

# Staring at Lightning

**T**here's something mesmerizing about watching a thunderstorm. You stare at the dark, dramatic clouds waiting for split-second bursts of brilliant light — intricate bolts of lightning spidering across the sky. Look away at the wrong time and (FLASH!) you miss it.

Lightning is much more than just a beautiful spectacle, though. It's a window into the heart of the storm, and it could even provide clues about climate change.

Strong vertical motions within a storm cloud help generate the electricity that powers lightning. These updrafts are caused when warm, moist air rises. Because warmth and lightning are inextricably connected, tracking long-term changes in lightning frequency could reveal the progress of climate change.

It's one of many reasons why scientists want to keep an unwavering eye on lightning. The best way to do that? With a satellite 35,800 km overhead.

At that altitude, satellites orbit at just the right speed to remain over one spot on the Earth's surface while the planet rotates

around its axis — a “geostationary” orbit. NASA and NOAA scientists are working on an advanced lightning sensor called the Geostationary Lightning Mapper (GLM) that will fly onboard the next generation geostationary operational environmental satellite, called GOES-R, slated to launch around 2015.

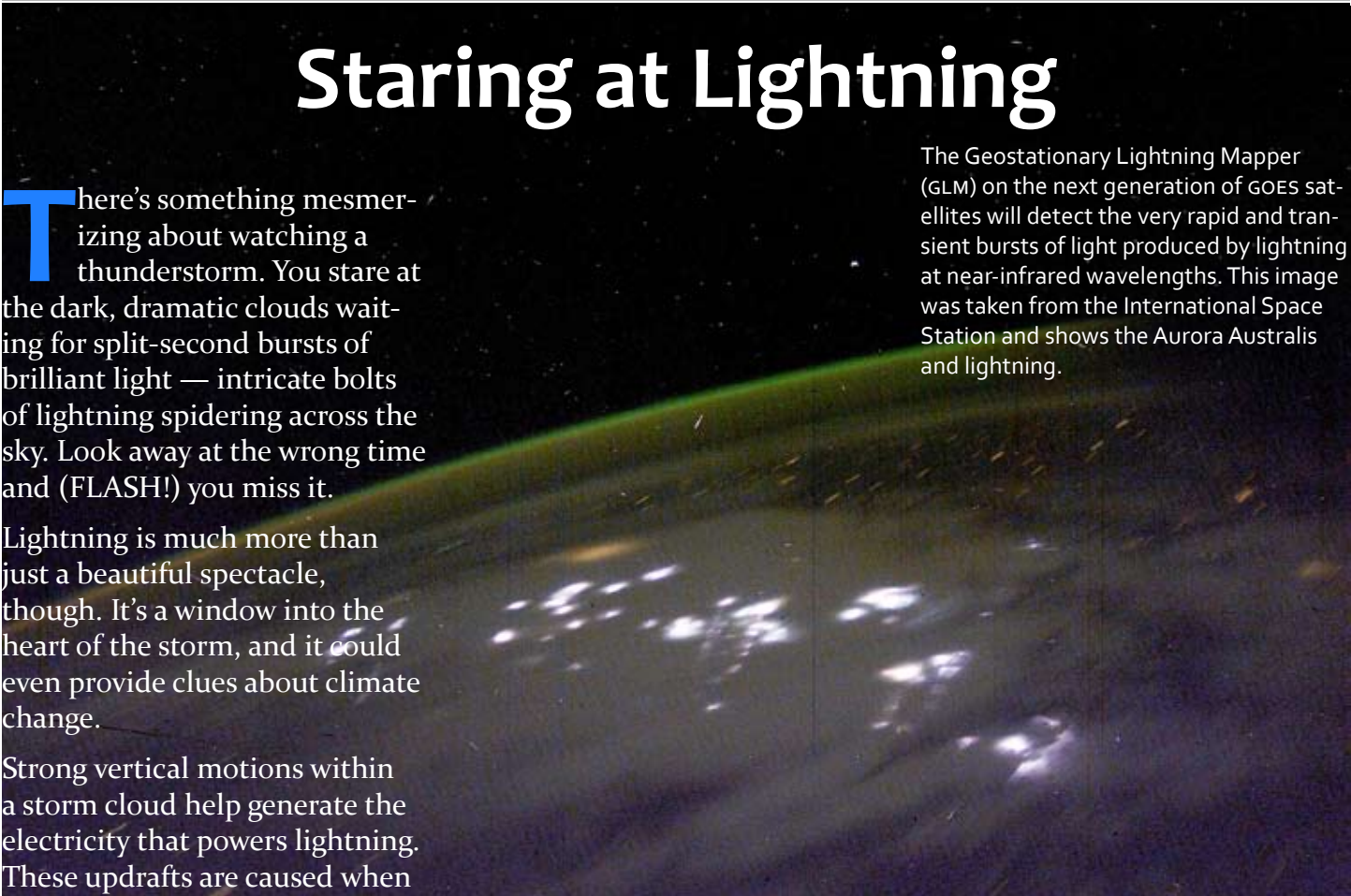
“GLM will give us a constant, eye-in-the-sky view of lightning over a wide portion of the Earth,” says Steven Goodman, NOAA chief scientist for GOES-R at NASA's

