

The Reflector

Newsletter of the Peterborough Astronomical Association

Big Science in Small Packages

MARCUS WOO

ABOUT 250 MILES overhead, a satellite the size of a loaf of bread flies in orbit. It's one of hundreds of so-called CubeSats — spacecraft that come in relatively inexpensive and compact packages — that have launched over the years. So far, most CubeSats have been commercial satellites, student projects, or technology demonstrations. But this one, dubbed MinXSS (“minks”) is NASA’s first CubeSat with a bona fide science mission.

Launched in December 2015, MinXSS has been observing the Sun in X-rays with unprecedented detail. Its goal is to better understand the physics behind phenomena like solar flares — eruptions on the Sun that produce dramatic bursts of energy and radiation.

Much of the newly-released radiation from solar flares is concentrated in X-rays, and, in particular, the lower energy range called soft X-rays. But other spacecraft don't have the capability to measure this part of the Sun's spectrum at high resolution — which is where MinXSS, short for Miniature Solar X-ray Spectrometer, comes in.

Using MinXSS to monitor how the soft X-ray spectrum changes over time, scientists can track



Astronaut Tim Peake on board the International Space Station captured this image of a CubeSat deployment on May 16, 2016. The bottom-most CubeSat is the NASA-funded MinXSS CubeSat, which observes soft X-rays from the sun — such X-rays can disturb the ionosphere and thereby hamper radio and GPS signals. (The second CubeSat is CAD-RE — short for CubeSat investigating Atmospheric Density Response to Extreme driving - built by the University of Michigan and funded by the National Science Foundation.) Credit: ESA/NASA

changes in the composition in the Sun's corona, the hot outermost layer of the Sun. While the Sun's visible surface, the photosphere, is about 6 000 Kelvin (10,000 degrees Fahrenheit), areas of the corona reach tens of millions of degrees during a solar flare. But even without a flare, the corona smolders at a million degrees — and no one knows why.

One possibility is that many small nanoflares constantly heat the corona. Or, the heat may

come from certain kinds of waves that propagate through the solar plasma. By looking at how the corona's composition changes, researchers can determine which mechanism is more important, says Tom Woods, a solar scientist at the University of Colorado at Boulder and principal investigator of MinXSS: “It's helping address this very long-term problem that's been around for 50 years: how is the corona heated to be so hot.”

See “MinXSS” on page 16

Past-President's Message

Be A Contributor

The next time you open *The Reflector* to read about the world of astronomy and the happenings of the PAA, why not share your view of the world.

If every member of the PAA contributed just one article in a year, our editor would be overwhelmed with articles, as there would be about six or seven extra articles per issue. Wow, this is the power of one.

Tell us about a recent trip you did or event you were part of. Maybe you witnessed an atmospheric phenomena or just have an opinion or point of view. Maybe you have a burning question that is astronomy related. We can post it for you and get an answer posted that can educate everyone.

The rest of the membership would be interested in hearing from you.

There are no barriers, criteria or qualifications to submit to our newsletter. Photos, questions, articles are all good and all we ask is that you be the originator.

Make a New Year's resolution and stick to it. "I will contribute at least one submission to *The Reflector* in 2017." Who knows, you might like it and even find your calling to be a more regular contributor.

We are looking forward to your input in 2017.

**Your fellow PAA member and contributor,
Rick Stankiewicz
(and past-President [ed.])**

Happy New Year

Welcome to the new year. I hope this new one will be a little less, shall we say, chaotic.

Let's get right at it. This is edition is all Crossen, all the time. Seven articles from Mr. Astronomy himself. That's gotta be a record. I will highlight a few. First up is a report of the awards ceremony at the club's last annual general meeting in December. Congratulations to the Flindall Family, Ken Seals, David Mills and Steve Morgan.

Next is the sky in January as John highlights the celestial targets you should easily find and enjoy. January is the prime viewing season for the constellation Orion. He dominates the winter sky.

His history lesson of the Jet Propulsion Laboratories is a fascinating read. I didn't realize they began as a private U.S. government contractor at the beginnings of the Space Race.

To complement our NASA Space Place cover story, John even writes gives us more details on the new CubeSats, currently in vogue.

