PETERBOROUGH ASTRONOMICAL ASSOCIATION

THE REFLECTOR

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NASA celebrates 18th anniversary of Hubble Space Telescope with release of 59 new images of colliding galaxies

Interacting galaxies are found throughout the Universe, sometimes as dramatic collisions that trigger bursts of star formation, on other occasions as stealthy mergers that result in new galaxies. A series of 59 new images of colliding galaxies has been released from the several terabytes of archived raw images from the NASA/ESA Hubble Space Telescope to mark the 18th anniversary of the telescope's launch. This is the largest collection of Hubble images ever released to the public simultaneously.

Galaxy mergers, which were more common in the early Universe than they are today, are thought to be one of the main driving forces for cosmic evolution, turning on quasars, sparking frenetic star births and explosive stellar deaths. Even apparently isolated galaxies will show signs in their internal structure that they have experienced one or more mergers in their past. Each of the various merging galaxies in this series of images is a snapshot of a different instant in the long interaction process.

Our own Milky Way contains the debris of the many smaller galaxies it has encountered and devoured in the past, and it is currently absorbing the Sagittarius dwarf elliptical galaxy. In turn, it looks as if our Milky Way will be subsumed into its giant neighbour, the Andromeda galaxy, resulting in an elliptical galaxy, dubbed "Milkomeda", the new home for the Earth, the Sun and the rest of the Solar System in about two billion years time. The two galaxies are currently rushing towards each other at approximately 500,000 kilometres per hour.

Cutting-edge observations and sophisticated computer models, such as those pioneered by the two Estonian brothers Alar Toomre and Juri Toomre in the 1970s, demonstrate that galaxy collisions are far more common than previously thought. Interactions are slow stately affairs, despite the typically high relative speeds of the interacting galaxies, taking hundreds of millions of years to complete. The interactions usually follow the same progression, and are driven by the tidal pull of gravity. Actual collisions between stars are rare as so much of a galaxy is simply empty space, but as the gravitational webs linking the stars in each galaxy begin to mesh, strong tidal effects disrupt and distort the old patterns leading to new structures, and finally to a new stable configuration.

The pull of the Moon that produces the twice-daily rise and fall of the Earth's oceans illustrates the nature of tidal interactions. Tides between galaxies are much more disruptive than oceanic tides for two main reasons. Firstly, stars in galaxies, unlike the matter that makes up the Earth, are bound together only by the force of gravity. Secondly, galaxies can pass much closer to each other, relative to their size, than do the Earth and the Moon. The billions of stars in each interacting galaxy move individually, following the pull of gravity from all the other stars, so the interwoven

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Spring is in the air

President's Message

By the time you read this, Earth Hour will have been finished and International Astronomy Day will be soon upon us and we will be busy getting ready for the big public event of our club year on May 10th. Let us hope the weather holds as it has in the past. With brisk advanced tickets sales again this year, we will be in great shape for our outreach efforts in the coming year. Thanks to all of you who helped in anyway. I have no doubt that our upcoming Astronomy Day will be a success for all involved.

May is a favourite time to get out and stargazing. The bugs are few, the temperature is comfortable and the dew factor is minimal. Take advantage of one of the best months of the year to be out doors at night. I hope to see you at the next observing session.

Keep looking up,

Rick Stankiewicz, President
PAA

Sharing Astronomy

Editorial

For my birthday last month I got the Collector's Edition DVD box set of Carl Sagan's *Cosmos*. I was thirteen when I first saw the original airing in 1980. I was duly impressed with what Sagan's personal voyage gave me. It was that wonder and excitement that you get when you think about what it means to discover the mysteries of the cosmos, to think about your place in the context of what was, what is and what will be the universe.

So it was that I began to ask myself again why some of us are so keen to look at the stars and planets. What is it about those distant bodies that appeals to our minds and senses? Why would we spend our hard earned money to buy exceptional telescopes or build our own, and if we are also into astrophotography, the amount of time required to develop great photos that rival those of professional astronomers?

For some it is pure enjoyment and fun. The thrill of seeing the rings of Saturn, the craters of the Moon are enough to sustain us. Others feel compelled by a curious intellectual passion for learning new things whether it be learning how to use a telescope to find dim galaxies and nebulae or mastering the art of astrophotography.