The Geostationary Lightning Mapper (GLM) on the next generation of GOES satellites will detect the very rapid and transient bursts of light produced by lightning at near-infrared wavelengths. This image was taken from the International Space Station and shows the Aurora Australis and lightning.

Goddard Space Flight Center. Once GLM sensors are flying on GOES-R and its sister GOES-S, that view will extend 18,000 km from New Zealand, east across the Pacific Ocean, across the Americas, and to Africa's western coast.

With this hemisphere-scale view, scientists will gather an unprecedented amount of data on how lightning varies from place to place, year to year, and even decade to decade. Existing

see “Lightning” on page 12



# Give Yourself a Pat on the Back

**O**ur year is slowly coming to an end and our Annual General Meeting (AGM) will quickly be upon us (Dec.4th). The call is out for re-election of executive positions (“Thank you” Pat, for taking over this task), not that we are expecting a massive change over, but this is the chance that members have every two years to “step-up to the plate”, so to speak and serve their club in a special and important way. Give it some thought or at least support those that are willing to run for or continue in office.

Hats off to all those this year that have been helping create, generate and participate in our PAA “Galileo Moments” (GM) for the IYA. As of this writing, we have surpassed any goal I had of 2,000 GM’s for the year and we are not done yet. For a club our size, we have gone above and beyond to add to the very successful National IYA goal of over one million GM’s! This is something to be proud of and I hope it is just the start of what we can do for our hobby into the future.

*Rick Stankiewicz, President*

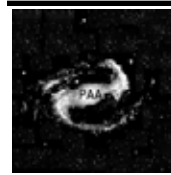
## So long summer, we hardly knew ya

**T**he *Astroartography* show was a resounding and popular success. I would like to personally thank all the PAA members who helped organize the show: Rick Stankiewicz for recruiting the featured artists and for nudging some of our shy members to contribute photographs; Rodger Forsyth for handling the publicity; and Val Mathias for lending us her display racks and orchestrating the final setup. Without her and Peter’s and Robin’s help I would have been stuck at the college all night!!! Also, I would like to thank Dr. Tony Tilly for so graciously participating at the gala opening, knowing the busy schedule he keeps.

Our October public observing night was clouded over, including the backup night. Alas, we could not participate in the Galilean Nights event. There has been talk amongst the executive about staging one more public observing night in November. Stay tuned for further details.

Having been a club member for almost three years I have been amiss in not ever attending a PAA observing session. Well, finally, circumstances favoured me and I made the trip out to Cedar Knoll Observatory and was treated to a fine tour of the fall skies by Brett Hardy. It was a rewarding time. If you have not done so I encourage you to attend at least one.

*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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# What's Up For November

## — astronomically speaking?

Please don't shoot the messenger for delivering bad news, but November is traditionally the cloudiest month of the year in Ontario. Then again, considering the topsy-turvy summer we just endured, maybe November will pleasantly surprise us. Being an optimist and a beer lover — my glass is always half full.

Jupiter continues to rule the night sky as the brightest star-like object visible. Look for Jupiter in the southern sky just after sunset. Using binoculars, try to see if you can spot Jupiter's moons orbiting it. Steady hands are a big help and a small telescope on a tripod makes this a snap.

