

Scoring More Energy from Less Sunlight

For spacecraft, power is everything. Without electrical power, satellites and robotic probes might as well be chunks of cold rock tumbling through space. Hundreds of millions of miles from the nearest power outlet, these spacecraft must somehow eke enough power from ambient sunlight to stay alive. That's no problem for large satellites that can carry immense solar panels and heavy batteries. But in recent



Helen Johnson, a spacecraft technician at NASA's Goddard Space Flight Center, works on one of the three tiny Space Technology 5 spacecraft in preparation for its technology validation mission.

years, NASA has been developing technologies for much smaller microsattellites, which are lighter and far less expensive to launch. Often less than 10 feet across, these small spacecraft have little room to spare for solar panels or batteries, yet must still somehow power their onboard computers, scientific instruments, and navigation and communication systems. Space Technology 5 was a mission that proved, among other technologies, new concepts of power

generation and storage for spacecraft.

"We tested high efficiency solar cells on ST-5 that produce almost 60 percent more power than typical solar cells. We also tested batteries that hold three times the energy of standard spacecraft batteries of the same size," says Christopher Stevens, manager of NASA's New Millennium Program. This program flight tests cutting-edge spacecraft technologies so that they can be used safely on mission-critical satellites and

probes. "This more efficient power supply allows you to build a science-grade spacecraft on a miniature scale," Stevens says. Solar cells typically used on satellites can convert only about 18 percent of the available energy in sunlight into electrical current. ST-5 tested experimental cells that capture up to 29 percent of this solar energy. These new solar cells, developed in collaboration with the Air Force Research Laboratory in Ohio, performed flawlessly on ST-5, and

Kudos and have a great summer

I would like to start by thanking every one of you who helped make this year's Astronomy on the Hill a success (May 2 & 3). You not only showed that we do accomplish great things as a club when we work together, but the public clearly appreciates our efforts, as do I. You provided Galileo Moments for many and we had another very successful raffle this year as well. It is through these efforts that we are able to raise funds for public outreach resources, materials and light pollution abatement efforts too. Thank you for all your hard work and dedication. Let this just be the start of what we can accomplish during this International Year of Astronomy.

Another season is about to draw to a close, but the year is far from over. By the time you read this we will likely have had our last meeting before our "summer break" (from monthly meetings), but this does not mean we will stop getting together as a club. There will be many opportunities for public observing sessions throughout the area, so stay tuned to our website and e-mails, for further and future details. Have a safe and fun summer and if we do not cross paths over the summer at some event at a provincial park or outdoor concert, then see you at our next monthly meeting on September 4th?

Keep looking up!

Rick Stankiewicz, President

Galactic Connections

Well, this is the time we come to our summer hiatus: No meetings nor newsletters for two months. But, we as a club will still have opportunities to meet. There will be observing sessions during the summer and hopefully we shall gather for a Perseid session on Armour Hill in August, weather permitting.

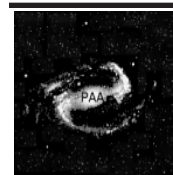
International Year of Astronomy has been a great success so far in the first half of the year and there's still the rest of the year to go. As I write this there have been 375, 157 recorded Galileo Moments as documented by the Canadian IYA web site counter; that's 37.5% of achieving the goal of 1 million.

While I was editing this newsletter on Friday night I was listening to a repeat CBC Radio broadcast of last Saturday's *Vinyl Tap* with Randy Bachman. The theme was "Galactic Connections." The playlist was songs that had stellar connections in the lyrics. Randy's wife Denise talked about International Year of

Astronomy and the celebration of 400 years since Galileo looked at the night sky with a telescope. Her research was impeccable and she presented Galileo to a wider audience. Kudos to the Bachmans for helping to promote IYA!

So, see you in September. Please have articles and photo submissions in to me by August 27.

Phillip Chee



**Peterborough
Astronomical
Association**

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

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If you like to biggie your fries You'll love Jupiter

Everything about Jupiter is big. The planet is 1,000 times larger than Earth. The Giant Red Spot that whistles around the planet is the largest tornado in the solar system—it could swallow Earth two times over. The winds inside the Giant Red Spot are blowing at over 400 km/h. Oh, and when it comes to age, the Giant Red Spot has been storming along for about 300 years since we first observed it.