On May 10 at our Astronomy Day you can help by encouraging friends, especially ones with young children, to check out the event and share our enthusiasm for astronomy.

Phillip Chee, Editor

Astronomy Day 2007. Twilight sky with Moon, Saturn, Venus and Mercury. **Photo** 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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There's life on Earth because we have a big Moon

Our species owes a huge debt to the Moon. On the practical side our ancestors used the Moon's phases to mark the day of each month. Sailors used dear old Luna as a navigational aid. And farmers could harvest the fall crops into the night thanks to its bright light.

On a more aesthetic note, the Moon has inspired song writers and poets. And we can't overlook those romantic moonlit nights and the lovers huddled in its glow. Many of you probably owe your existence to the Moon's enchanting glow — okay, maybe Mom and Dad had something to do with you. But there's a much bigger story to tell.

It begins with the fact that compared to Earth, the Moon is huge. It's about ¼ the size of Earth — almost like two planets orbiting each other. If you've ever looked through a telescope you know that Jupiter's moons seem like pellets of buckshot compared to a baseball-sized planet. The same goes for the rest of the moon/planet relationships in our solar system. All are big planets with dinky moons. And size really does matter, especially when it comes to the effects of the planet/moon gravitational tug-of-war.

Jupiter's gigantic mass and gravity pulls and pushes the tiny moon Io to the point that the constant flexing has heated the little gaffer into a volcanic hot spot – the most volcanic area in our solar system. Happily things are different back on Earth.

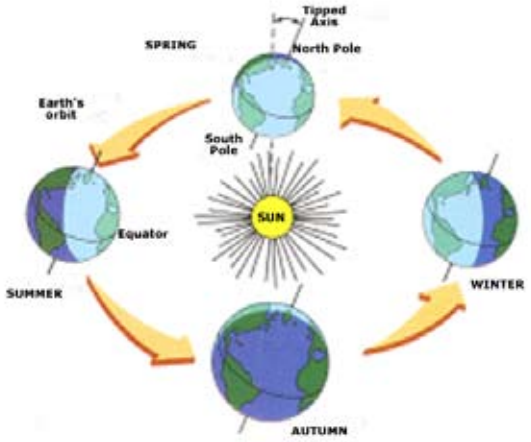
Sure, our big Moon pulls our oceans and gives us high and low tides. But while it's doing that, the Moon's gravitational tug is also stabilizing our big whirling globe. The Earth's 23.5-degree tilt is the reason we have predictable seasons. Our tilt towards the Sun in summer and away from it in summers not only makes the days longer or shorter, but also affects the amount of heat that builds up in our oceans — the powerhouses behind our global weather systems.

Take the Moon away and Earth would start to wobble like a drunken top. Our reliable 23.5-degree tilt would be constantly changing as we flopped around the Sun. That would make weather patterns erratic and unpredictable. Parts of our planet would be hot like the tropics one month and plunged into a deep freeze the next. Imagine being a life form trying to take root in that kind of environment. You'd have no time to adapt to the external conditions. And adaptation is how any species survives. Palm trees can't grow in the tundra, but lichen and moss can.