Of course we have a couple of beautiful images in the Gallery from John Chumack and Brian McGaffney.

Till next month.

**Phillip Chee
Editor, The Reflector**



The Reflector

The Reflector is a publication of the Peterborough Astronomical Association (P.A.A.) Founded in 1970, the P.A.A. is your local group for astronomy in Peterborough and the Kawarthas.

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Will that be chocolate chip or a short tube refractor?



The Flindall Family accepting their Membership Award from Dean Shewring.

JOHN CROSSEN

THE PETERBOROUGH Astronomical Association's 2016 Annual General Meeting had it all.

Just over 40 members snuggled into the meeting room at the Rotary Educational Building at the Riverview Zoo. As the evening unfolded they enjoyed a quick series of talks by various Executive Members about their specific duties. Then the Annual Membership Awards were presented to the individuals who had contributed the most to the club during the previous year.

Award winners (earners) were Ken Seals, the entire Flindall family, David Mills, and Steve Morgan. Dean Shewring, Phillip Chee and Boyd Wood did the presentations. There was no red carpet, but the heartfelt

applause from the rest of the members showed their appreciation. Thank you from the PAA to all the 2016 winners. Well done.

Our coffee break took a little longer than usual because Santa's helpers brought along bags and plates of cookies plus home baked delights. Suddenly all thoughts of diets were forgotten as members munched and chatted together.

Once the cookie crunching calmed down, elections were held for new members to the executive. David Mills will be assisting Phil Chee as the Editor's Apprentice and is taking over the position as Observing Director from John Crossen who is moving over to become the PAA Astronomy Educator. Ken

See "AGM" on page 15

January's Sky is Ablaze with Constellations and More

JOHN CROSSEN

SOMEONE ONCE TOLD ME that the stars are brighter during the winter. But the fact is there are simply fewer stars to see from our position in orbit during the winter months. Plus the night sky's brightest star (Sirius) is visible during those nippy nights.

This January is a constellation collector's delight. Orion, the Great Hunter strides

across the dark sky. Next to The Big Dipper, Orion is the most popular constellation going. If you follow a line up through Orion's belt you'll come to Taurus The Bull and M45, a naked eye Messier object best known as the Pleiades or Seven Sisters.

Follow a line down through Orion's belt

and you'll step on the tail of Canis Major, The Big Dog and home to the brightest star we can see from the Northern Hemisphere, Sirius. Both Canis Major and Canis Minor are Orion's faithful hunting dogs.

Still hanging in are a couple of left over constellations from fall. Andromeda home to the famous Andromeda Galaxy is still overhead and moving towards the west as are her parents Cepheus and Cassiopeia—the big “W” shaped constellation. But

while the sky may be ablaze with constellations, don't forget to dress warmly.

While you're ogling Orion, don't overlook the sword hanging from his belt. In it is yet another Messier object—M42, the famous Orion Nebula. It's visible naked-eye and is a standout in binoculars. The telescopic view of M42 is nothing short of breathtaking.

Moon muggers will enjoy a First Quarter Moon on January 5 and bask in the bright-

ness of a Full Moon on January 12. New Moon or no moon happens on January 27, so stargazers can get back to gazing without any moonshine to contend with, unless they have a nip in their flask.

The best lunar phase to view the Moon is the First Quarter. That's when there are enough