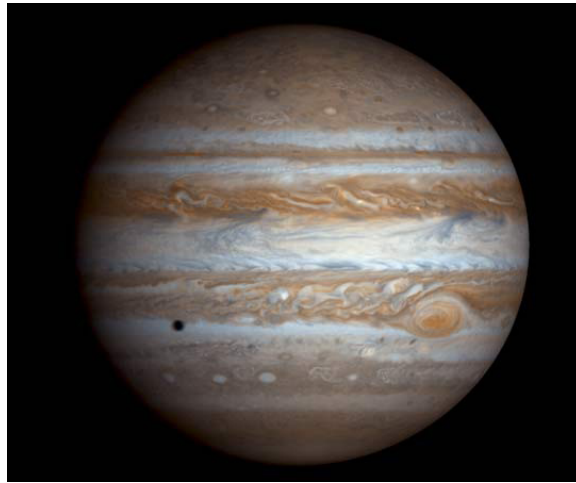
Then there's the lightning. Compared to a lightning bolt on Earth, Jupiter's zappers are nearly 1,000 times more powerful. Ouch, that's gonna leave a mark!

When it comes to moons, Jupiter tops the list with 67 orbiting its tremendous girth. And if you want a big Moon, Jupiter's Ganymede is the solar system's largest. It's bigger than our Moon and even out-sizes planet Mercury.

Take all the other planets, dwarf planets plus their moons and mush them into a big ball and Jupiter still comes out on top for size—by about 2.5 times. But don't let Jupiter's size fool you. It's a gas giant, made mostly of hydrogen and helium gas with a touch of methane thrown in. So as big as it is, Jupiter only has 318 times the mass of the Earth. Still, a 100 lb Earthling would tip the scales at a not-so-dainty 236 lbs on Jupiter. A Big Mac really would be big—but only in weight.

Despite its large size, Jupiter is a real speed demon. A day on Jupiter lasts only 9.8 hours. This high rotational velocity combined with the fact that the planet is made of gas causes Jupiter to be bigger around than it is tall. The term is oblate—sort of like having the Invisible Man sitting on your beach ball.

Not to be outdone by its neighbour Saturn, Jupiter also has rings. They're larger in diameter than Saturn's rings but aren't visible to ground-based telescopes.



JUPITER. During the Cassini Mission fly-by Jupiter displays its unique weather bands, the tiny black shadow of its moon Io and the Giant Red Spot. Photo courtesy of NASA.

Even in mythology Jupiter was big on humour. He was often called the jovial giant and is sometimes referred to simply as Jove—by jove. Gustav Holst's *The Planets Suite* calls Jupiter the bringer of jollity. Odd, for a fellow who was also portrayed on Roman coins as a naked old man who flung thunderbolts at people who annoyed him.