Also visible in the southwestern sky is the constellation Sagittarius — also known as the teapot. The summer Milky Way — an arm of our galaxy — arcs

down straight into the teapot's spout. Early November will be one of your last chances to enjoy the bright summer view of the Milky Way. Soon the much dimmer winter Milky Way view will take over. The change is due to the fact that Earth's position in its orbit around the Sun has changed. During the summer we are positioned to look inward towards our galaxy's bright core during the dark hours. In winter we are looking towards an outer arm.

Auriga is now well up in the eastern sky as are the Seven Sisters. The Andromeda Galaxy is high overhead now and is visible with the naked eye if you know just where to look. Binoculars reveal it as an elongated yellow smudge against the background stars.

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**ORION NEBULA.** Winter's crowning sight, the Orion Nebula. This star birthing area is visible to the naked eye and grows considerably in binoculars. An amateur telescope reveals detail such as shown above. Photo by John Crossen.

# Looking Back Through the Telescope — Part 2

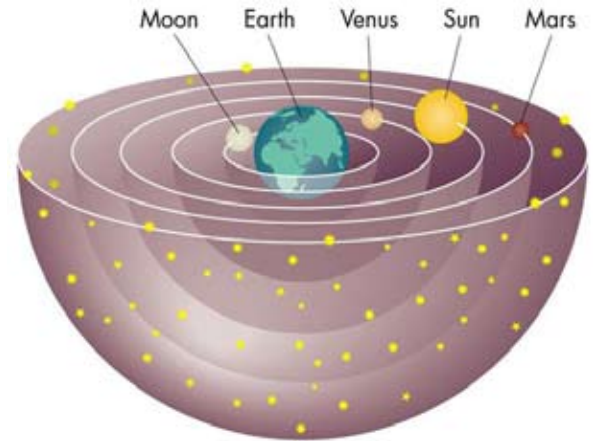
The ancient astronomers made some incredible observations and discoveries with nothing more than brain power. Looking back on those discoveries, they only seem like common sense today. But in 300 B.C. their reasoning was fairly uncommon.

Aristotle knew that the Earth was round by simply observing its round shadow as the Moon drifted into it during a lunar eclipse. He also reasoned that Earth was a sphere because if all material fell downward, the only shape it could produce would be a sphere. We now say that gravity attracts evenly from all directions.

Another golden oldie, Eratosthenes calculated the circumference of the Earth to within 5% of its now known size using poles and shadows. And he used triangulation to show that the Sun was much farther away from Earth than the Moon. That's not too shabby for a guy with no sophisticated tools, just using his noodle.

One of my favourite thinkers from the same period was Aristarchus of Samos. Aristarchus proposed that the Sun and not the Earth was the centre of what was then the known universe. The Earth orbited the Sun once each year. He explained that the 24-hour rotation of the Earth was responsible for the Sun's rising and setting, and for the stars moving from east to west. That's absolutely correct and about 2,000 years before Copernicus and Galileo came to the same conclusion. Happily there was no church to sentence Aristarchus to house arrest for speaking what he knew to be true.

Unfortunately other great minds of the time differed. Aristotle, despite his astute observations still believed that the Earth was the centre of the universe and that all



PTOLEMY'S SPHERES. Ptolemy's concept of spheres within spheres was the accepted model for the universe during the dark ages.

else revolved around it. He found explanations for the motion of the planets and he also found a great ally, Claudius Ptolemaeus, widely known as Ptolemy.

Ptolemy was the man of many spheres. He reasoned that the Earth was at the centre with separate spheres containing the Moon, Sun, planets and stars rotating around it. Even the retrograde motion of the planets could be explained because they too were inside smaller spheres. It was perfect – perfectly wrong.

Nonetheless, Aristotle's and Ptolemy's work flourished while Aristarchus's correct assumptions gradually faded away. The Catholic Church, the mightiest power in Europe, came to accept the work of Aristotle and Ptolemy as the truth and declared that any other belief was an unforgivable and punishable sin. With that and the fall of the Great Library of Alexandria came the end of learning and the beginning of the Dark Ages. It would be 1,500 years before scientists and great thinkers again moved to the forefront of society.

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

*John Crossen*

# 100 Meteors per Hour Forecast for November 17 Leonid Shower



METEOR WATCH. The best equipment for watching a meteor show is your eyes. This group has just spotted a fireball with its smoking trail.

