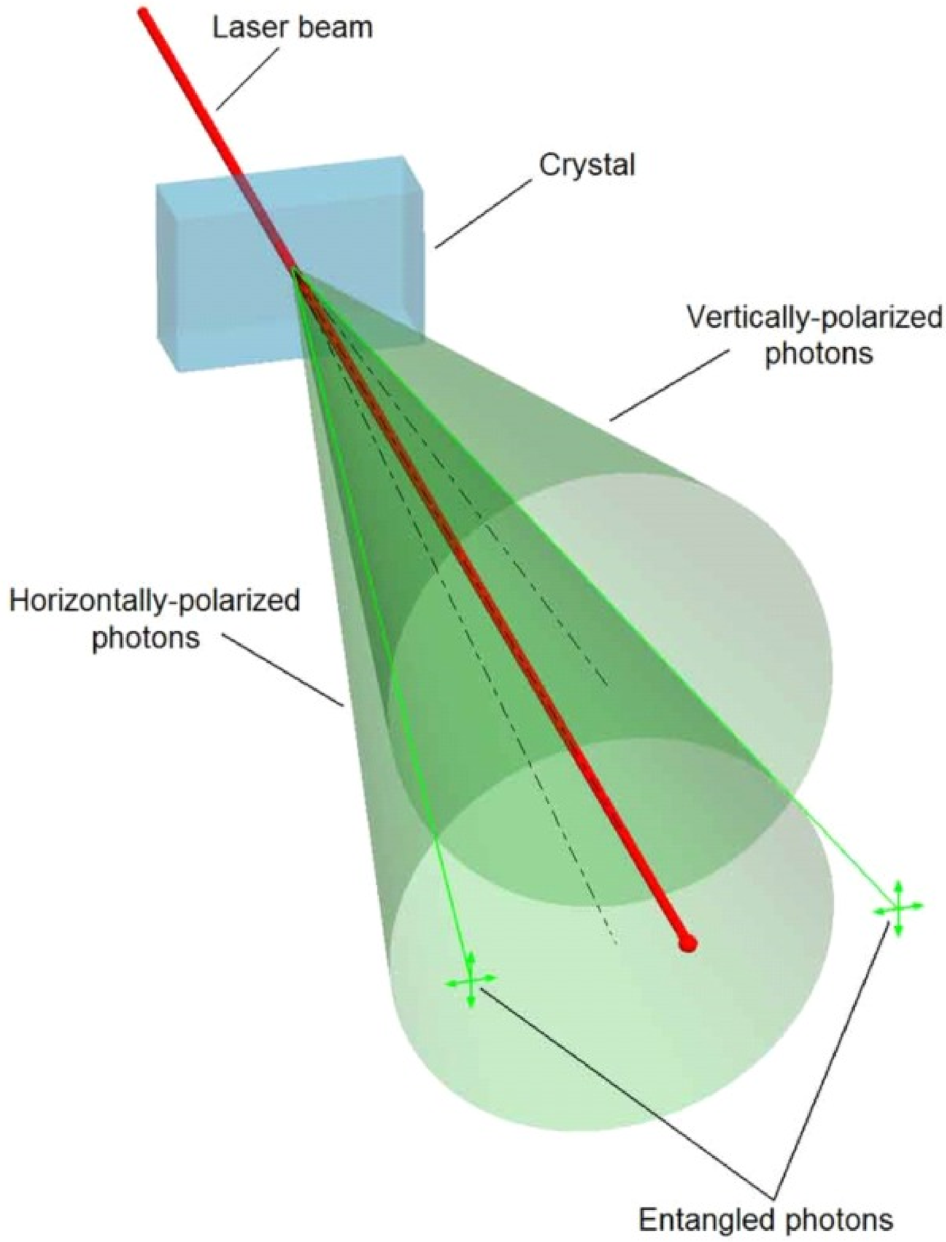
Wanted --- Dead and Alive (continued)



matching alteration occurs instantaneously (faster than light speed), entanglement cannot be used to transmit information faster than light since this would violate special relativity.