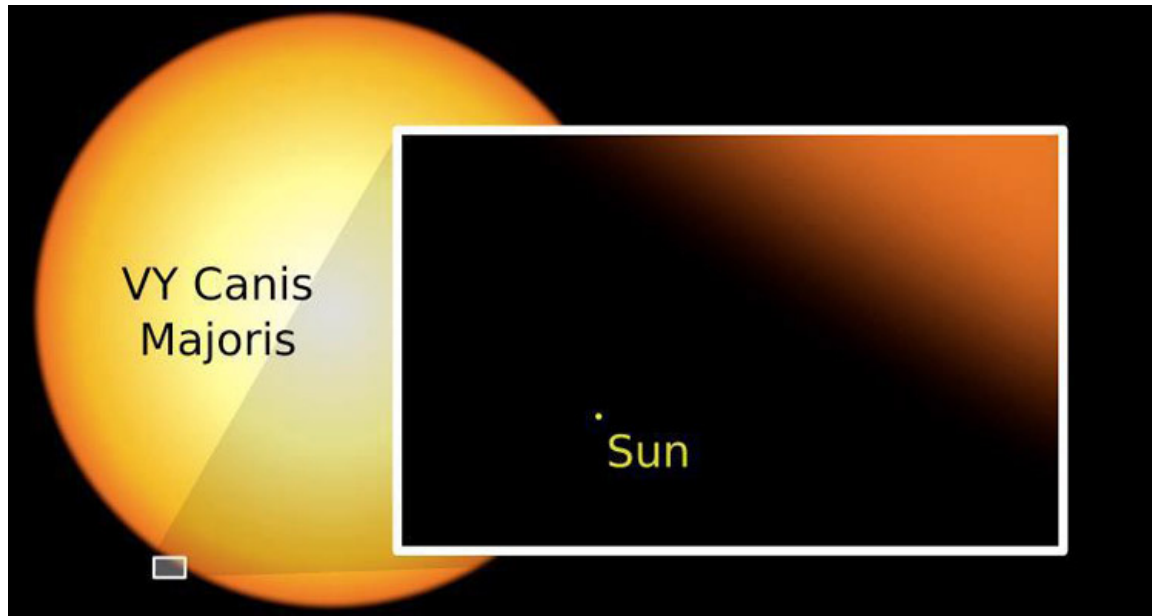
The Sun casts shadows on the First Quarter Moon accenting the craters and mountains. It's the best phase to go loony.

shadows to really highlight the craters and mountain ranges. If you have access to a telescope, binoculars or even a simple spotting scope, have a gander. You'll be amazed. I have a friend who does his stargazing with a rifle scope, so you're not limited to a fancy Dan telescope that costs bazillions of dollars.

January's planets are sure to please. Bright Venus hovers low in the western sky just after Sunset. Mars also continues

See “Quarter Moon” on page 15

DANGER! These Space Oddities May Fry Your Loaf



SUN VS. VY CANIS MAJORIS. If you want to wish big, wish on a big star. Here's a comparison between our host star, the Sun and VY Canis Majoris. Feeling small?

JOHN CROSSEN

HERE'S SOME MARTIAN big talk that'll amaze you. The red planet may be only half the size of Earth, but its now-dormant volcano, Olympus Mons has no short comings. The humongous mountain is 1.5 times as high as Mt. Everest. That makes it 13km high versus Mt. Everest at just over 8km. Were it on Earth, Olympus Mons would punch into our stratosphere.

But height isn't its only claim to fame. The base of Olympus Mons is nearly the as large as the country of Spain. Small wonder it is considered to be the largest mountain currently known to exist in our solar system. But the big stuff doesn't end there. Let's travel back to planet Earth.

It is estimated that when measured by mass, mammals, fish and birds add up to 10% of the life forms on Earth. The other 90% is made up of bugs. Yetch! While we're in bug-land here on Earth, let's peek inside your tummy.