**T**he Leonid Meteor Shower peaks in the early morning hours of November 17. While it is nearly impossible to forecast how many meteors we thrill seekers can expect, I have counted up to 1,300 per hour on one amazing night. It wasn't a shower, it was a storm. I'm glad I braved the cold and stuck it out until Sunrise. It was a once in a lifetime event.

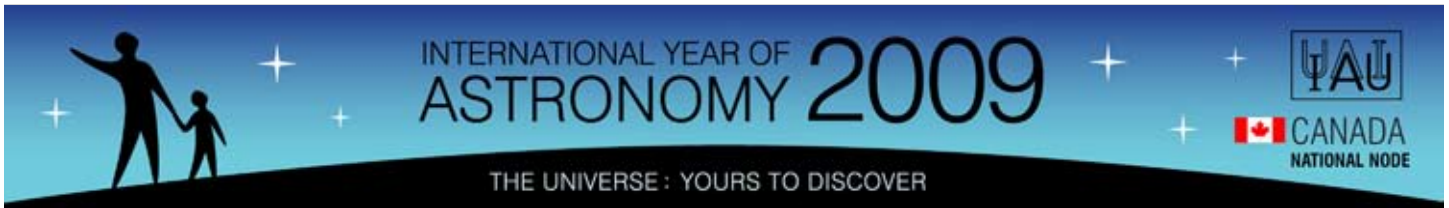
With three observers counting, we made a mark for every 100 we counted. Each of the counters was facing a slightly different direction, so that we didn't overlap in our tally. At the end of an hour we added up the marks and between us we have 13 checks — wow! At that point our Cheshire cat grins made us look like three 1954 Buicks parked side-by-side. Then we settled back, relaxed and took in the rest of the show.

What's up for this year's shower? At the moment predictions are running up to 100 per hour. That averages out to about 1.6 meteors every minute. Toss in a few bolides (fireballs) and that should be plenty of fireworks. You definitely shouldn't have to prop your eyelids open. What's the best way to take in a meteor shower? Here are some hints.

The sky should be relatively cloud free. Meteors hit our atmosphere about 60 km up, so they are well above any clouds. You'll also need a dark sky location. So as is the case for almost all astronomical observing, get out of town. The farther you are from light pollution, the better off you are.

What are the Leonid Meteors? Let's start with meteors in general. Meteors are

[see "Leonids" on page 11](#)



## Astroartography a Big Success!

On Thursday, September 17 Fleming College played host to the Peterborough Astronomical Association with a gala opening night to herald the Astroartography Art Exhibition. The show ran from September 18 to October 8 and showcased a variety of art and photographs of local artists and amateur astronomers. Represented in the roster were a number of Fleming Alumni, some of whom are members of the PAA.

Dr. Tony Tilly, President of Fleming College, was on hand to welcome the artists and guests in attendance. Dr. Tilly emphasized the importance of the International

Year of Astronomy and was pleased to have the show housed at the college as an IYA event. The PAA presented him with a Galileoscope as a token of thanks.

As a Galileo Moment the three week show registered an estimated 750 GMs. Many college staff have give me positive reviews of the show and the President's Office at Fleming College has chosen three of my photographs to display for the school year.

If you missed the show there are possible plans to mount a smaller display at the Peterbrough Library in 2010.

*Phillip Chee*



ASTROARTOGRAPHY DISPLAY. Main Foyer, Fleming College. One of two displays showcasing astro photos and astronomy-themed art organized by the Peterborough Astronomical Association. Photo: Phillip Chee



**F**our hundred years ago Galileo Galilei turned his telescope on the planet Jupiter, and his discoveries changed forever the way humanity thinks about the Universe.

In 2009 we are commemorating this 400th anniversary in the International Year of Astronomy, the IYA. To celebrate Galileo's discoveries, on the 22nd of November we will undertake the Jupiter: Project24, 24 hours of continuous radio observation of the planet Jupiter using the radio telescopes of NASA's Deep Space Network, the DSN.

This is a worldwide antenna network which supports the exploration of the solar system. It consists of three deep-space communications facilities, one at Goldstone in California's Mojave Desert, one near Madrid in Spain, and one near Canberra, Australia. This strategic placement permits constant observation of spacecraft as the Earth rotates and makes the DSN the largest and most sensitive scientific telecommunications system in the world. A fraction of the network time is also made available for radio astronomy projects under an agreement between NASA and Host Countries.