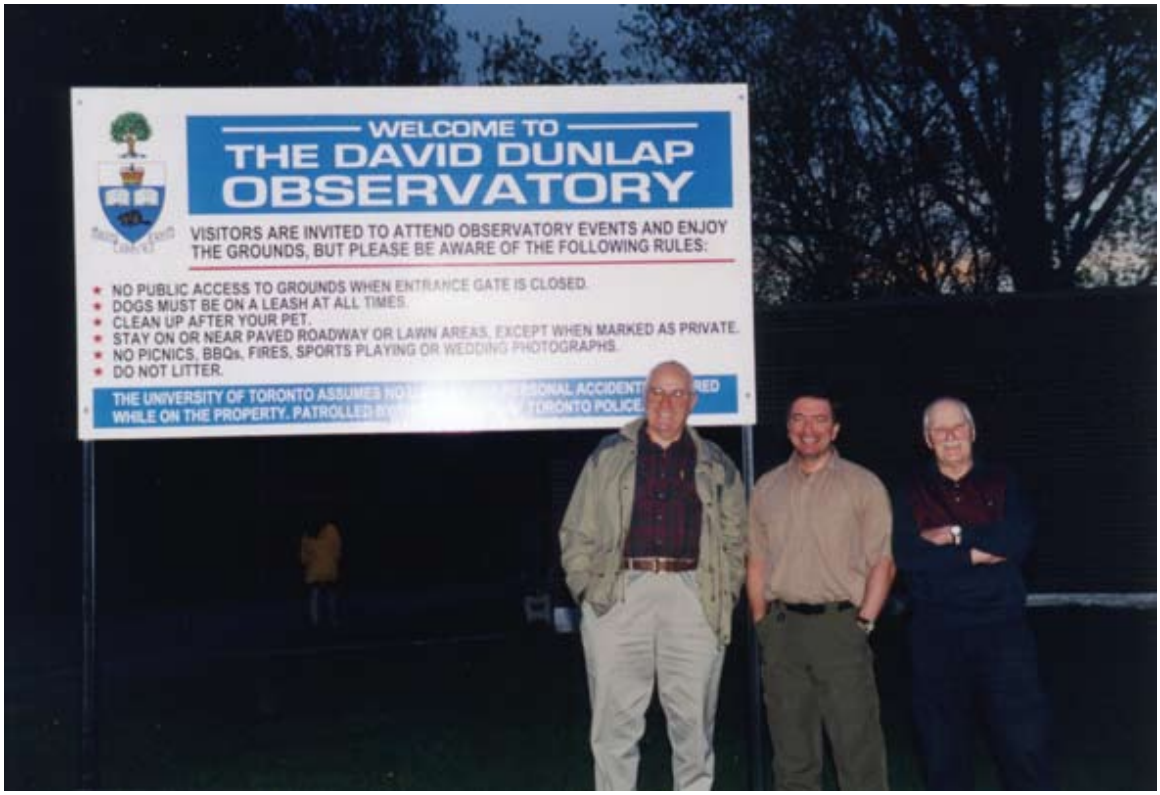
Water is essential to life. But if it were constantly vacillating between Mr. Freezy and a Big Slurpy, the prospect of life developing becomes very slim. Next time you look up don't thank your lucky stars. Thank our big fat Moon and the gravitational group hug it's giving the 6.65 billion inhabitants of Earth*.

John Crossen (johnstargazer@xplornet.com) belongs to the Canadian Science Writers' Association and owns BHO (www.buckhornobservatory.com)

*February, 2008 global population estimate.



The Earth's tilt and its relationship to the seasons. Without the Moon's stabilizing gravitational hand, Earth's tilt would be in constant flux resulting in climate changes so erratic that life couldn't have taken a foothold.



The Passing of a Past Member

It is with fond memories that I remember a previous member of the PAA. Bill Plewes, of Cavan, passed away suddenly on Sunday, April 6th. Unless you have been a member of the PAA between 2001 and 2004, you may not recall Bill. Well I do, he was a quiet and gentle spoken man and the brother-in-law of Rene Bowe (current PAA Treasurer). Bill was a supporter of the PAA. He would often use Rene's telescope and would show up at many of our meetings and observing sessions (public or private), to help out, learn and support our club. I know Rene influenced Bill greatly and I know it was because of Rene that Bill was member.

A trip I recall the most vividly was our big evening to the David Dunlap Observatory in Richmond Hill (May 5, 2001). The attached picture shows Bill, myself and Rene at the entrance to the observatory area. It was a night to remember, as it will never be repeated again, by Bill or any of the rest of us for that matter. It is times like this that I am glad I record the events I do. I know Bill's failing health in recent years prevented him from continuing with our club, but I am glad to have known him as a member for the years I did. I know Rene lost more than just his brother-in-law, he lost a friend.

Our condolences,

Rick Stankiewicz, President
PAA

"X" Marks The Spot!

Mark May 12th on your calendars, because this is the next chance you will get to see a unique lunar phenomenon. I have never tried this myself yet, but I have read about many times. I think all you need is a small scope or pair of binoculars to do the trick.