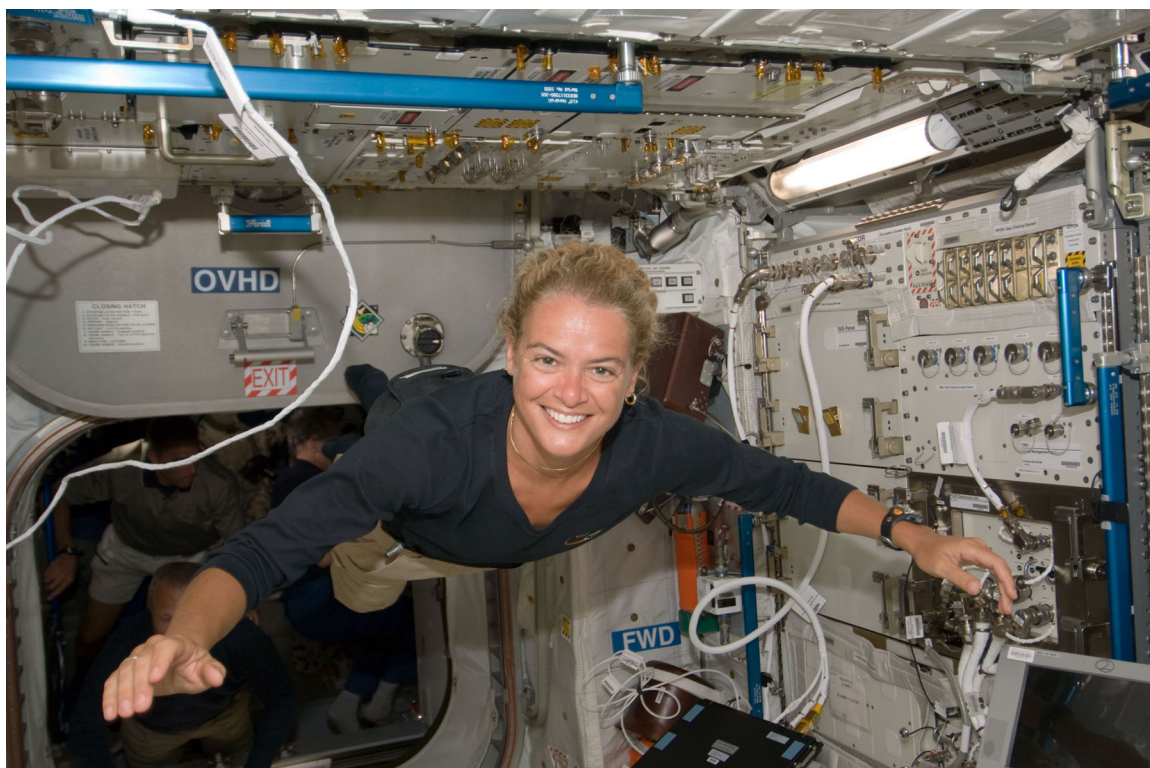
It was once estimated that there are 10 times as many bacteria in the human gut as there were cells in the adult human body. Since 2014 the estimated ratio has been scaled down to 3:1 in favour of bacteria. Nonetheless, that still posts the final tally at 30 trillion bacteria. Next we rocket out to our solar system again.

The Sun is about 1 million times the size of Earth. If you could cut the Sun open and scrape its innards out like you do a pumpkin at Halloween, there would be room inside the Sun for Earth and our Moon to orbit around Earth—without ever touching the inside walls. But the Sun is just a pee-wee when it comes to star size.

Top dog among stars is VY Canis Majoris. It's in Canis Major, the hunting dog that follows Orion the hunter across the winter sky. This stellar goliath would extend out to the orbit of Jupiter if placed at the centre of our solar system. Beside it our Sun would

See "Oddities" on page 15

Some Wrong Space Ideas You've Always Thought Were Right



FLOATING ASTRONAUT. Astronauts are not floating in a gravity-free environment. The International Space Station and all on board it are actually falling around the Earth. Travelling at 27,600 km/h the ISS has just enough velocity to counteract Earth's gravity to keep it in orbit. Otherwise it would come crashing down in farmer Brown's back forty.

JOHN CROSSEN

MAYBE THEY'RE IDEAS your teacher told you in grade school or a friend passed on during a conversation. Whatever the source, they're wrong. So let's set the record straight on a few of them.

The North Star is not the brightest star in the night sky. It is in fact the 49th brightest star. It is the first star in the handle of the Little Dipper, a constellation that is also a difficult find. Chances are the brightest thing you'll see in the night sky aside from the Moon is a planet. So if you've been wishing on a planet, no wonder your wishes didn't come true.

The Sun isn't yellow. It's white. You may think it's yellow because when you look at the setting Sun it is low in the sky and tainted by all the pollution in our lower

atmosphere. It may be classified as a yellow dwarf star, but if you've ever looked at our Sun through a Baader Solar filter you'll see a nice white Sun.

If you think you can't see the Moon in the daytime, think again. It's not unusual for the Moon to be visible in the late morning sky. That's because once the Moon passes its full phase it rises so early in the morning that it's still visible at 10:00 am or later.

Most people think the days in summer are longer. But the longest day of the year occurs on June 21 or 22, the Summer Solstice. After that the days get shorter until we come to December 21, the Winter Solstice and shortest day of the year. Then the days start to grow in length.