The radio emission from Jupiter comes from both the thermal emission from the planet plus the non-thermal emission of high-energy electrons trapped in Jupiter's magnetosphere. Due to a misalignment of Jupiter's magnetic and rotation axes, the non-thermal intensity varies as the planet's magnetosphere rotates, and is most apparent at frequencies between 1 and 5 GHz. The rotation

period is close to 9 hours 55 minutes, so we will see almost two and a half rotations.

This is the first time that such a long continuous series of radio observations has been undertaken. The goal of the 24 Jupiter project is to search for possible non-thermal variability from other causes, such as variations in solar activity, and possible changes from a remnant of the big impact spotted by an amateur astronomer near Canberra in July 2009.

More information:  
<http://jupiterproject24.wordpress.com>

## Astronomy Beyond 2009

**O**n 9 and 10 January 2010 the International Year of Astronomy 2009 will be brought to an official close with a ceremony to be held in Padova, Italy, in the Aula Magna of the University, where Galileo taught experimental physics and astronomy.

Astronomy Beyond 2009 is the title of the meeting and the aim is both to have an initial account of this fantastic year and discuss the astrophysics of the next decade, and beyond.

Professional astronomers, historians of science and Single Points of Contact from various countries that participated in IYA will deal with the impact of IYA, the legacy of Galileo, the role of science in society and the future of astronomy. Besides this, a number of diverse activities are planned that will involve both the public in Padova and individuals who participated in the programs of the IYA2009.

## What's Wrong With This Picture?



On Wednesday, September 9th, 2009, I set-up in my back yard south of Peterborough, Ontario at 9:42 EDT, to watch and record the second transit of the evening of the space shuttle Discovery (Space Transportation System — STS-128) and the International Space Station (ISS). They had been undocked for Discovery's return to Earth later the next day. The attached image is what I captured using my Canon 400D camera with Sigma 10 to 20mm lens, set at 10mm (f/4.0/800 ISO and 60 seconds). Remember that the spacecraft in this image are traveling from west to east (left to right) and that the STS-128 is preceding the ISS by about 1:10 minutes. According to the tables from the Heavens Above website ([www.heavens-above.com](http://www.heavens-above.com)) the STS-128 was to have a magnitude of 0.7 and the ISS was to be at about -1.3 magnitude.

You will note that the shuttle looks more like an iridium flare and a maximum magnitude of closer to -2.5! As I stood there watching naked eye I noticed what looked like a faint haze glow around the shuttle as it passed during its maximum brightness, but I could also detect a faint reversed comma like tail below it. I thought I was seeing things. This looked more like a comet than the STS-128, but I realized that the sky was clear of any cloud or haze (just some unfortunate light pollution from Peterborough to the northwest at the horizon). None of this naked eye details shows on my one-minute time exposure, but the much fainter ISS is visible and I did record the fading disappearing act of the shuttle.

Of course the next morning (Sept. 10th) when I checked the NASA SpaceWeather website ([www.spaceweather.com](http://www.spaceweather.com)) all became clear to me. I had been fortunate enough to have witnessed and recorded a "space dump". The STS-128, in preparation for its return to Earth, was doing a scheduled emptying of its excess waste and liquids (pure and otherwise). I was so "relieved" to know that I was not just seeing things the night before and there was a logical explanation for what I had seen and recorded. The increased brightness of the shuttle over the ISS was astounding. I would have never believed that a water dump would or could affect the reflectivity of a spacecraft that is so much smaller and normally less reflective than the ISS. Well, I have proof it does. I guess when you are traveling at 28,000 kph and are 350 km above the Earth you can get away with it and it really did add to the show. I hate to "dump and run", but I have to get ready for the next passing of the ISS.

**Rick Stankiewicz**

## Summer Triangle at the Zenith with Milky Way



September and October are great months to see the Summer Triangle — the trio of Deneb, Vega, and Altair, the brightest stars in the constellations Cygnus, Lyra, and Aquila, respectively. With astronomical twilight ending between 8 and 9 pm you can enjoy an evening of stargazing before going to bed while not freezing in the outdoors. While this portion of the Milky Way that the Summer Triangle overlays is not the brightest region of our galaxy, there are some small, star-packed patches cut through with thick dust lanes.