A prism after the crystal beam splitter sends one of the entangled photons (signal photon) from each slit directly to a signal detector. The entangled twin (idler photon) is then sent through an arrangement of beam splitters and mirrors to one of four additional detectors. The arrangement allows the researchers to preserve information related to the source slit for two of the detectors but erases the information for the remaining two detectors. The eraser part of the experiment allows the researchers to verify if coherence of the waveforms was maintained or not.

For those who are interested in details of the Delayed Choice Quantum Eraser Experiment, it is summarized on Page 12.

The results are similar to the classic double slit experiment. When the path is known there isn't an interference pattern but when it isn't known there is. The fact that an interference pattern was obtained when the path information was erased indicates the use of the entangled signal photon did not interfere with the coherence of the waveforms. What really makes the delayed quantum eraser experiment different is that the position of the signal photon measured at D0 is measured 8 nanoseconds prior to the decision to preserve or remove the path information of the corresponding idler photon (distance to detector D0 is 2.5m shorter). While funky quantum mechanical behaviour such as this can be expected, it is not intuitive to the way us humans perceive causality. Although it is not interpreted this way, it appears information is being transmitted back in time.

It is noted that researches associated with the University of Vienna repeated this experiment, once in Vienna where the signal photons were separated from the idler photons by 50m, and also in the Canary Islands where the signal/idler photons were separated by a distance of 144 km. The increased distance was to absolutely rule out the chance of any physical signal between the entangled photons. The results remain unchanged.

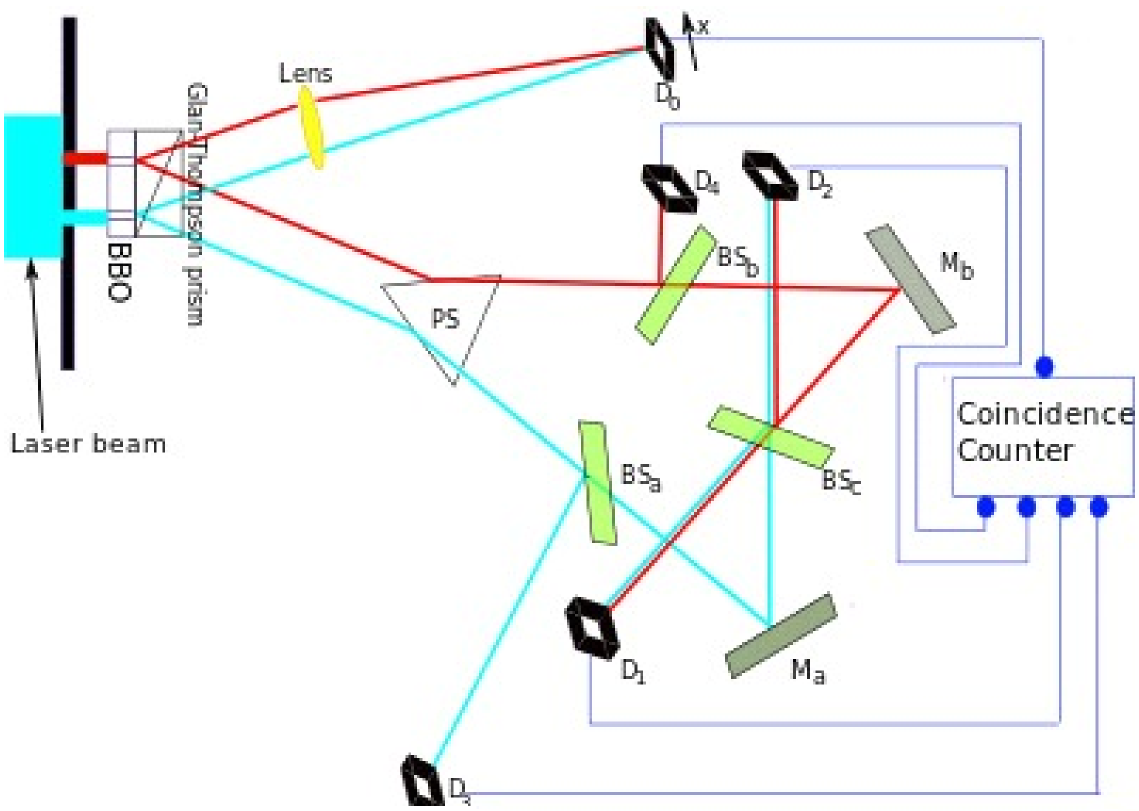
Well, that seems to clinch the Copenhagen interpretation where observation results in wavefunction collapse. Or does it? It is well known that the quantum world is not intuitive and we humans tend provide interpretations from a human reality perspective. Perceived human reality may not be equivalent to what is actually true. Stay tuned for alternative realities.

