# Orbit

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# Issue Number 5, March, 2014
## Roger Hill, Editor

Hooray!! The parking lot has been plowed and it's now March, which means the Vernal Equinox is not far away!

It also means that AstroCATS is about 9 weeks away.

There's lots going on, and more to come...at least this month I've put the correct calendar on the back page!

I've got two more NOVA sessions to go, with first one on March 3rd (tomorrow, as I write this). I have to say that I really appreciate the efforts of Mark Pickett and Ed Mizzi in helping out. Mark helped out last year, too, but his suggestion of moving the observing portion of the evening to the beginning of the evening has helped out.

Ed Mizzi is a great help, too. As you know, I am not a professional educator, although both my wife and our daughter are. Ed's been great helping me with the actual teaching. You see, Ed is a retired High School teacher, whose specialty was Geography. However, he used to help out by doing the Grade 9 Astronomy portion of the curriculum. He also goes to Algonquin park every year to help out with an excursion, showing the students the night sky. Ed could do major portions of the NOVA course all by himself, and I'm hoping that we'll be able to split the course up in such a way that the future attendees get the best that all of us have to offer.

Last month, for Orbit, Ed produced the first of what I've started calling Mizzi's Quizzis. Considering he's also done a quiz for each NOVA session so far, I'm beginning to suspect that what Ed misses about being a teacher is not the teaching, but the testing! Maybe that's the case with all teachers...Will Gray, our former treasurer, was also fond of giving a testing question at each general meeting! Anyway, you'll find the answers for last month later in Orbit, and another quiz for your enjoyment.

If you find yourself in Eastern Ontario around 2:08am EDT and it's clear, head outside for an asteroid occultation. 163 Erigone will occult Regulus, an event easily seen by naked eye, and could even be caught by some cell phone cameras. Not sure how to find Regulus? If you're at the March General meeting, you don't know where Regulus is in the sky, and you don't already have one, I'll give you an RASC Planisphere. Actually, even if you're not in Eastern Ontario you should check out Regulus at the time. Many asteroids have small companions, and knowing exactly where you are and the exact time, if you record Regulus vanishing from outside the predicted path, you may have a far more valuable observation than those inside it, looking for the Main Event.

There is also a lunar eclipse on the night of April 14-15 (Monday night /Tuesday morning). Lunar eclipses offer some great opportunities for photography, but fortune favours the prepared. To get ready, use the Full Moon on Sunday, the 16th of March 2014 to gauge how bright and how large the Moon is, and how quickly it can move, particularly if you're using a tripod or a mount that doesn't have a lunar rate. You'll want to capture the entire Moon, so a long telephoto or a small telescope is ideal. If your observing site has some foreground features, or you'd like to photograph the eclipsed Moon with a foreground object, the Moon at mid-eclipse will be 26 degrees high, in the southwest sky. For instance, if you're about 1200 meters North East of the CN Tower, you should be able take a picture of the eclipsed Moon balanced on the top of the tower! This is somewhere in Toronto's Financial District, and the Tower is probably invisible from this spot, anyway. However, perhaps this has given you a good idea!

Finally, in case you're wondering why Neil deGrasse Tyson is on the front cover of Orbit, it's because his update of Carl Sagan's COSMOS starts on Sunday evening, March 9th.

See you next month!