Although we do not know exactly how the Milky Way looks, astronomers speculate our galaxy is a barred-spiral with either two or four major arms. When we look at the Milky Way from our latitude we are possibly looking along the plane of the galaxy through a cross-section of three of those arms: The Perseus, the Cygnus, and the Sagittarius. The Sagittarius arm is fairly large and bright, befitting the galactic core. The Cygnus arm is smaller and less bright, while the Perseus arm is rather faint, indicating its position as an outer arm of the galaxy. Our sun is located in a spur arm called the Orion local arm. Each arm is named after the constellation it is apparently seen through.

This month will be the last good month to see the brighter summer portion of the Milky Way until next summer as the fainter Perseus and Orion arms take centre stage. So don't you forget your gloves and mitts and step outside on the next clear night. Just be sure to get outta town because you will need a relatively dark sky to our galactic neighbourhood.

*Phillip Chee*

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**November**

A small telescope operating a very low power will show the whole galaxy along with its two companions M110 and M32. But choose a warmish night because this view will blow your socks off.

Those with the stamina for a late session will enjoy Gemini as it rises. In addition to being the home of four beautiful open star clusters, Mars will join the show this year.

The Leonid Meteor Shower peaks on the morning hours of November 17. This year's shower may run as high as 100 per hour. I'll have more details in my next article.

For Moon lovers, the Full Moon arrives on November 2. Last Quarter Moon falls a week later on November 9 and November 16 is New Moon, when we don't see the Moon at all. First Quarter Moon puts on its show of craters and shadows on November 24. Binoculars are all you need to map out some of the Moon's surface geography, so give them a try. You'll be surprised at what you can see.

If we get a couple of clear nights I'll pull an all nighter this month. That way I can pre-view Orion and more of the winter constellations before the deep-freeze weather strikes. I'm either getting older or wiser, because that -30°C observing takes more out of me than I have left in me. Besides, having your nose frozen to an eyepiece hurts.

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

*John Crossen***Moon Phases**

Full Moon	2:14 PM	November 2
Last Quarter	10:56 AM	November 9
New Moon	2:14 PM	November 16
First Quarter	4:39 PM	November 24

**The Sky this Month**

**Mercury** is at superior conjunction on the 5th and becomes an evening star before mid-month.

**Venus** still visible in morning twilight. Passes 4° north of Spica on the 2nd. Comes within 10° of the Sun at the end of the month.

**Mars** passes through the Beehive Cluster on the 1st and remains in Cancer for the month. The moon passes 3° south of it early on the 9th.

**Jupiter** transits at 5:47 pm LMT on the 15th. Passes 4° south of the quarter moon during the afternoon of the 23rd providing a possible daytime viewing of the planet.

**Saturn** is high during morning civil twilight and by the 15th is about 38° up. Rings are now inclined at 3.8°.

**Moon** is 0.05° south of Beehive (M44) on the 1st. On the 4th it's 0.2° south of the Pleiades (M45).

**South Taurid Meteors** peak at 5 am on the 5th.

**North Taurid Meteors** peak at 5 am on the 12th.

**Leonid Meteors** peak at 1 pm on the 17th.

**Daylight Savings Time** ends at 2 am on the 1st.

## PAA Gets a New Loaner Scope

A new, improved 60mm scopes replaces the old club pea shooter. The new scope features a more stable tripod that is also lighter weight and easier to use. This type of scope is good for observing lunar detail, the brighter planets such as Jupiter and Saturn as well as some of the brighter Messier objects. The Andromeda Galaxy, the Orion Nebula, the Pleiades, the Double Cluster and the Bee Hive cluster would be excellent targets. Included with the scope is a Red Dot Finder (RDF) and two eyepieces. This is a PAA loaner scope. If you're a club member and would like to borrow it let John Crossen (johnstargazer@xplornet.com) know. He'll arrange to get it to you or you can pick it up at Buckhorn Observatory.



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### Leonids

random bits of space debris that are constantly falling to earth. We don't see the ones in the daytime, because the sky is too bright. Most are no larger than bits of gravel or the size of a pea. But when these granules hit our atmosphere the friction of the air causes them to burn. On a clear moonless night the little bits put on a big show.