Is it warmer in the Canadian summer because the Earth is closer to the Sun?

See "Ideas" on page 13

What's JPL and What Has It Been Up To Lately?



JOHN CROSSEN

IN THIS ANNOYING and confusing age of acronyms, JPL stands for Jet Propulsion Laboratories. Eighty years ago the company was born when seven young men went into the San Gabriel Mountains to play with their favourite toys — rockets. Their successes didn't go unnoticed by the US Army, so when the Russians launched Sputnik, they were charged with coming up with a response — in 3 months. Working with Werner Von Braun, the group launched Explorer 1 and the space race was on.

Today JPL is a part of the National Aeronautics and Space Administration — NASA — and is overseen by the California Institute of Technology or simply CalTech. Their list of successes range from the Mercury, Gemini and Apollo Missions to the Moon landings, the Hubble Space Telescope and today's myriad of communications and weather satellites.

Most amazing of their lengthy list of successes is The Space Technology 7 Disturbance Reduction System. It involves a union between NASA and ESA — the European Space Agency — and is holding ESA's LISA satellite in near perfect position. How close to perfect? Try 25 micronewtons. That's the diameter of a DNA Helix or equivalent to the pressure of sunlight on the orbiting satellite. This portion of the project is managed by JPL.

JPL-developed satellites are also our eyes in the sky, keeping tabs of weather fronts, ocean currents and shipping lines. The latest image beamed back to an airborne craft has shown the amount of land loss experienced after the Gulf Oil Spill of 2010.

The oil has weakened and killed vegetation to the point that 13 feet of shoreline has been lost along the gulf coast. This is quadruple the recession compared to just one year ago. What will succeeding years bring?

See "JPL" on page 13

PHOTO GALLERY

Barred Spiral Aurora Borealis



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Aurora Borealis Spiral in Alaska! Sure looks like a barred Spiral in the sky! Here is my shot of twelve of our Aurora Hunters from March 30, 2016. Do you want to be part of the next Twelve Aurora Hunters in March 2017? Then sign up for our 2017 Trip, a 7 Day/ Night Aurora Expedition/Photo Workshop in Alaska!

Alaska is hand down the Best place to watch and capture the Aurora Borealis! And yes we take Beginners to Pros, so all are welcome! Only 4 spots left!

Come join us from March 19-25th of 2017.

<http://www.sphotography.com/photo-tours-workshops/alaska-northern-lights-aurora-photo-tour>
http://www.galacticimages.com/galactic_trips.html

Best Regards,
John Chumack www.galacticimages.com

Cirrus Nebula NCG 6960



Thousands of years ago a new light would have suddenly appeared in the night sky and faded after a few weeks. Today we know this light was from a supernova, or exploding star, and record the expanding debris cloud as the Veil Nebula, a supernova remnant. This part of the Veil is the Western Strip.

The colors here are well separated into atomic hydrogen (red) and oxygen (blue-green) gas. The complete supernova remnant lies about 1400 light-years away towards the constellation Cygnus. This Witch's Broom actually spans about 35 light-years. The bright star in the frame is 52 Cygni, visible with the unaided eye from a dark location but unrelated to the ancient supernova remnant. I imaged this as a high resolution set up and cropped it in higher detail. I will re-visit this object again later in H α and OIII to bring out more of the subtle details. But even so, the color data turned out quite good. (*Editor's note: the image above is the H α +OIII image.*)