Roger

**An Asteroid hides Regulus**

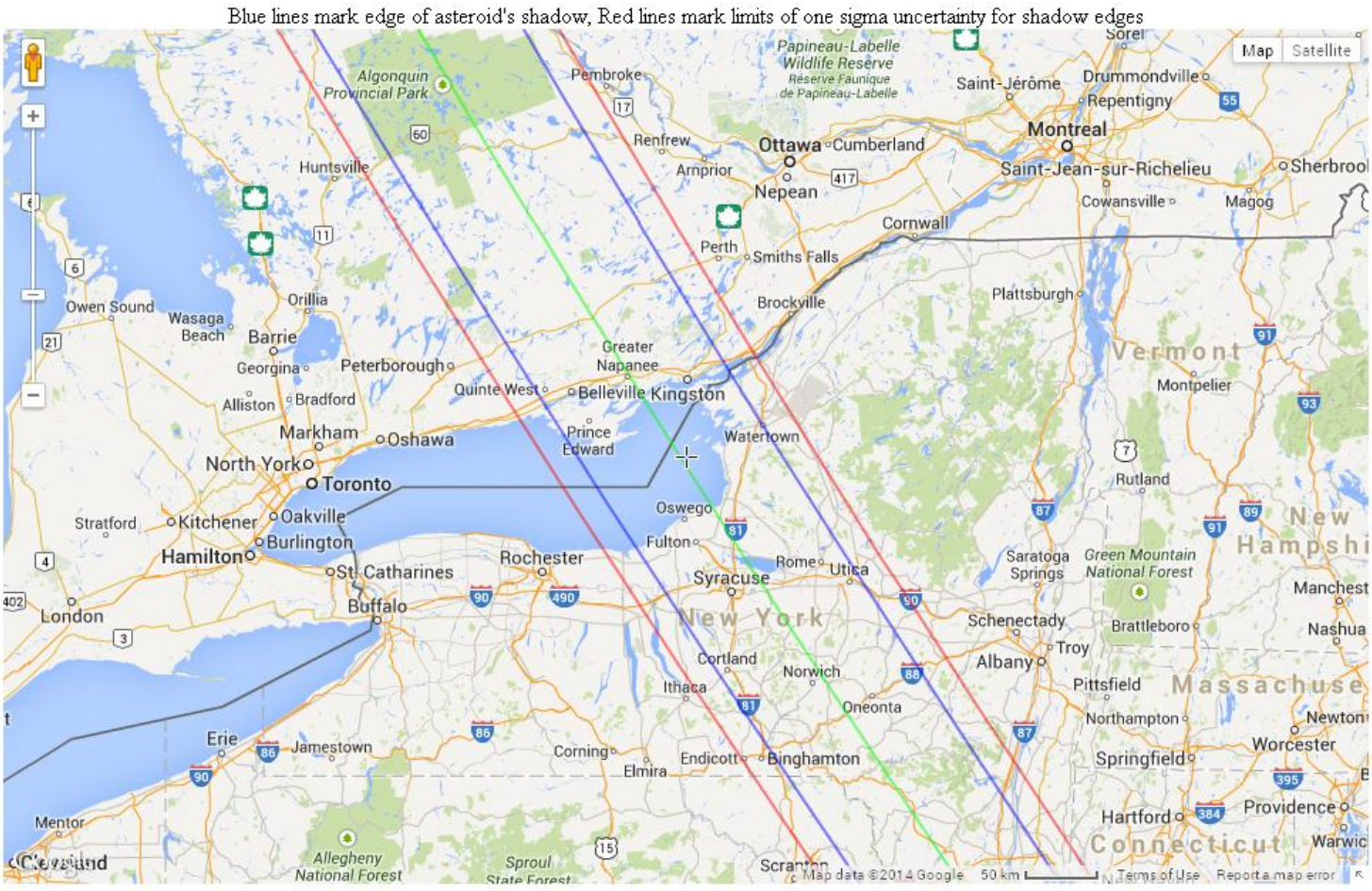
In the early morning of March 20th the asteroid (163) Erigone will pass in front of Regulus, the brightest star in Leo. This event, known as an occultation, will only be able to be seen from thin path over north-eastern North America. The predicted path, about 72km wide, is expected to pass directly over New York, so if there are clear skies that night there is a potential for millions of people to witness this rare event, which may last as long as 14 seconds for observers along the centreline of Erigone's shadow. Imagine looking up into the sky and seeing a bright star just blink off and disappear from sight for several seconds!

An occultation is when one body covers or 'hides' another. Asteroids, planets and moons can occult stars, the Moon can occult the planets and even solar and lunar eclipses are occultation events as well. These events can tell us much more than the basics of how big or what shape an asteroid is or, in the case of lunar occultations, how well we know the orbit of the Moon. They can help to refine the orbit of an asteroid; if it has a satellite or is a double asteroid; if the position of the star it occulted was known accurately and they regularly result in the discovery of new double stars. Occultations involving Pluto are particularly valuable at the moment as the New Horizons spacecraft approaches the distant dwarf planet, monitoring the state of Pluto's atmosphere and even keeping a check on where Pluto actually is!

Occultations of stars by asteroids happen every night of the year all around the world, but the stars occulted are typically faint and need a moderate sized telescope to see them. But this one will be visible to the unaided eye, which makes it special. Similar events have happened before (there have been at least two in the last decade) and while there is no indication of when the next event may occur as we gradually increase our knowledge of the asteroids out there in our solar system another possibility may arise again in the not too distant future.