To be continued……

Summary of the Delayed Choice Quantum Eraser Experiment (mainly from Wikipedia)

Paths

- Individual photo goes through slit A or slit B or both.
- BBO (beta barium borate) crystal converts the photon into two identical polarized entangled photons.
- Glan Thompson Prism causes the entangled photon paths to diverge.
- One photon (signal photon) travels to detector D_0.
- Other "idler" photon travels to the PS prism were it sent on a divergent path depending on which slit the photon came from.
- Idler photons then encounter the beam splitters BS_a, BS_b, and BS_c, each having a 50% chance of allowing the photon through or to be reflected.
- M_a and M_b are mirrors.
- Beam splitters and mirrors direct idler photons to detectors D_1, D_2, D_3 and D_4.

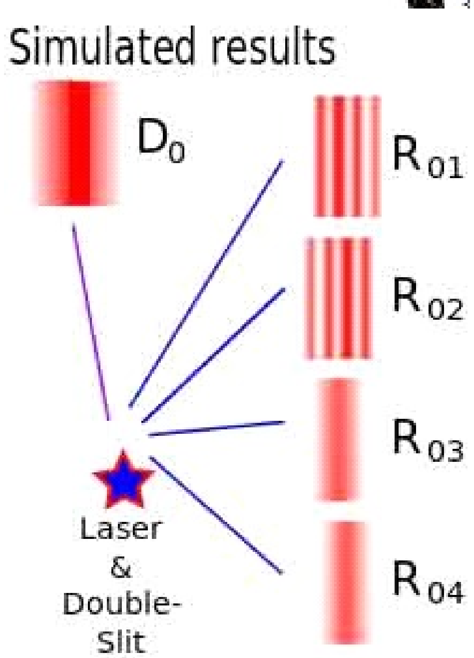


Idler Photon Detectors

- D_3 – only detects Slit B photons
- D4 – only detects Slit A photons
- D_1, D_2 – photon may have come from Slit A or Slit B
- Path length to D_1, D_2, D_3 and D_4 is 8 nanoseconds longer then to D_0

Results

- R_0 – total pattern will never show interference (due to constraints of related to Special Relativity) but interference or no-interference can be recovered on by looking at corresponding entangled idler photons in detectors D_1 to D_4.
- R_1 or R_2 – paths not known – interference pattern
- R_3 or R_4 – paths known – clumping pattern



Detection at D_0 (signal photon detector) does not directly provide path information. Detection of idler photons at D_3 or D_4, which do provide path information means that the recovered corresponding subset of signal photons at D_0 does not produce and an interference pattern. Detection of idler photons at D_1 or D_2, which do not provide path information (path info has been effectively erased by the two mirrors and beam splitter BS_c) do produce an interference pattern with recovered corresponding subset of signal photons at D_0.

This article is provided by NASA Space Place.

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One Incredible Galaxy Cluster Yields Two Types of Gravitational Lenses

By Ethan Siegel

There is this great idea that if you look hard enough and long enough at any region of space, your line of sight will eventually run into a luminous object: a star, a galaxy or a cluster of galaxies. In reality, the universe is finite in age, so this isn't quite the case. There are objects that emit light from the past 13.7 billion years—99 percent of the age of the universe—but none before that. Even in theory, there are no stars or galaxies to see beyond that time, as light is limited by the amount of time it has to travel.

But with the advent of large, powerful space telescopes that can collect data for the equivalent of millions of seconds of observing time, in both visible light and infrared wavelengths, we can see nearly to the edge of all that's accessible to us.

The most massive compact, bound structures in the universe are galaxy clusters that are hundreds or even thousands of times the mass of the Milky Way. One of them, Abell S1063, was the target of a recent set of Hubble Space Telescope observations as part of the Frontier Fields program. While the Advanced Camera for Surveys instrument imaged the cluster, another instrument, the Wide Field Camera 3, used an optical trick to image a parallel field, offset by just a few arc minutes. Then the technique was reversed, giving us an unprecedentedly deep view of two closely aligned fields simultaneously, with wavelengths ranging from 435 to 1600 nanometers.