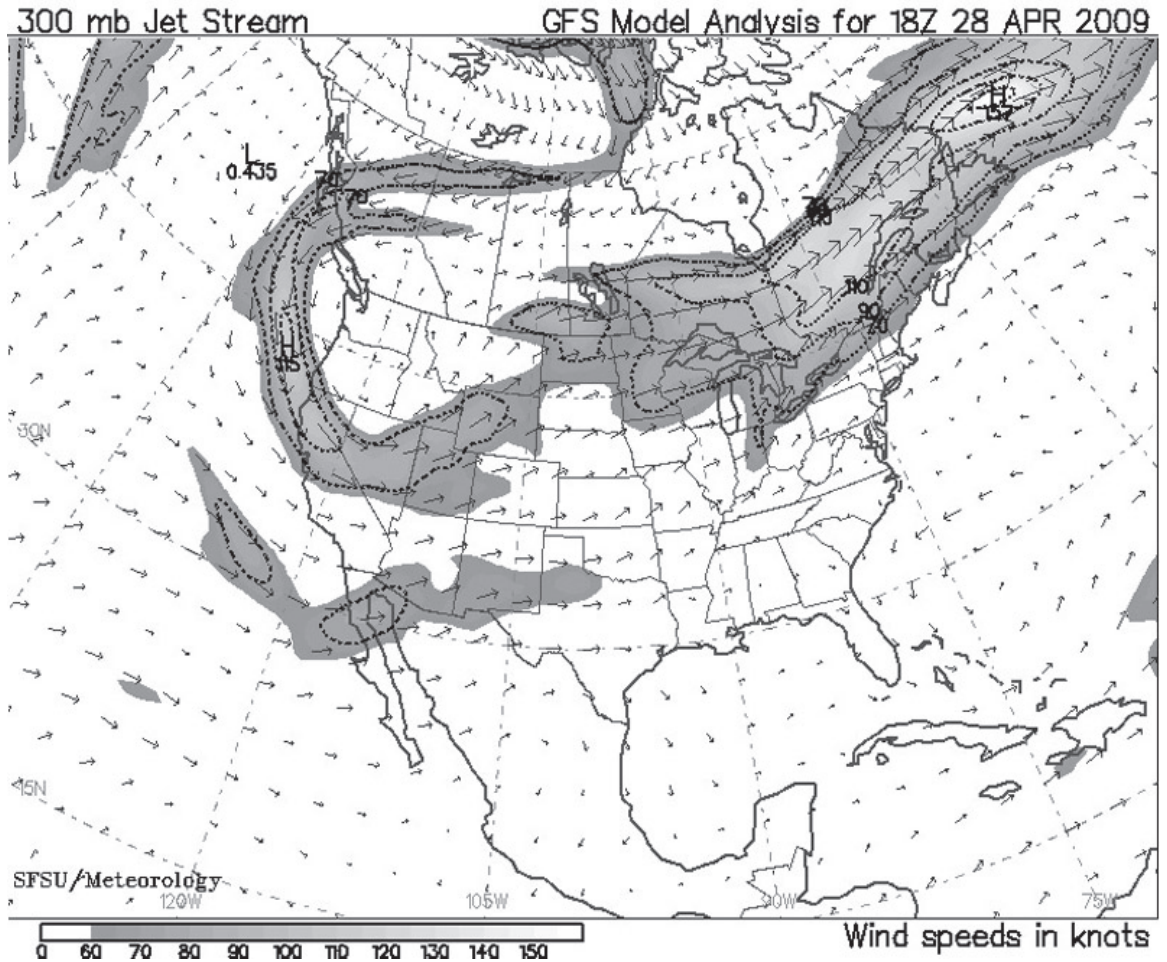
There's only one thing in the solar system that's bigger than Jupiter and that's our Sun. Fact is the Sun alone is responsible for 98% of our solar system's mass. So even giant Jupiter is small potatoes compared to old Sol.

If you'd like to meet up with Jupiter in July, look to the East about 10:00 p.m. He'll be rising in the constellation Capricorn. By midnight Jupiter will be well up and out of the soupy atmosphere of the horizon. That's the time to reach for your binoculars and see if you can spot the four moons that Galileo first saw in 1609. On that night he became the first person ever to see a moon other than our own.

Until we meet again by the backyard telescope, keep your outdoor lights aimed down and the stars up big and bright.

John Crossen

Why do stars twinkle? You're breathing the answer



JET STREAM. The jet stream shoots right over us on most nights. Its turbulence makes the observing miserable on most night for amateur astronomers, especially those trying to image planets and deep sky objects.

That's right, our atmosphere is the culprit. And, while good old air is real handy for sustaining life, it's the bane of an Earth-bound astronomer's existence. It all has to do with photons of light and the bumpy ride they have traveling through Earth's atmosphere.

To explore what happens let's get small—size of a photon of light. A beam of light is composed of billions of tiny photons. They scarcely have any mass at all.

Now let's say they began their journey from the bright star Vega. That means they are part of a beam of light that is 26 light years long. That's the distance Vega is from Earth, so that's also how long—26 years—it takes for a beam of light to reach us.

Our happy little photon is whistling along

through space at the speed of 300,000 kilometers per second. At that speed a photon of light would zip around the Earth over 10 times in a second. Space being relatively empty, there's nothing for the photons to run into or to slow them down. Earth is where the poor photons run into our atmosphere.

Bam, the photons hit the elements in our atmosphere—oxygen, hydrogen, helium, not to mention the dust and particles floating in it. That's when the bumpy ride begins.