A short animation showing what is expected to happen on March 20th can be found here:
http://www.youtube.com/watch?v=ywAENyB-ne4

The International Occultation Timing Association's (IOTA) information page for this event is: http://occultations.org/Regulus2014/



## A Two-Toned Wonder from the Saturnian Outskirts By Dr. Ethan Siegel

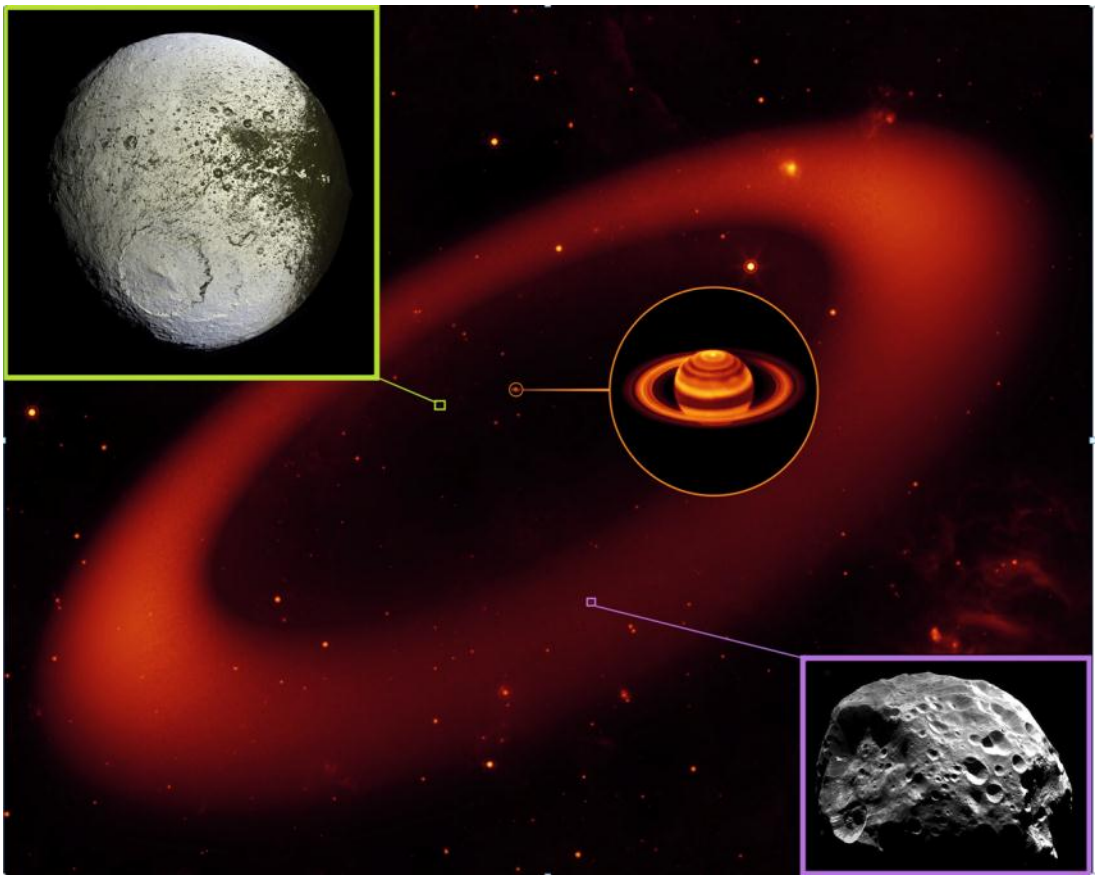
Although Saturn has been known as long as humans have been watching the night sky, it's only since the invention of the telescope that we've learned about the rings and moons of this giant, gaseous world. You might know that the largest of Saturn's moons is Titan, the second largest moon in the entire Solar System, discovered by Christiaan Huygens in 1655. It was just 16 years later, in 1671, that Giovanni Cassini (for whom the famed division in Saturn's rings—and the NASA mission now in orbit there—is named) discovered the second of Saturn's moons: Iapetus. Unlike Titan, Iapetus could only be seen when it was on the west side of Saturn, leading Cassini to correctly conclude that not only was Iapetus tidally locked to Saturn, but that its trailing hemisphere was intrinsically brighter than its darker, leading hemisphere. This has very much been confirmed in modern times!

In fact, the darkness of the leading side is comparable to coal, while the rest of Iapetus is as white as thick sea ice. Iapetus is the most distant of all of Saturn's large moons, with an average orbital distance of 3.5 million km, but the culprit of the mysterious dark side is four times as distant: Saturn's remote, captured moon, the dark, heavily cratered Phoebe!