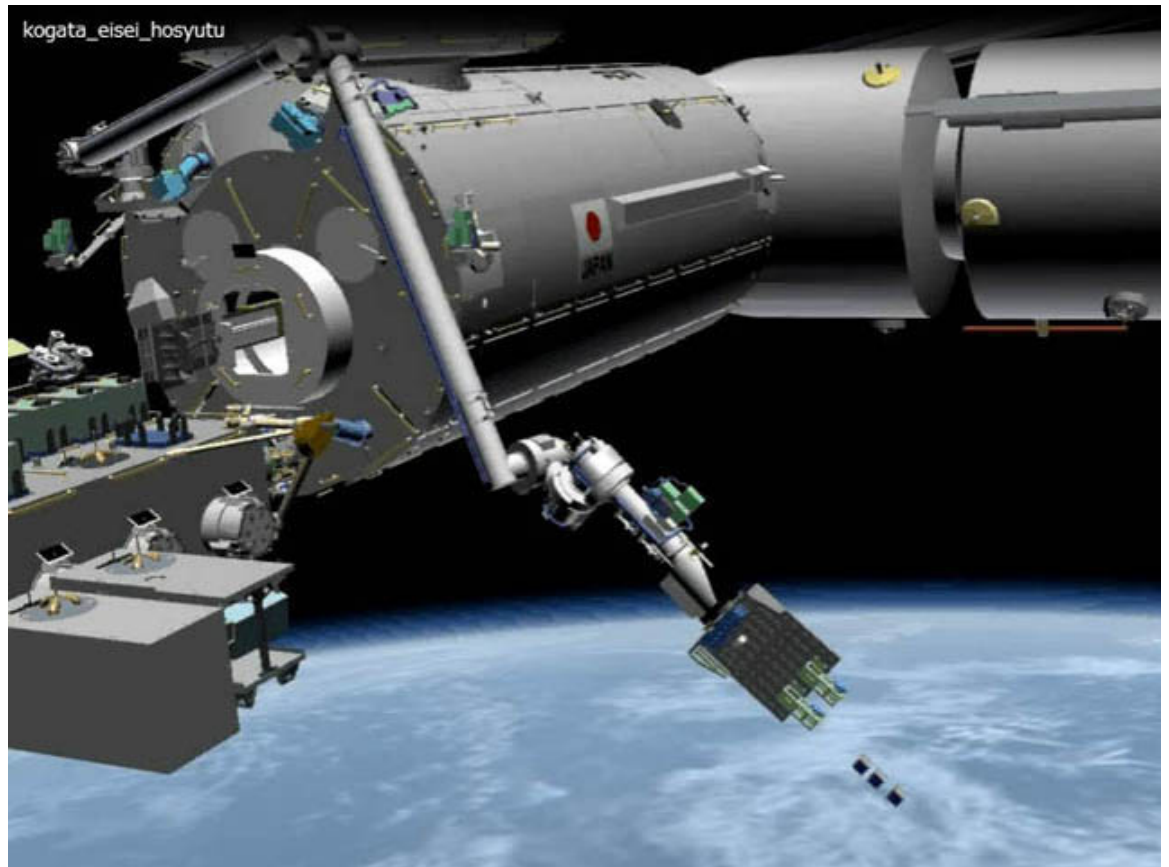
Technical Details

Data obtained for this image was a combination of LL (RG Gb) imaged remotely from my office in Richmond Hill, through to the observatory here. Acquisition time was about 4 hours total.

Processing was done through MaxIm, and CCD Soft, and Luminance noise reduction scripts in PixInsight. DDP and Decon were also used. Remaining algorithms were done in MaxIm 6.03 and PS.

Brian McGaffney

Peewee Satellites to Explore Space Cheaper



SHOT OF CUBE BEING DEPLOYED FROM THE ISS. A rack of cubesats are shown in artwork being deployed by the Kibo arm of the International Space Station (ISS). The goal is to use the cubesats for amateur radio operators around the world. First deployment was on February 28, 2015 with more to come. A single cubesat will sit in the palm of your hand with room to spare.

JOHN CROSSEN

THEY ARE CALLED CubeSats and each of the little critters is just 10 centimetres (4") square. The simplest CubeSat is called a 1U (for one unit). A 1U costs as little as \$3,500 to build thanks to the happy fact that many of its components come from off-the-shelf smart phone technology. Depending on the required end function the units can be combined to accomplish a variety of tasks. A U1 to a U6 are currently available.

In 2018, when NASA puts its powerful new Space Launch System (SLS) on a test launch with the new Orion Spacecraft on board there will be three stowaways along. They'll

be CubeSat U6 models and the beauty of it all is they're small enough — about the size of a big shoe box — for a free ride. Free is good — especially at NASA these days.

NASA already has a number of cubesats in Lo-Earth-Orbit (LEO) many of which are demonstrating the feasibility of using existing technology from the consumer market for future space exploration. One of the experimental satellite series is called PhoneSat.