The starlight from Vega is bounced up, down, all over the place. For the romantics out there the stars twinkle and everybody gets warm and mushy. Unfortunately the images in an astronomer's telescopes are mushy too. *Grumble, grumble.*

Now let's add in a couple of other things that happen to light as it strikes our atmosphere. Light is made up of all colours. When you hold up a prism in the path of a beam of light it splits the light into its different components, which we observe as colours. At the blue end are the shortest wavelengths of light. At the red end are the longest wavelengths.

The shorter blue wavelengths are easiest to bounce around, plus the moisture in our atmosphere tends to scatter the photons of light. That's why the sky is blue. If it's dry sky like in the deserts, we see a darker blue. If the humidity is high, the sky is light blue.

At the long end of the wavelength scale is red. The effect of atmospheric bending of these light rays is the big red ball of sunlight we see rising or setting near the horizon. The effect is compounded by the fact that the observer is looking through more of Earth's atmosphere as he or she looks across to the horizon. That's also why bright stars appear to twinkle more near the horizon.

If you could remove all of Earth's atmosphere the sky—even in the daytime—would be jet black. Happily science had a better solution: put the telescopes in space.

Lyman Spitzer fought for years to bring this to fruition. He lived to see the launch of the Hubble Space Telescope. Today the Spitzer Space Telescope bares his name.

Adaptive optics is another solution to our atmosphere's blurring effect on starlight. But that's another story.

John Crossen

The Sky this Month

Mercury is at greatest elongation west (23°) on the 13th. The morning planet is rather faint during the first week of June. Passes 3° N of Aldebaran on the 22nd.

Venus is at greatest elongation west (46°) on June 5th but it rises 30 minutes after morning astronomical twilight in mid-northern latitudes.

Mars is in Aries. On the 19th a bright Venus passes 2° below a fainter Mars.

Jupiter rises in late evening and transits at 4:12 LMT on the 15th. It also begins retrograde motion on the 15th. Double shadow transits on Jupiter occur on the 2nd, 9th, and 16th.

Saturn transits in late afternoon local mean time on the 15th and sets around local midnight.

Moon will occult 0.6° above Antares on the 7th but will be full. Jupiter 3° S of Moon on the 13th. On the 19th in the morning and early afternoon Venus and Mars pass south of the Moon. Saturn is 7° N of the Moon on the 27th.

Summer Solstice occurs 1:46 am on the 21st.

Moon Phases

Full Moon	4:12 PM	June 7
Last Quarter	6:15 PM	June 15
New Moon	3:35 PM	June 22
First Quarter	7:28 AM	June 29
Full Moon	5:21 AM	July 7
Last Quarter	5:53 AM	July 15
New Moon	10:35 PM	July 21

I Pulled an All-Nighter

but there was no exam next day

One of the joys of being retired is that every day is Saturday. So when an exceptionally clear, crisp Tuesday night happened I took full advantage of it.

The evening started about 10 p.m. with the usual spring objects in the eyepiece. A quick tour of Leo yielded M65/66 and NGC 3629 in the single field of view. Also known as the Leo Trio, the three galaxies are quite a sight in a low power eyepiece. Also forming up a galactic three-some were M105 and two nearby NGC galaxies. They, too, are in the celestial kitty. But the real galactic treat came while drifting down the Markarian Chain of Galaxies. At one point I managed to squeeze 5 of them into a single field of view. Not bad considering they average 30,000 light years across.

My first planetary nebula of the night was the Ghost of Jupiter. This long-since expired star leaves no doubt as to why it is called

a planetary nebula. It looks exactly like a planet—compact, round and clean-edged. It's in long, lanky horizon-hugging Hydra, so be prepared to hunt a little if you're not computerized.

I combed Hydra for a couple more dim galaxies, and then it was time to look further up for some globular clusters. M3 is the third brightest globular cluster visible from North America. This cluster is big, bright and beautiful—the clichéd burst of diamonds on black velvet. Ophiuchus was up high enough that I could dig into three more gorgeous globs—M12, M10 and M14.

As the night continued the Summer Triangle became visible and with it a host of fruits usually forbidden until July. M11, the Wild Duck Cluster was my first target in Aquila. Next up was M26. It, too, is an open cluster but M11 is bigger and brighter.



CROSSEN AND HIS SCOPE. Captain Quirk and his trusty C-11 prior to engaging Warp Drive.