Orbiting Saturn in retrograde, or the opposite direction to Saturn's rotation and most of its other Moons, Phoebe most probably originated in the Kuiper Belt, migrating inwards and eventually succumbing to gravitational capture. Due to its orbit, Phoebe is constantly bombarded by micrometeoroid-sized (and larger) objects, responsible for not only its dented and cavity-riddled surface, but also for a huge, diffuse ring of dust grains spanning quadrillions of cubic kilometers! The presence of the "Phoebe Ring" was only discovered in 2009, by NASA's infrared-sensitive Spitzer Space Telescope. As the Phoebe Ring's dust grains absorb and re-emit solar radiation, they spiral inwards towards Saturn, where they smash into Iapetus—orbiting in the opposite direction—like bugs on a highway windshield. Was the dark, leading edge of Iapetus due to it being plastered with material from Phoebe? Did those impacts erode the bright surface layer away, revealing a darker substrate?

In reality, the dark particles picked up by Iapetus aren't enough to explain the incredible brightness differences alone, but they absorb and retain just enough extra heat from the Sun during Iapetus' day to sublimate the ice around it, which resolidifies preferentially on the trailing side, lightening it even further. So it's not just a thin, dark layer from an alien moon that turns Iapetus dark; it's the fact that surface ice sublimates and can no longer reform atop the leading side that darkens it so severely over time. And that story—only confirmed by observations in the last few years—is the reason for the one-of-a-kind appearance of Saturn's incredible two-toned moon, Iapetus!

Learn more about Iapetus here: http://saturn.jpl.nasa.gov/science/moons/iapetus.



*Images credit: Saturn & the Phoebe Ring (middle) - NASA / JPL-Caltech / Keck; Iapetus (top left) - NASA / JPL / Space Science Institute / Cassini Imaging Team; Phoebe (bottom right) - NASA / ESA / JPL / Space Science Institute / Cassini Imaging Team.*

This article comes courtesy of the Communication Coordinator, NASA's Space Place at the Jet Propulsion Laboratory, California Institute of Technology

# Researchers say distant quasars could close a loophole in quantum mechanics by Jennifer Chu, MIT News Office

In a paper published this week in the journal Physical Review Letters, MIT researchers propose an experiment that may close the last major loophole of Bell's inequality - a 50-year-old theorem that, if violated by experiments, would mean that our universe is based not on the textbook laws of classical physics, but on the less-tangible probabilities of quantum mechanics.

Such a quantum view would allow for seemingly counterintuitive phenomena such as entanglement, in which the measurement of one particle instantly affects another, even if those entangled particles are at opposite ends of the universe. Among other things, entanglement - a quantum feature Albert Einstein skeptically referred to as "spooky action at a distance"- seems to suggest that entangled particles can affect each other instantly, faster than the speed of light.

In 1964, physicist John Bell took on this seeming disparity between classical physics and quantum mechanics, stating that if the universe is based on classical physics, the measurement of one entangled particle should not affect the measurement of the other - a theory, known as locality, in which there is a limit to how correlated two particles can be. Bell devised a mathematical formula for locality, and presented scenarios that violated this formula, instead following predictions of quantum mechanics.

Since then, physicists have tested Bell's theorem by measuring the properties of entangled quantum particles in the laboratory. Essentially all of these experiments have shown that such particles are correlated more strongly than would be expected under the laws of classical physics - findings that support quantum mechanics.

However, scientists have also identified several major loopholes in Bell's theorem. These suggest that while the outcomes of such experiments may appear to support the predictions of quantum mechanics, they may actually reflect unknown "hidden variables" that give the illusion of a quantum outcome, but can still be explained in classical terms.

Though two major loopholes have since been closed, a third remains; physicists refer to it as "setting independence," or more provocatively, "free will."

This loophole proposes that a particle detector's settings may "conspire" with events in the shared causal past of the detectors themselves to determine which properties of the particle to measure - a scenario that, however far-fetched, implies that a physicist running the experiment does not have complete free will in choosing each detector's setting. Such a scenario would result in biased measurements, suggesting that two particles are correlated more than they actually are, and giving more weight to quantum mechanics than classical physics.

"It sounds creepy, but people realized that's a logical possibility that hasn't been closed yet," says MIT's David Kaiser, the Germeshausen Professor of the History of Science and senior lecturer in the Department of Physics. "Before we make the leap to say the equations of quantum theory tell us the world is inescapably crazy and bizarre, have we closed every conceivable logical loophole, even if they may not seem plausible in the world we know today?"