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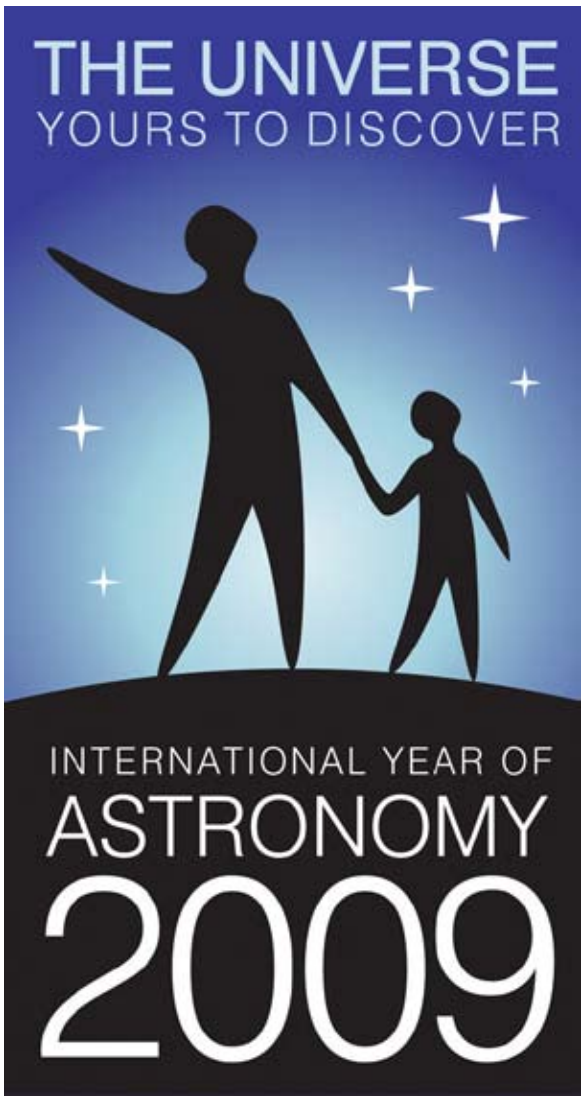

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X spot

Only at certain times of the lunar cycle are the shadows such that an "X" shape can be seen in the lunar surface near the terminator (line between shadow and illuminated surface of the Moon). It will help if you can find the craters named Werner and Aliacensis, as it right nearby. The following website will show you what you are looking for.

http://the-moon.wikispaces.com/Lunar+X

So, put an "X" on your calendar and if it is clear, have a close look at our closet celestial neighbour and see if you can find this unique lunar feature. I hope to for the first time.

Rick Stankiewicz, PAA

The Sky this Month

Mercury reaches greatest elongation east (22°) on the 14th and inferior conjunction on the 7th. The first half of the month provides best evening viewing this year.

Venus is difficult to see as it will reach superior conjunction on the 9th.

Mars crosses into Cancer on the 5th. At mid-month it will be about 45° in the west-southwest. During the evenings of 22nd-23rd it moves through the Beehive Cluster (M44).

Jupiter begins retrograde motion on the 9th. Rises in late evening by the 15th. Transit at 4 am only 23° high.

Saturn near Regulus. It's stationary on the 3rd and then begins its eastward motion. It is 54° high in the south-southwest at end of civil twilight and sets about 45 minutes before start of astronomical twilight in the west

Moon at perigee on the 6th. Also 0.9° N of the Pleiades and later Mercury 3° Smallest full moon on the 19th.

Moon Phases

New Moon	3;23 pm	May 5
First Quarter	11:47 pm	May 11
Full Moon	10:11 pm	May 19
Last Quarter	10:57 pm	May 27

Earth Hour 2008 (Boom or Bust?)

Photos taken by Rick Stankiewicz during Earth Hour 29 April 2008 on Armour Hill looking down to Peterborough.

I guess it all comes down to perspective, but the bottom line is that "it is a start". What are your feelings? For those of us who gathered on Armour Hill on March 29th for the first official Earth Hour in Peterborough (as for many cities around the world) we did not see a dark city vista as we looked west, but there is no doubt that if anyone turned lights out, it was a success. It was interesting to note that although you could see homes that were darkened on the inside, these same homes had porch lights left on outside. Go figure!

I know some downtown restaurants held candlelight dinners and the like, which is fantastic. However, there is no question that we must get "industry" to lead by example. It is the larger corporations like car dealerships and the Quaker Plant that need to be convinced that this is a good idea. As the above image(s) illustrates, one company can make a huge difference in the over all landscape.

On a much smaller scale, I have seen a difference in my own neighbourhood. Ever since Earth Hour I have never seen my neighbourhood as dark as it is now. In four years of waiting, "the lights" have finally come on in people's heads and off in their yards!