THE MILKY WAY. The Milky Way rises about 2 a.m. during late May.

Slewing the scope over to Lyra brought my first look at M57, also known as the Ring Nebula. It, too, is a planetary nebula and as its name implies it looks like a ring. I call it the Tim Horton's Nebula because it reminds me of a doughnut. Was I hungry?

Cygnus was just drifting over the observatory roof, so I made a point of checking out the double star Alberio. The blue and orange stars side-by-side makes a stunning sight, just upstaging Algieba in Leo as my favourite stellar duet.

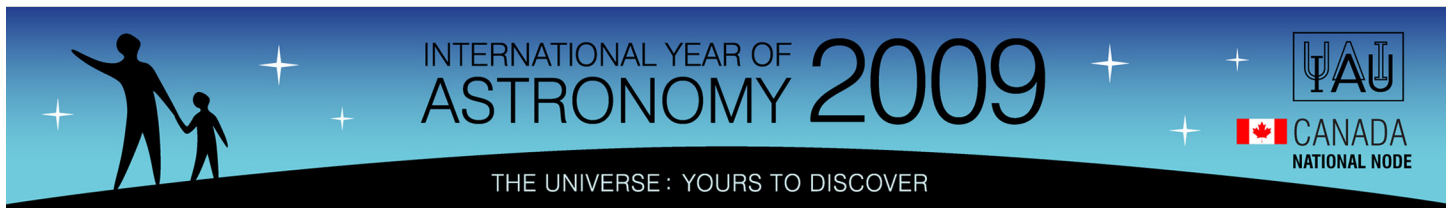
It was now just past 2 a.m. and Sagittarius was nicely up in the southeast. Slewing the scope over to the point where the Milky Way just exits the spout on the Teapot (a more fitting name for Sagittarius) I swam up the river of milk stopping off at little Messier islands along the way. The globular cluster, M22 as my first stop, then I dropped down to take in the Lagoon and Trifid Nebulae. Further upstream were the Swan Nebula and the Eagle Nebula. The Eagle is home to the Pillars of Creation made famous by the Hubble Space Telescope. While in the southeast I also popped over to M4 and M80 in Scorpio. Both are globular gems, though not as nice M22.

Finally Hercules was directly overhead and it was time for my favourite piece of eye candy, M13. Saving the best for last had me first going to the other globular in the strong man, M92. But finally I could resist no more. With my magnitude 5.5 skies I could just make M13 out with averted vision. Then, at long last, I was observing the Great Hercules Globular through my 31mm ultra wide. Stunning would be an understatement! After a few minutes I upped the power with a 22mm ultra wide field eyepiece. The cluster resolved to the core. A million stars in a ball just 160 light years in diameter!

At this point my 64 solar orbits began to show so I powered down, cranked the roof closed and reluctantly put the padlock on a fabulous night of observing. Strolling back to the house I took one last look to see Jupiter hovering above the tree tops and Venus blazing in the East. To quote Oliver Twist, 'more please.'

John Crossen

All photos by PAA member Steve Thoms. Taken with Canon Rebel XTi and an AstoTrac star tracker.
Location—Buckhorn Observatory.



IYA and the Peterborough Concert Band

This year the Peterborough Concert Band, (150th anniversary last year), will recognize IYA and the 400th year of the telescope by including a special “planetary” selection as part of their summer concert series.

The music chosen is “Jupiter” from *The Planets Suite* [see review in February 2009 *The Reflector. ed.*] by Gustav Holst (1874–1931).

This symphonic suite of seven sections, one for each planet, was first performed in 1918 and was devoted to the mystical astrological qualities of each planet, excluding earth, known at that time.

The planets and their associated qualities which the music represented were:

Mercury	the winged messenger
Venus	the bringer of peace
Mars	the bringer of war
Jupiter	the bringer of jollity
Saturn	the bringer of old age
Uranus	the magician
Neptune	the Mystic

The following excerpt may help in enjoying this somewhat complex piece:

JUPITER the spirit of this music is much in keeping with the astrological significance



of Jupiter as a planet of benevolence and generosity.