Now Kaiser, along with MIT postdoc Andrew Friedman and Jason Gallicchio of the University of Chicago, have proposed an experiment to close this third loophole by determining a particle detector's settings using some of the oldest light in the universe: distant quasars, or galactic nuclei, which formed billions of years ago.

The idea, essentially, is that if two quasars on opposite sides of the sky are sufficiently distant from each other, they would have been out of causal contact since the Big Bang some 14 billion years ago, with no possible means of any third party communicating with both of them since the beginning of the universe - an ideal scenario for determining each particle detector's settings.

As Kaiser explains it, an experiment would go something like this: A laboratory setup would consist of a particle generator, such as a radioactive atom that spits out pairs of entangled particles. One detector measures a property of particle A, while another detector does the same for particle B.

A split second after the particles are generated, but just before the detectors are set, scientists would use telescopic observations of distant quasars to determine which properties each detector will measure of a respective particle. In other words, quasar A determines the settings to detect particle A, and quasar B sets the detector for particle B.

The researchers reason that since each detector's setting is determined by sources that have had no communication or shared history since the beginning of the universe, it would be virtually impossible for these detectors to "conspire" with anything in their shared past to give a biased measurement; the experimental setup could therefore close the "free will" loophole.

If, after multiple measurements with this experimental setup, scientists found that the measurements of the particles were correlated more than predicted by the laws of classical physics, Kaiser says, then the universe as we see it must be based instead on quantum mechanics.

"I think it's fair to say this [loophole] is the final frontier, logically speaking, that stands between this enormously impressive accumulated experimental evidence and the interpretation of that evidence saying the world is governed by quantum mechanics," Kaiser says.

Now that the researchers have put forth an experimental approach, they hope that others will perform actual experiments, using observations of distant quasars.

"At first, we didn't know if our setup would require constellations of futuristic space satellites, or 1,000-meter telescopes on the dark side of the moon," Friedman says. "So we were naturally delighted when we discovered, much to our surprise, that our experiment was both feasible in the real world with present technology, and interesting enough to our experimentalist collaborators who actually want to make it happen in the next few years."

Adds Kaiser, "We've said, 'Let's go for broke - let's use the history of the cosmos since the Big Bang, darn it.' And it is very exciting that it's actually feasible."

Artist's interpretation of ULAS J1120+0641, a very distant quasar. Image courtesy ESO/M. Kornmesser.

# Build a Cheap, Simple Laptop Light Control Hutch by Alan Sheehan B.E

Most of the time while I'm out by my myself imaging, I'm not too concerned about stray light from my laptop, but with IISAC2007 approaching I thought now might be a good time to build a light control hutch for the laptop. The other reason I want a light control hutch is to help me see the screen during the day for solar imaging, so there are a number of criteria I want my hutch to meet:

⇒ It must be robust enough to handle being frequently packed, unpacked and transported;
⇒ It must shield the laptop screen from light during the day;
⇒ It should help control stray light from the laptop screen at night;
⇒ It must be dew resistant;
⇒ It shouldn't get too hot when in the sun.

Materials Required

⇒ 1 only 120 litre storage box
⇒ 1 only can of gloss white spray enamel
⇒ 1 only can of flat black spray enamel
⇒ 1 metre of black "Cover-It" contact vinyl
⇒ 1 to 2 metres of adhesive Velcro hook strip (optional)
⇒ 1 fabric hood to attach to the Velcro on the box for additional light control (optional)
⇒ Masking tape
⇒ Newspaper

Tools Required

⇒ Sandpaper
⇒ A Stanley knife
⇒ A Sewing machine to make the optional fabric hood.

Method

I considered a number of alternatives before settling on this solution:
•Cardboard box - cheap, reasonably durable but not real tolerant of dew.
•Fabricated folding hutch from MDF or plywood – not so cheap, complex to build, etc.
•Recycled plastic box – slightly cheaper than the storage box, opaque plastic and available in either black or white, but at the time I was concerned they wouldn't be quite big enough, but certainly robust enough and dew resistant.
•Storage box – Slightly more expensive than the recycled plastic box, not as robust but still good, not opaque so a little bit more painting required, certainly big enough.

I ended up going with the 120 litre storage box (because I was confident it was big enough.

It is necessary to paint the storage box to make it opaque. Because I don't want the box to get hot when out in the sun, it needs to be white to reflect the light and not absorb it and turn it into heat. I chose to paint the inside of the box so that the outside surface remains robust and impervious to scratches.