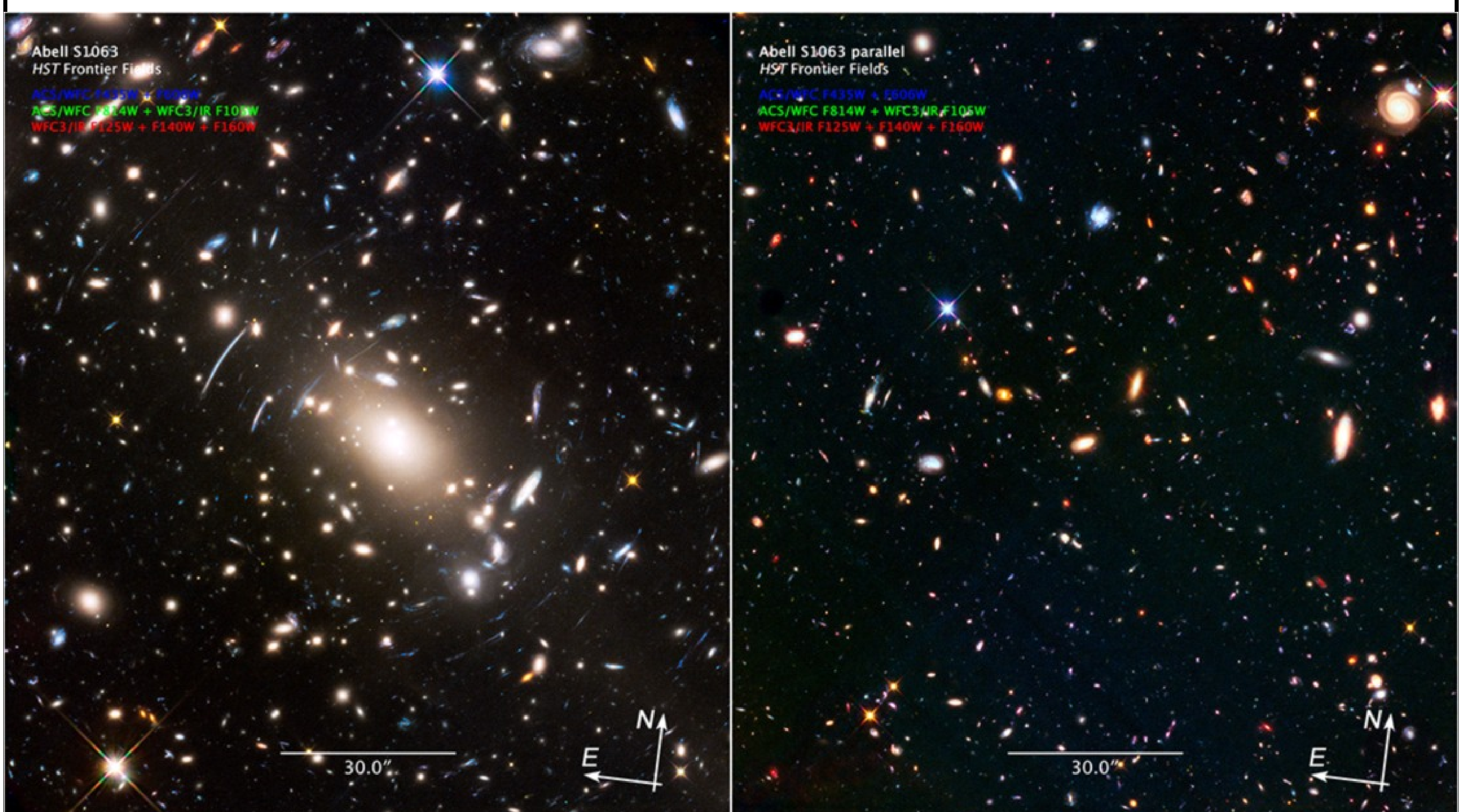
(Continued on page 14)

NASA's Space Place (continued)

With a huge, towering galaxy cluster in one field and no comparably massive objects in the other, the effects of both weak and strong gravitational lensing are readily apparent. The galaxy cluster—over 100 trillion times the mass of our sun—warps the fabric of space. This causes background light to bend around it, converging on our eyes another four billion light years away. From behind the cluster, the light from distant galaxies is stretched, magnified, distorted, and bent into arcs and multiple images: a classic example of strong gravitational lensing. But in a subtler fashion, the less optimally aligned galaxies are distorted as well; they are stretched into elliptical shapes along concentric circles surrounding the cluster.