The Leonids are debris left behind by Comet P/55 Tempel-Tuttle as it crossed Earth's orbital path and melted when it neared the Sun. Comets are like snowballs filled with dirt and when they melt, they leave a dirty trail in space. That's what we pass through every November 17th and they hit our atmosphere — its like bugs on the windshield of your car. Only they're a whole lot prettier.

The Leonid Meteors appear to radiate from the constellation Leo. That's why they are called the Leonids. The lion king is an early spring constellation so in November it won't rise until the wee hours. I'd hit the sack early and plan to be up around 1am. I guarantee that it will be cold, so warm dress is essential. Remember, you won't be moving around much, so you won't build up any body heat.

Layer your clothing and don't forget that most of your body heat radiates out through the top of your head. A warm hat is essential. Hot coffee or hot chocolate is also a warm thought. But no Bailey's in the coffee, please. Alcohol actually makes you colder once the warm glow has disappeared.

Until we meet again in the backyard, keep your lights dim and pointed down. Oh, and don't to cross your fingers for clear sky the morning of November 17.

*John Crossen*

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## Lightning

lightning sensors are either on the ground — which limits their geographic range — or on satellites that orbit much closer to Earth. These satellites circle the Earth every 90 minutes or so, quickly passing over any one area, which can leave some awkward gaps in the data.

Goodman explains: “Low-Earth orbit satellites observe a location such as Florida for only a minute at a time. Many of these storms occur in the late afternoon, and if the satellite’s not overhead at that time, you’re going to miss it.”

GLM, on the other hand, won’t miss a thing. Indeed, in just two weeks of observations, GLM is expected gather more data than NASA’s two low-Earth orbiting research sensors did in 10+ years.

The new data will have many uses beyond understanding climate change. For example, wherever lightning flashes are abundant, scientists can warn aircraft pilots of strong turbulence. The data may also offer new insights into the evolution of storms and prompt improvements in severe weather forecasting.

(FLASH!) Did you miss another one? The time has come for GLM.

Want to know how to build a weather satellite? Check the “how to” booklet at [scijinks.gov/weather/technology/build\\_satellite](http://scijinks.gov/weather/technology/build_satellite).

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



THE UNIVERSE  
YOURS TO DISCOVER

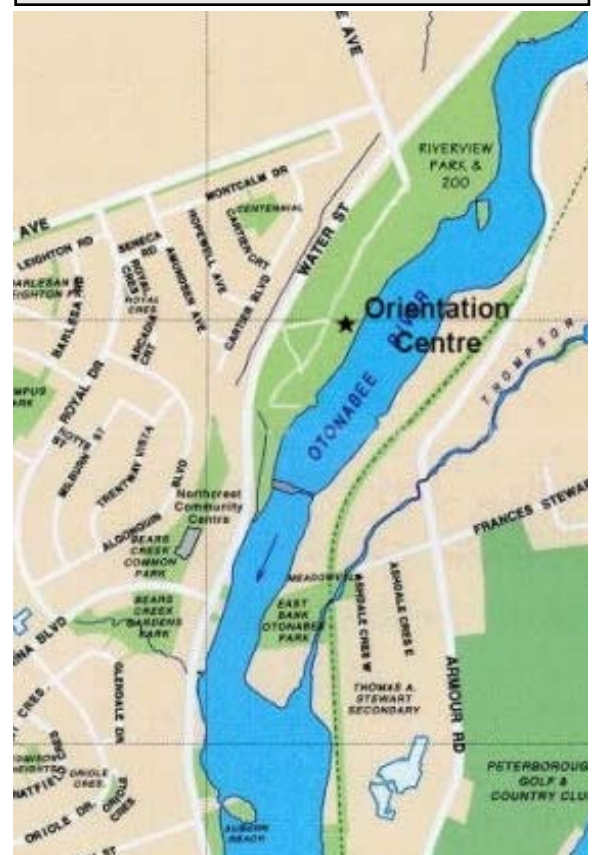
INTERNATIONAL YEAR OF  
ASTRONOMY  
2009

## 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  
phillip.chee@gmail.com

**Next submission deadline:  
November 23, 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.