This Jupiter has no thunderbolts to hurl down on us, but only knowing smiles and a wink or two. He has come

down from Olympus to flirt with us in the moral realm, and, if flirtation leads to something more, so much the better. We hear him chasing but not catching ladies. He invites all to dance, then seems not to favour any one of them more than the others—one of those men who loves all women because they are women and for no other reason. The music emerges from its cavorting, twirling and gamboling out on to a central plateau of graceful dance music, then sinks back into the carefree patterns of before. A very famous poem, near and dear to British hearts, was later set to this music and the two have been inseparable ever since. The first verse was played at the Royal Wedding of Charles and Diana, while its second was sung at Diana’s funeral.

The band’s summer concert series includes the Festival of Lights on Saturday, August 8th, when Jupiter will be played with suitable recognition of the significance of IYA and the Peterborough Astronomical Association.

Ted Taylor

Astronomy in Philately – Canada Joins The IYA! (Part 2)



Last month I introduced one of Canada Post's offerings for the International Year of Astronomy (IYA). I only focused on the "stamp booklet" that contains the two main stamp designs and does make a lovely souvenir for this year, but there are 6 million of these being produced for worldwide distribution. If you are looking for something a little more unique and collectible, how about a First Day Cover (FDC)? Featured in this article are the front and back of the FDC and of this item there are only 21,700 being produced and for \$2.08 (plus tax), it is a great deal. You are getting two for the price of one really. The front of the envelope has a background image of NGC 1532-31, with a cancelled "souvenir sheet" of the double stamp design on the right hand side. The background image of the souvenir sheet is the Carina Nebula "caterpillar". The cancellation records the date of this issues release on April 2, 2009 in Saanich, B.C., home to the National Research Council's Dominion Astrophysical Observatory (featured on one of the stamps).

The back of the envelope mentions the IYA and the following text:

"Since the dawn of time, we have looked to the sky for hints of our cosmic roots. Astronomy was practiced in Canada long before the nation came to be; Aboriginal peoples studied the constellations to track changing seasons, plan rituals and shape their understandings of the universe. Later, European explorers relied on the sky to guide them to the New World. The International Year of Astronomy in 2009 is a chance to rediscover our place in time and space through the celestial worlds above."

Then there are five circular images of the Rosette Nebula, NGC 896, Trifid Nebula, Milky Way and Witchhead Nebula. These are similar to half of the envelope seals included with the stamp booklet. All

of these images too were taken with the Canada-France-Hawaii Telescope (CFHT) on Mauna Kea, in Hawaii (featured on the other stamp.)

If you are looking for something else to collect, there are the souvenir sheets, like the one on the front of the FDC, which are sold separately (\$1.08 + tax), without the envelope. There are 250,000 of these being produced, but then there is a twist. Canada Post is releasing only 80,000 of what looks like the identical souvenir sheet, except they have embedded an IYA logo in the upper left hand corner (called an "overprint"), but it can only be seen clearly with an ultraviolet (black) light. These are going fast too! I called the main office order number for Canada Post (800) 565-4362 and was informed that as of early May, they are sold out of the "overprint" variety. So, the only way to get one of these now is to find a postal outlet that still have them or through a dealer. And if that is not enough, there is one more item that might be of interest?

The rarest item being produced for IYA by Canada Post is the "uncut press sheet". This beauty measures 650mm (25.5") X 483mm (19") and includes 14 uncut souvenir sheets of the stamp pairs around a gorgeous background image of a spiral galaxy. Yet again there is a hidden surprise "overprint" included in this item too. That black light will come in handy again. For \$19.95 (plus tax) this sheet comes rolled up and protected in a silver metallic tube that may remind you of a telescope.

Don't delay in getting your souvenirs for IYA from Canada Post. There is lots to choose from and something for everyone's budget. You don't have to be a stamp collector (philatelist) to appreciate these gems of 2009. Who knows, maybe you will get the bug?

Your Astronomical Philatelist
Rick Stankiewicz

PHOTO GALLERY

A Conjunction of Equilateral Proportions?

In the early morning hours of May 21st, 2009, the following conjunction image was sure worth getting up for. The attached images were taken in Keene, (just southeast of Peterborough), between 4:34 & 4:36 a.m. EDT. It was a calm clear morning and the mosquitoes did not manage to find me until after I was finished my photo session.