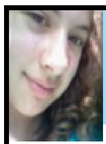
A visual inspection yields more of these tangential alignments than radial ones in the cluster field, while the parallel field exhibits no such shape distortion. This effect, known as weak gravitational lensing, is a very powerful technique for obtaining galaxy cluster masses independent of any other conditions. In this serendipitous image, both types of lensing can be discerned by the naked eye. When the James Webb Space Telescope launches in 2018, gravitational lensing may well empower us to see all the way back to the very first stars and galaxies.

If you're interested in teaching kids about how these large telescopes "see," be sure to see our article on this topic at the NASA Space Place: http://spaceplace.nasa.gov/telescope-mirrors/en/.



Galaxy cluster Abell S1063 (left) as imaged with the Hubble Space Telescope as part of the Frontier Fields program. The distorted images of the background galaxies are a consequence of the warped space dues to Einstein's general relativity; the parallel field (right) shows no such effects. Image credit: NASA, ESA and Jennifer Lotz (STScI)

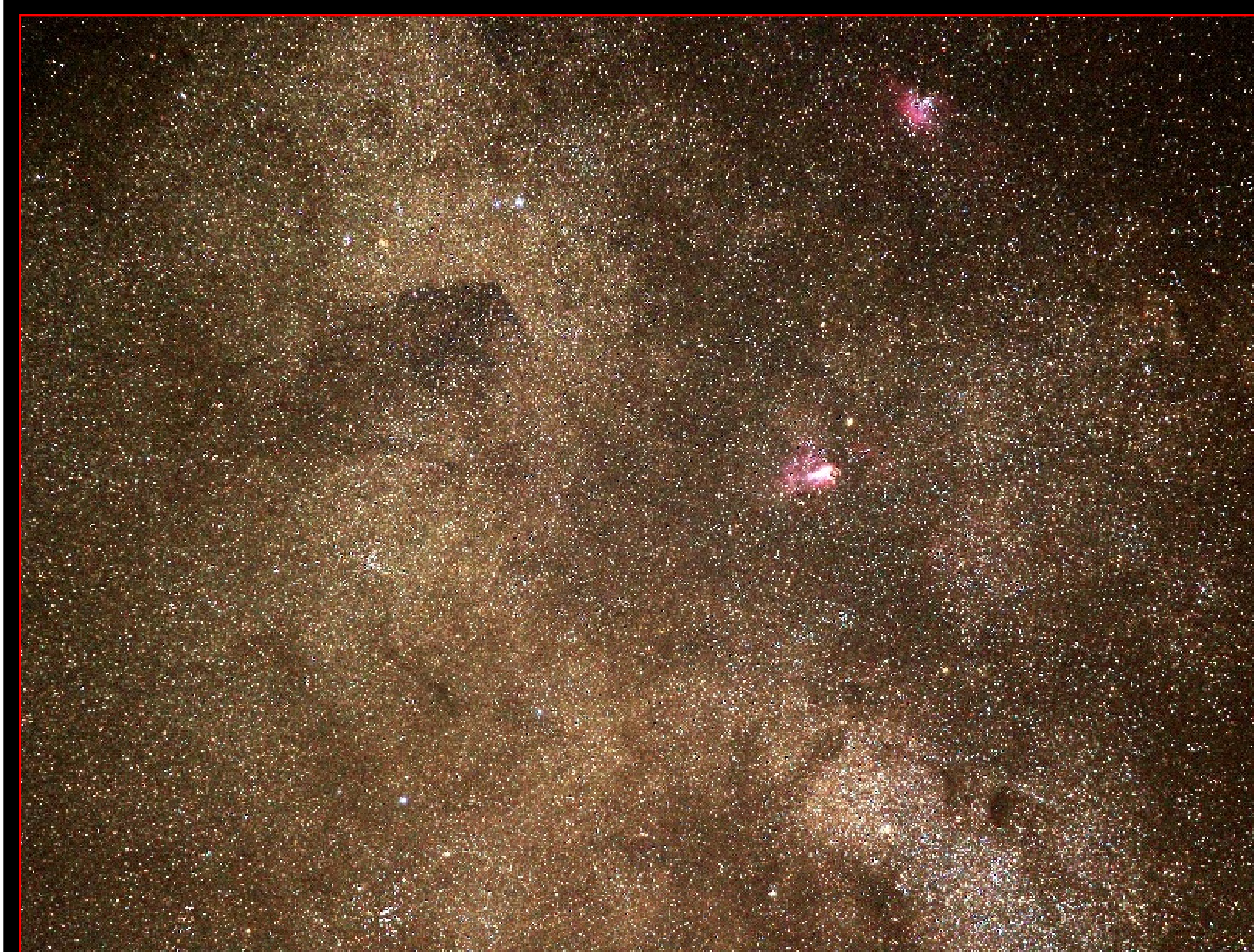
Cartoon Corner by Alexandra Tekatch



If Galileo was a yodeller, he would be Galile-hee-hoo!

Eye Candy the Members' Image Gallery

Telephoto Sunset at Binbrook C.A., August 6, 2016, by **Chris White**
Canon EOS Digital Rebel XS; 200mm focal length.



M16 & M17, August 2016, by **Janice Mannering**
The Eagle Nebula (M16; at top) and below it, the Swan Nebula (M17).
Canon T5 DSLR with 18-135mm zoom lens, tracked on an ioptron mount.

For Sale

(top) 17.5" Newtonian 3 piece telescope. 4.5-2000 focal length. Base section is made of 3/4" Baltic Birch plywood and has an 18" machined bearing (infinite control)- mid section is made of aluminum that houses the 17.5"x .625" mirror on a 18 point mounting and medium density plastic trunnions (infinite control)- top section is made of aluminum that has a 4 piece spider with a 4"x6" secondary mirror and a 1.25"/2" focuser. This telescope is easily transported by my 2006 Dodge Caravan.