To give the paint a reasonable chance at sticking, sand the inside surface of the box. I sanded the bottom, both ends and only one long side. The unsanded side will be left unpainted. Once the surface is sanded and clean of dust, mask off all the areas you don't want to paint. I masked right around the top of the box and also the unsanded side (inside).

Spray paint the inside of the box. Wear old clothes for this and a dust mask to keep the paint out of your nose. Reapply as many costs as you like to make the box as opaque as possible. I used a full can of gloss white spray paint.

Allow the white paint to dry for between 5 minutes and an hour (or as directed for recoating) and then paint over the white paint with the flat black paint. Again I used a full can of flat black spray paint. The black on the inside helps to absorb the light on the inside of the box. Figure 3 shows the box after painting with the flat black paint. Notice the masked off side and also the show through from the white paint. If you can afford a second can of flat black paint, it will make a more professional finish!

Once the paint is dry, unmask the box. Figure 4 shows the box unmasked. Notice the outside looks white and the inside is black (except for the bottom which is unpainted).

Next I added a strip of adhesive Velcro hook material around the top and both sides of the "hutch" – see Figure 5. This will allow me to attach a fabric hood to the hutch to make it darker inside and achieve better contrast to view the laptop screen during the day. A black fabric hood is best for this application, but a black hood will get hot in the sun, so I am planning to get a double sided hood sewn up – white on top and black underneath. Another option that may be worth experimenting with here is to use a space blanket shiny side out. Most space blankets are very light though and might blow away or lift in a breeze, but there are some more robust versions around that might be worth a try.

The final step to finishing the hutch itself is to cover the bottom surface. I chose black "Cover-It" adhesive vinyl, so it will absorb light and provide a robust surface for the laptop and mouse to sit and work on. Use the Stanley knife to trim the vinyl to size after application. Figure 6 shows the finished hutch with the vinyl installed.

Figure 7 shows the laptop in pride of place with lots of ventilation and room for the mouse to run around. Even without the hood it makes some difference to the visibility of the screen.

Not counting the Velcro (which was surplus to previous projects) the hutch cost less than $35 to make, and it can be done in an afternoon.

# NASA Administrator Bolden's Statement on the Agency's FY 2015 Budget Request

The following statement is from NASA Administrator Charles Bolden on the Obama Administration's budget request for the 2015 fiscal year:
"Today, President Obama released his Fiscal Year 2015 budget request for the nation, and there is a lot of good news in it for NASA. The president's funding plan for America's space program reaffirms the path we are on, and will keep us moving forward -- pushing farther in the solar system and leading the world in a new era of exploration. "Through NASA's work at all of our centers, our nation is recognized for scientific and technological leadership and knowledge-sharing that improves lives all around the world.

"Over the past six years, the Obama Administration has invested more than $100 billion in America's space program, including the $17.5 billion that is part of this year's budget. The president's budget, once again, affirms the bi-partisan strategic exploration plan agreed to with the Congress in 2010. It keeps us moving toward the missions and breakthroughs of tomorrow even as it enables the tangible successes of today.

"This budget keeps us on the same, steady path we have been following – a stepping stone approach to send humans to Mars in the 2030's. It's a path that has seen many recent successes, from the launch of the Global Precipitation Measurement mission last week -- the first of an unprecedented five Earth Science launches this year -- to returning space station resupply missions to U.S. soil with private American companies… to the power-up of Orion and the countdown toward its first flight test later this year… to the final mirrors for the James Webb Space Telescope being delivered.

"This budget ensures that the United States will remain the world's leader in space exploration and scientific discovery for years to come. The budget supports the administration's commitment that NASA be a catalyst for the growth of a vibrant American commercial space industry, and keeps us on target to launch American astronauts from right here in the USA by 2017, ending our reliance on others to get into space and freeing us up to carry out even more ambitious missions beyond low-Earth orbit.

"We are committed to the International Space Station, and the latest extension guarantees we'll have this unique orbiting outpost for at least another decade. This means an expanded market for private space companies, more ground-breaking research and science discovery in microgravity – and additional opportunities to live, work and learn in space over longer and longer periods of time.

"This budget keeps NASA's deep space exploration program on track by funding the Space Launch System (SLS) and Orion crew vehicle to take American astronauts farther into the solar system than we have ever gone before. Our stepping stone approach to sending humans to Mars involves continued research on the space station, testing our new capabilities beyond the moon, exploring an asteroid and ultimately sending a crewed mission to the Red Planet. "In order to carry out these pioneering missions, we have to develop technologies for our asteroid redirect mission that will lead to the subsequent first crewed mission to Mars.