Another series is called Doves. These are 3U CubeSats which are designed to scan Earth in high detail. Planet Labs, the origi-

see "CubeSats" on page 12

Messier Object M22 — Woof!

Hi everyone,

Those of you who were at the last observing session (July 2016) were all talking about globular cluster M22 in the constellation Sagittarius.

Attached is an image Ron Brecher took of M22 at StarFest. You're looking at well over a million stars in a ball that's about 100 light years across. Age wise, astronomers have estimated that is nearly 12 billion years old in a universe that's 13.7 billion years old. All I can say is Wow!

Seeing wonders like this is one of the reasons the PAA observing sessions are so important – and enjoyable.

Those of you who may recall, Ron was one of our most intriguing guest speakers two years ago. As further testimony to his talents, he also has an article in an upcoming Sky & Telescope Magazine.

Congratulations Ron, and clear skies to everyone.

John Crossen



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CubeSats

nating company, has already launched 71 Doves into LEO. More from differing sources are expected in the near future.

But deep-space is where the real testing ground is. Given that these little boxes can snuggle into such a small space, programs aimed at orbiting Mars and nearby asteroids are next up on the schedule.

The first of these goes by the tongue-twisting moniker of Interplanetary Nano-Spacecraft Pathfinder In Relevant Environments. But around the water cooler it's just called INSPIRE.

The mission will take two U3 cubes on a 3-month, deep-space tour of duty. They'll travel 1.5 million kilometres from Earth to see if they function and survive. Price tag for the mission is \$5.5 million. That's a hefty price for you and me, but for space travel it's a bargain-basement bonanza.

Two 6U CubeSats are on stand-by to launch in March of 2016 on a trip to Mars. They'll be part of NASA's InSight lander mission. Their job will be to relay communications back to Earth during the probe's entry, descent and landing.

As space travel gets less and less expensive I look forward to more unearthly excitement on the near horizon. The more we know, the more we can do and the farther we can go. Isn't that what us human critters are all about?

*continued from page 7***JPL**

The wetland impacts of the spill documented by the team included both the loss of wetlands due to shoreline erosion, and island fragmentation, where small islands are broken into even smaller islands, creating more shoreline. Land lost from fragmentation is unlikely to be reestablished, particularly in this part of the Mississippi River delta where levees prevent an influx of new sediments from the river. This will alter natural coastal defenses against flooding.

The images collected in the annual surveys and following Hurricane Isaac were obtained from NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR), developed and managed by NASA's Jet Propulsion Laboratory, Pasadena, California. UAVSAR flies on a C-20A research aircraft based at NASA's Armstrong Flight Research Center facility in Palm-dale, California. UAVSAR's polarized radar produced detailed representations of the marsh, which USGS scientists then used to develop a process to analyze the shoreline recession by mapping the change in shore location.

*continued from page 6***Ideas**

Nope. Blame it on Earth's 23.5 degree tilt. Our Summer happens when the Earth's elliptical orbit around the Sun finds us at our furthest point from dear old Sol. What does happen during our summer is that the Northern Hemisphere is tilted towards the Sun. So we enjoy more sunshine and warmer weather. Of course it's just the opposite in the Southern Hemisphere. So let's all move to the equator.

Here's one you've probably heard and retold. On a dark, moonless night in the country you can see millions of stars. Sorry, but even at the darkest location in the world you'll only be able to see about 2,500 stars. There are indeed millions of stars, but the human eye can only see stars down to magnitude 5.5. So the best estimate is 2,500. Go ahead count 'em.

**Peterborough Local 590**



KW *Telescope*
P E R C E P T O R



The Sky this Month

Mercury emerges in the early morning sky early in the month and is well-placed during month. Reaches greatest elongation west (24°) on the 19. Makes a wide pair with the Moon on the 26th.

Venus is well placed in the evening sky. Reaches greatest elongation east (47°) on the 19th. Has a wide conjunction with the Moon on the 2nd and 31st.

Mars begins the year in central Aquarius. Crosses into Pisces on the 19th. In close conjunction with Venus and waxing crescent Moon on the 31st.

Jupiter begins the year in central Virgo northwest of Spica. Moon passes 3° north on the 19th.

Saturn begins the year in southern Ophiuchus near the point it ends its retrograde motion in 8 months.