$1,950

(left) SkyWatcher Refractor telescope & tripod 4"

$150

Red dot finder-eye pieces- diagonal available at fair prices.

Contact Harvey Garden (905) 692-4595

For Sale

Celestron Schmidt- Cassegrain Nexstar 8SE Goto - 1 1/4" / 2" eyepiece adapter - red dot finder -

Celestron suit case kit (3 - 2 " eye pieces - 2x Barlow - diagonal - filters)

Celestron stereo binocular with 1 pair matching eye pieces . Used in my insulated domed observatory since new.

$1,350

Contact Harvey Garden (905) 692-4595

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:**
  - **Oct 5: Introductory Astronomy for Kids (1st Wed of every month)**
  - **Oct 12: Carl Sagan's Universe**
  - **Oct 19: Robotic Renaissance**
  - **Oct 26: Dammit Jim, I'm an astronomer!**
- **For more details, visit**
  www.physics.mcmaster.ca/planetarium

UPCOMING EVENTS

October 8, 2016 - 8:00 pm - 11:00 pm — *Public Stargazing Night for Astronomy Day* at Bayfront Park, Harbour Front Dr. at Bay Street, in Hamilton.

October 14, 2016 - 7:30 pm — *Annual General Meeting* at the Hamilton Spectator Auditorium.

November 11, 2016 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium.

2015-2016 Council

Chair	Bernie Venasse
Second Chair	Mike Jefferson
Treasurer	Steve Germann
Webmaster	David Tym
Membership Director	Leslie Webb
Observing Director	Matthew Mannering
Education Director	John Gauvreau
Event Horizon Editor	Bob Christmas
Recorder	Ann Tekatch
Secretary	Jim Wamsley
Publicity Director	Mario Carr
Councillors at Large	Denise White Brenda Frederick Harvey Garden Kevin Salwach

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/
905-692-3228

Check out the H.A.A. **Website**

www.amateurastronomy.org

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HAMILTON AMATEUR ASTRONOMERS