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Does the lord of the rings have a moon with rings?

A few weeks ago Dean Shewring, one of my fellow star-nerds from the Peterborough Astronomical Association, mentioned that the Cassini Mission to Saturn had discovered what could be a ring of rocky material orbiting Rhea, one of Saturn's 59 moons. If so this would mark the first ringed moon ever discovered.

Rhea is roughly 1,500 kilometers (950 miles) in diameter. The apparent debris disk measures several thousand miles from end to end. The particles that make up the disk and any embedded rings probably range from the size of small pebbles to boulders. An additional dust cloud may extend up to 5,900 kilometers (3,000 miles) from the moon's center, almost eight times the radius of Rhea.

The instruments used to find the rings were originally designed to study the atmosphere around Saturn and its moons. This accidental discovery could well be the signature of a ring system because it has been found on both sides of Rhea.

"Like finding planets around other stars, and moons around asteroids, these findings are opening a new field of rings around moons," said Norbert Krupp, a scientist with Cassini's Magnetospheric Imaging Instrument from the Max Planck Institute for Solar System Research.

Since the discovery, Cassini scientists have carried out numerical simulations to determine if Rhea can maintain rings. The models show that Rhea's gravity field, in combination with its orbit around Saturn, could allow rings that form to remain in place for a very long time. The discovery was a result of a Cassini close flyby of Rhea in November 2005, when instruments on the spacecraft observed the environment around the moon. Three instruments sampled dust directly. The existence of some debris was expected because a rain of dust constantly hits Saturn's moons, including Rhea, knocking particles into space around them. Other instruments' observations showed how the moon was interacting with Saturn's magnetosphere, and ruled out the possibility of Rhea having an atmosphere like Saturn's famous moon, Titan. While evidence is still being analyzed, the tentative conclusion is that Rhea does have a ring system surrounding it.

Artist's concept of Rhea's rings. Based on data collected so far, this is an artist's concept of what Rhea's rings might look like. It is hoped that further study will confirm them.

The discovery of the Rhea's ring reminded many scientists of the serendipitous manner in which the rings around Uranus were first detected. It seems NASA's Kuiper Airborne Observatory was studying the planet. The light from a background star blinked on and off as it passed behind Uranus' rings. Analysis of the blinks led astronomers to conclude that there were nine rings circling the planet. The year was 1977 but the rings weren't confirmed visually until a Voyager 2 flyby in 1986. Voyager also imaged two more Uranian rings. The ring count increased to 13 in 2005 when the Hubble Space Telescope imaged Uranus.

John Crossen

The View from Cadillac Mountain

Last June we spent a week at Acadia National Park on Mount Desert Island on the coast of Maine. This is a great place for a holiday as it offers a wide variety of things to do (when you're not star gazing, that is!). Within the Park there are many miles of "carriage ways" for horse back riding or easy bicycling, and there are also numerous hiking trails. Motorcycling is pretty good also – some nice curves. And there is a nice sandy beach for the less energetic types. Even shopping in Bar Harbor, the local town. A big attraction is sea kayaking, and for this reason we stayed at an excellent family type campground, Mount Desert Campground, right on Somes Sound, which is the only fjord on the Atlantic coast of the United States.

But I digress from the main point of this article, which is that it is also a really interesting place to star gaze. Right in the middle of the Island is Cadillac Mountain, which at 1530 feet is the highest point on the North Atlantic seaboard.

And guess what – you can drive right to the top, so there's no need to lug your telescope up one of the hiking trails. There is a lookout at the summit with a fairly large parking lot and Park building. During the day this area is quite busy, and especially at sunset it is very popular to take in the view of the setting sun (sunrise is also great, as you see the first light hitting the USA each morning). But 10 minutes after the sun goes down the place is deserted except for one or two cars, and their occupants are into their own thing.

At the north end of the parking lot, on the other side from the Park office, there are no lights, and there is lots of room to set up your gear on the adjacent flat rock surfaces. Light pollution is minimal. Bar Harbor is to the east and well below you, and that's about the only significant light source. And there's no smog. However, you need to be prepared to be chilly – there is minimal wind protection and the

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The sun sets behind Cadillac Mountain in Acadia National Park. **Photo** Justin Russell.