Quarantid Meteors peak on the 3 at 10 AM.

Moon Phases

First Quarter	2:47 PM	January 5
Full Moon	6:34 AM	January 12
Last Quarter	5:13 PM	January 19
New Moon	7:07 PM	January 27

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AGM

Seals has vacated his seat as the PAA Secretary, leaving that position open for the time being.

Two important announcements were also made. Our guest speakers for the January 6, 2017 meeting will be Crystal and Jared Cook who will give us a presentation on their specialty, video broadcast astronomy. This is a rapidly expanding new field for astronomers and is particularly useful in public outreach work.

The other news note is that blackhole expert Dr. Julie Banfield will be in Peterborough for the 2017 holiday season. You may have seen her Skype presentation to the PAA from Australia where she works with one of the largest telescopes there. It was a superb presentation and we are indeed honoured to have her speak to us in person.

The final presentations of the night came from PAA members who brought their telescopes along and explained the differences between them. For our beginners it was a great opportunity to “fondle the merchandise” and ask questions — lots of questions.

I’ve been to a lot of meeting over the past 15 years and this was the most informative and entertaining one yet. Oh yah and the cookies weren’t half bad either.



**Ontario Telescope
and Accessories**

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Quarter Moon

to be visible. It will appear as the orangey bright star-like object in the evening sky. Also visible to telescope owners are Uranus and Neptune, though they will only appear as bluish green orbs, even at high powers. Pluto will also be visible through a large telescope, though it is so distant that it will just look like another star.

Early morning planet viewers can catch Mercury, Jupiter and Saturn. Beautiful Saturn through a telescope is well worth the early rise. Plus Jupiter’s four moons just add to the fun. They’re even visible through a pair of 10 × 50 binoculars. So throw on the coffee, pop open your peepers and have a look at what’s up in the dawn sky.

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Oddities

be barely visible. That’s because VY Canis Majoris is 1,500 times larger than our Sun.

So what’s the largest exoplanet yet discovered?

A journey into deep space reveals that the big boy is a real whopper. Going by the highly romantic name of HD 100546 b, this exoplanet currently tops the list at nearly 7 times the size of Jupiter. And how big is Jupiter you ask? You could take all the other planets and moons in our solar system and stuff them inside Jupiter with room left over. It is so large that it is almost big enough to be considered a brown dwarf star.

Now let’s tackle a real biggie — the universe.

Recent calculations indicate that our “observable universe” could be twice as large as was once thought. That would bring its size up to 90 million light years across containing an estimated 100 billion galaxies. But astronomers think that our universe is actually bigger than that. But who’s counting?

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MinXSS

The \$1 million original mission has been gathering observations since June.

The satellite will likely burn up in Earth's atmosphere in March. But the researchers have built a second one slated for launch in 2017. MinXSS-2 will watch long-term solar activity—related to the Sun's 11-year sunspot cycle—and how variability in the soft X-ray spectrum affects space weather, which can be a hazard for satellites. So the little-mission-that-could will continue—this time, flying at a higher, polar orbit for about five years.

If you'd like to teach kids about where the Sun's energy comes from, please visit the NASA Space Place: <http://spaceplace.nasa.gov/sun-heat/>

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!



Articles

Submissions for *The Reflector* must be received by the date listed below. E-mail submissions are preferred (Microsoft Word, OpenDoc, ASCII and most common graphic formats are acceptable). If your article contains photos or graphics, please provide a separate file for each. Typed or hand-written submissions are acceptable provided they are legible (and not too long.) Copyrighted materials will not be published without written permission from the copyright holder. Submissions may be edited for grammar, brevity, or clarity. Submissions will be published at the editor's sole discretion. Depending on the volume of submissions, some articles may be published at a later date. Please submit any articles, thoughts, or ideas to:

phillip.chee@gmail.com

**Next submission deadline:
January 27 2017**



Meetings

The Peterborough Astronomical Association meets every first Friday of each month, except July and August, at the **Peterborough Zoo Guest Services and Rotary Education Centre** (inside the main entrance at the north end of the Zoo) at 7 p.m. P.A.A. general announcements will begin each meeting with the guest speaker starting at 7:30 p.m.