I was shooting to the southeast, from a hill top cemetery over looking the Indian River as it enters Rice Lake. Mars was faint but shows nicely as the “Red Planet” that it is and Venus shone like a diamond. The Earthshine that showed on the crescent Moon that was only 3 days from “new”, was perfect too. This perfect equilateral triangle in the predawn sky was very impressive to say the least.

Mars initially was hidden in the twilight haze, but as the Sun started to brighten the horizon, the celestial trio slowly rose to reveal Mars and the Moon and Venus continued to outshine every other in the sky. Jupiter sat high in the south and was brighter than Mars, but no match for Venus.

You can also see another photo I took on the Lunar Photo of the Day web site: <http://lpod.wikispaces.com/May+28%2C+2009>



I was using a tripod mounted Canon 400D at 200 ISO; 10 to 6 sec. exposure; f/4.0 and Sigma 18–70mm lens (at 70mm.)

Rick Stankiewicz

continued from page 1

St-5

they've already been swooped up and used on NASA's svelte MESSENGER probe, which will make a flyby of Mercury later this year. Like modern laptop batteries, the high-capacity batteries on ST-5 use lithium-ion technology. As a string of exploding laptop batteries in recent years shows, fire safety can be an issue with this battery type.

"The challenge was to take these batteries and put in a power management circuit that protects against internal overcharge," Stevens explains. So NASA contracted with ABSL Power Solutions to develop spacecraft batteries with design control circuits to prevent power spikes that can lead to fires. "It worked like a charm." Now that ST-5 has demonstrated the safety

of this battery design, it is flying on NASA's THEMIS mission (for Time History of Events and Macroscale Interactions during Substorms) and is slated to fly aboard the Lunar Reconnaissance Orbiter and the Solar Dynamics Observatory, both of which are scheduled to launch later this year. Thanks to ST-5, a little sunlight can go a really long way. Find out about other advanced technologies validated in space and now being used on new missions of exploration at nmp.nasa.gov/TECHNOLOGY/scorecard. Kids can calculate out how old they would be before having to replace lithium-ion batteries in a handheld game at spaceplace.nasa.gov/en/kids/st5_bats.shtml.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Astronomy on the Hill

Astronomy on the Hill 2009 was a resounding success. This year the club organized a two-day event breaking from past tradition. The observing session was held Saturday night and while the daytime weather didn't look promising the clouds broke around the dinner hour. Sunday afternoon was clear and sunny for solar observing, the planetarium, displays and Peter McMahon's rocket launch. Here are some photographic memories of the weekend.

Phillip Chee



Photo: John Cameron



Photo: John Cameron



Photo: John Crossen



Photo: John Cameron



Photo: John Cameron



Photo: John Cameron



Photo: Mark Coady

FOR SALE

Custom Telescope Barrel Plugs



If you are looking for something unique and custom for your telescope, consider this. I have a source for custom made wooden telescope eyepiece barrel plugs. Each plug is hand crafted of wood. When you do not have an eyepiece in your telescope most people just put an old plastic 35mm film container in the barrel to prevent dirt and moisture from invading the space. This does work for the basic 1.25 inch diameter barrel, but I am not sure what people use in a 2 inch barrel? The attached image shows 3 examples of what I am talking about. On the left is a 1.25 size made of Black Cherry, the middle 2 inch is made of Black Walnut and the right 1.25 inch is made of Applewood. The grains and finish are one of a kind. These are for definitely for someone who wants something functional and unique for their equipment. The 1.25 size are \$15 and the 2 inch size \$20.

If you are at all interested, just let me know and I will see what I can turn up!

Rick Stankiewicz, PAA
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8" Netwonian

SKYWATCHER 8" NEWTONIAN—tube only. This scope is in mint condition. I am in my late 80s and it is too large for me to handle. I am asking 350 dollars. Thank you for your interest and consideration.

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THE UNIVERSE
YOURS TO DISCOVER

INTERNATIONAL YEAR OF
ASTRONOMY
2009

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). 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:

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Peterborough, ON K9H 4R1
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**Next submission deadline:
August 27, 2009**



Meetings The Peterborough Astronomical Association meets every first Friday of most months at the **Peterborough Zoo Orientation Centre** (Next to the PUC Water Treatment Plant) at 8PM. PAA executive business will be conducted starting at 7:30PM. Members and the public are welcome to attend the earlier time.