"This budget funds all elements of that stepping stone approach, and actually increases funding for space technology development and other efforts that will support the first crewed flight of SLS to an asteroid.

"In the coming year, we'll build on our nation's record of breathtaking and compelling scientific discoveries and achievements in space, with science missions that will reach far into our solar system, reveal unknown aspects of our universe and provide critical knowledge about our home planet. It includes funding for missions to Mars and the formulation for a mission to Jupiter's moon, Europa. It also funds science missions already heading toward destinations such as Jupiter and Pluto and operating throughout the solar system, a mission to study our planet's magnetic system, and steady progress on the James Webb Space Telescope.

"Under this budget, our pioneering aeronautics research program will continue to focus on substantially reducing fuel consumption, emissions and noise – and help make the Next Generation Air Transportation System, or NextGen, a reality.

"All of the investments we make at NASA help drive technology and innovation, spur economic activity and create jobs. That is why under the president's Opportunity, Growth, and Security Initiative, with Congressional approval, NASA will receive nearly $900 million in additional funding in FY15 to focus on specific priorities. This "invest in America" initiative recognizes that the type of innovation and technology development we do helps create opportunity, grow our economy and secure our future.

"The Fiscal Year 2015 budget advances NASA's strategic plan for the future, and with it we'll continue to build on U.S. preeminence in science and technology, improve life on Earth and protect our home planet, while creating good paying jobs and strengthening the American economy.

"The passion and dedication of the NASA workforce has taken us to new heights over the past 50-plus years. Today, we build on that strong foundation and carry out new pioneering missions to lead the world and reach even higher. Working together, we turn science fiction into science fact and make the impossible possible."

# What you missed last month—The February, 2014 meeting:

I missed it, too, but Ed Mizzi didn't, and he sent along some pictures of what you missed.

# Mizzi's Quizzis—Number 2 From Ed Mizzi

The following questions are taken directly from grade 9 science test banks and deal with the space unit. How well can you do?

1 In the 1920's two scientists began comparing the surface temperature of stars with the star's luminosity. They graphed their results in what is referred to as the:

A. Solar Shift Model
B Hertzsprung-Russell Diagram
C. Wegener-Darwin Illustration
D. Helio-Solar Diagram

2 A star has a definite life cycle. The first stage in the star's formation is called …

A. Nebulae
B. Dwarf
C. Massive
D. Protostar

3 At the end of the life cycle of a star it explodes in a catastrophic event called a ...

A. Massive
B. Supergiant
C. Black hole
D. Supernova

4 Astronomers are discovering these are more common than first thought. Although they are invisible to observers, using even the most powerful telescopes, Astronomers know of their existence because of how matter near it becomes very hot and bright. Because these bodies are so dense, even light cannot escape. They are called ...

A. Neutron Stars
B. Supernovas
C. Black Dwarfs
D. Black Holes

5 Constellations are groupings of stars that we see as patterns. The International Astronomical Union recognizes 88 officially. There are other patterns that are unofficially recognized, such as The Big Dipper, and are known as …

A. Anomalies
B. Asterisms
C. Asteroids
D. Aspergummies

6 Solar winds pass the Earth at an average speed of 400 km/s. This protects us from the devastating effects of the solar winds ...