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temperature drops surprisingly fast at night fall – dew can be an issue.

But forget the cold and the dew – the view is very dramatic – there is not a single obstruction, and the horizon is many, many miles away. As noted in previous articles, my measure of good viewing is the clarity of the Milky Way, and it's pretty darn good – not as excellent as Killarney in northern Ontario, but far superior compared to most spots. You can do a lot of interesting viewing from here!

Getting to Acadia is about 1100 km from Peterborough, being a relaxed two day drive via Montreal and the Eastern Townships, northern New Hampshire and then across Maine to the coast. The en route stopover can be an opportunity for star gazing also, as you cross thru the White Mountains, with 6,300 foot Mt. Washington the star attraction.

While Mount Desert is an island there is a causeway connecting it to the mainland, so there's no need to swim over.

See you there!

John Galle

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Earth Hour

However, now we have a reference point and one that hopefully can be repeated year after year and things will only get better as time goes by, right? My fingers are crossed anyway. It would be nice if for next year's Earth Hour the PAA can work ahead of the game and start to promote changes where they are need most and we could talk to the commercial establishments of Peterborough. Can we make a difference, sure we can.

Until next year, keep those light down and the stars up!

Rick Stankiewicz, President
PAA

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Colliding galaxies

tidal forces can produce the most intricate and varied effects as galaxies pass close to each other.

Typically the first tentative sign of an interaction will be a bridge of matter as the first gentle tugs of gravity tease out dust and gas from the approaching galaxies (IC 2810). As the outer reaches of the galaxies begin to intermingle, long streamers of gas and dust, known as tidal tails, stretch out and sweep back to wrap around the cores (NGC 6786, UCG 335, NGC 6050). These long, often spectacular, tidal tails are the signature of an interaction and can persist long after the main action is over. As the galaxy cores approach each other their gas and dust clouds are buffeted and accelerated dramatically by the conflicting pull of matter from all directions (NGC 6621, NGC 5256). These forces can result in shockwaves rippling through the interstellar clouds (ARP 148). Gas and dust are siphoned into the active central regions, fuelling bursts of star formation that appear as characteristic blue knots of young stars (NGC 454). As the clouds of dust build they are heated so that they radiate strongly, becoming some of the brightest (luminous and ultraluminous) infrared objects (APG 220) in the sky.

These objects emit up to several thousand billion times the luminosity of our Sun. They are the most rapidly star-forming galaxies in today's Universe and are linked to the occurrence of quasars. Unlike standard spiral galaxies like the Milky Way, which radiate from stars and hot gas distributed over their entire span of perhaps 100,000 light-years, the energy in luminous and ultraluminous infrared galaxies is primarily generated within their central portion, over an extent of 1000 to 10,000 light-years. This energy emanates both from vigorous star formation processes, which can generate up to a few hundred solar masses of new stars per year (in comparison,

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Light Pillars On The Move

It has been my experience that "light pillars" are similar to "solar pillars". They are both natural phenomenon and based on the same principles. The difference lies in their light source. In simple terms, a solar pillar is the Sun lighting up the undersides of plate-like ice crystals that are stacked in a column that is reflected toward the observer under the proper conditions. These conditions are usually best near sunrise and sunset and more often during the winter months. However, this atmospheric effect can occur at anytime of year because the icy platelets that stack up to allow this effect are in the upper atmosphere where it is very cold all the time.

Image #1 was taken just before sunrise on January 24, 2008, as I headed off for work. It is a classic solar pillar.

Light pillar are similar, but instead of the Sun, the light source is man-made (vehicles, street lights, etc., in other words sources of "light pollution"). This past winter I had the fortunate, or maybe unfortunate experience of making it to one of our fateful PAA meeting nights. I say "unfortunate" only because the first Friday of the month for January, February and March were less that ideal for traveling and attendance. So, I found myself heading home south of Peterborough on February the 1st (my 52nd birthday) as a fine icy rain fell late in the evening. However, I noticed that when vehicles off in the distance headed my way on County Road#2, I could detect a "light pillar" prior to their headlights hitting me. So, what do you do on your birthday on a PAA meeting night as you head home? If you are me, you pull over to the side of the road and strategically place yourself to try and capture oncoming light pillars.

Image #2 was taken from inside my vehicle in between wiper blades keeping the windshield clear, but I captured the light pillar of a vehicle heading toward me.

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Classic light pillar. Taken 24 January 2008 before sunrise. **Photo** Rick Stankiewicz.

Light pillar from car headlights on Peterborough County Road 2, 1 February 2008. **Photo** Rick Stankiewicz.

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I was able to attain the same effect as a solar pillar, but in this case the light source was vehicle headlights reflecting light from the ice crystals in the air that night. This effect only lasted a few seconds as the vehicle had to be close enough to produce the light required, but the hill in the foreground was able to block a direct hit of the headlights. This is the similar principle to what was happening with the Sun in Image #1.

So, be on the lookout for moving light pillars, but also be prepared to move into position to capture them if you can. Proving once again, it is always worth coming out to a PAA meeting regardless of the weather. This was my birthday surprise.

Rick Stankiewicz, President

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Colliding galaxies

the Milky Way generates a few solar masses of new stars per year), and from massive accreting black holes, a million to a billion times the mass of the Sun, in the central region.

Intense star formation regions and high levels of infrared and far-infrared radiation are typical of the most active central period of the interaction and are seen in many of the objects in this release. Other visible signs of an interaction are disruptions to the galaxy nuclei (NGC 3256, NGC 17). This disruption may persist long after the interaction is over, both for the case where a larger galaxy has swallowed a much smaller companion and where two more closely matched galaxies have finally separated.

Most of the 59 new Hubble images are part of a large investigation of luminous and ultra-luminous infrared galaxies called the GOALS project (Great Observatories All-sky LIRG Survey). This survey combines observations from Hubble, the NASA Spitzer Space Observatory, the NASA Chandra X-Ray Observatory and NASA Galaxy Explorer. The Hubble observations are led by Professor Aaron S. Evans from the University of Virginia and the National Radio Astronomy Observatory (USA).

A number of the interacting galaxies seen here are included in the The Atlas of Peculiar Galaxies, a remarkable catalogue produced by the astronomer Halton Arp in the mid-1960s that built on work by B.A. Vorontsov-Velyaminov from 1959. Arp compiled the catalogue in a pioneering attempt to solve the mystery of the bizarre shapes of galaxies observed by ground-based telescopes. Today, the peculiar structures seen by Arp and others are well understood as the result of complex gravitational interactions.

The Hubble Space Telescope is a project of international cooperation between ESA and NASA.

Credit: NASA, ESA, the Hubble Heritage Team (STScI/AURA)-ESA/Hubble Collaboration and A. Evans (University of Virginia, Charlottesville/ NRAO/Stony Brook University)

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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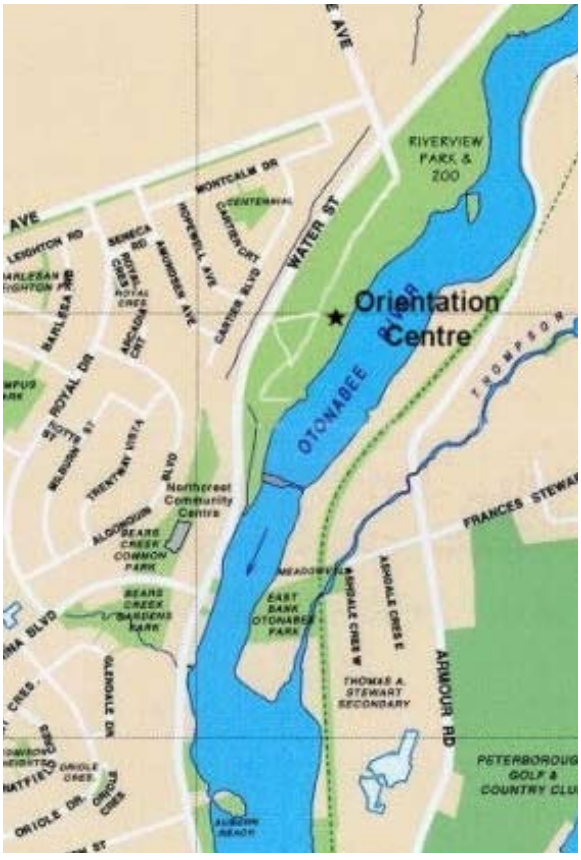
Next submission deadline:
Friday, May 23, 2008



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 8:00 p.m.