A. Earth's atmosphere
B. Earths gravity
C. Earth's magnetic field
D. Earth's ozone

7 Small pieces of rock that travel through space with no predictable or recognizable path are called ...

A. Comets
B. Asteroids
C. Meteoroids
D. Fragments

8 During a solar eclipse this is visible ...

A. The sun's core
B. The sun's electromagnetic shield
C. The sun's atmosphere
D. The sun's corona

9 The first spacecraft to successfully orbit and then land on an asteroid was

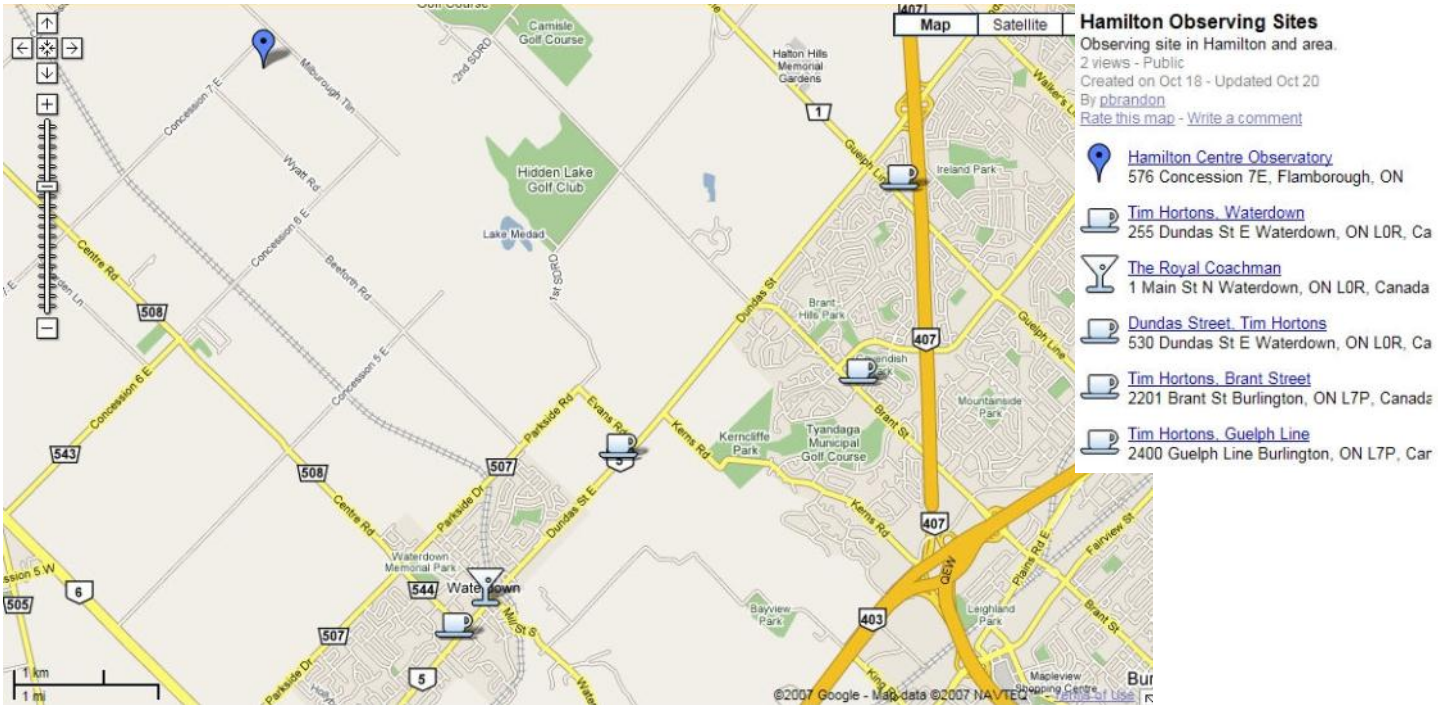
A. EUSA Beagle
B. NASA Opportunity
C. NEAR Shoemaker
D. FAR Eros

10 The direction directly overhead is called…

A. Azimuth
B. Altitude
C. Zenith
D. Astro-plane

Answers for Mizzi's Quizzi Number 1:

1. C: Summer Solstice
2. B. equinoxes
3. C. Seal pups would be born in two lunar cycles
4. A. water
5. D. ellipses
6. A. 5 AU's from the Sun
7. D. measure a star's height above the horizon
8. C. Make accurate charts of star positions predict the movement of stars
9. A. 5 hours
10. C. percent error

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Mark Pickett, Outreach Director / National Council
Shawn Preston, IT Director
Dave Surette, Secretary
Andy Blanchard, Past President / AstroCATS Co-Chairman

# Calendar for March, 2014

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun |
|---|---|---|---|---|---|---|---|
| WK09 | | | | | | 01 | 02 |
| WK10 | 03 • 7:30pm» NOVA Program - Lesson 3 | 04 | 05 | 06 • 8pm» Public Monthly Meeting | 07 | 08 | 09 |
| WK11 | 10 | 11 | 12 • 7:30pm» Star Gazing at the Observatory | 13 • 8pm» RASC Board Meeting | 14 | 15 | 16 |
| WK12 | 17 • 7:30pm» NOVA Program - Lesson 4 | 18 | 19 • CANCELLED - Scouts Night at the Observatory | 20 | 21 | 22 | 23 |
| WK13 | 24 | 25 | 26 | 27 • 8pm» Henry's Astrophotography Night | 28 | 29 | 30 |
| WK14 | 31 | | | | | | |