SkyWAAtch

◀The Running Man Nebula

Olivier Prache captured this image of NGC 1977 (the Running Man nebula) in Orion. He employed a Hyperion 12.5 inch astrograph and a FLI ML16803 camera on a MI-250 Mount. The exposure was 100 minutes each R,G,B no binning with 10-minutes sub frames; acquired with CCD Commander and MaxImDL. The image was processed with CCDStack2 and Photoshop. NGC 1977 is a reflection nebula associated with the Great Nebula in Orion and lies at a distance of 1500 light yrs.

The Orion Nebula▶

Courtesy of Carl Lydon is this image of M42, the Great Nebula in Orion. This vast stellar nursery is one of the gems of the winter sky.

Carl's image combines four four-minute and 20 one-minute exposures. He stacked these in photoshop (with levels, curves and a high dynamic range filter). He used a Canon Rebel T3 camera, though an 11" Celestron 1100HD telescope.

Events for January 2013

WAA Lectures

"Modern Telescope Mirror Manufacturing for Ground and Space Applications"
Friday January 11th, 7:30pm
Miller Lecture Hall, Pace University
Pleasantville, NY

Mr. Charlie Schaub will discuss the techniques and equipment used to develop telescope mirrors for space and ground applications. It will highlight how modern telescope mirror manufacturing involves a unique blending of the artisan classical finishing processes combined with modern computer controlled technologies. Mr. Schaub is the Director of Advanced Systems in the Intelligence, Surveillance, and Reconnaissance Division of the United Technologies Aerospace Systems group. A graduate of the Institute of Optics of the University of Rochester, he leads a team of scientists, engineers, and technicians in the development of advanced optical products for industry, the U.S. Government, and foreign governments. Free and open to the public. Directions and Map.

More Upcoming Lectures

Miller Lecture Hall, Pace University
Pleasantville, NY

On February 1st, our speaker will be Brother Robert Novak, Ph.d., who will will present the latest results from Mars Curiosity. Lectures are free and open to the public.

Annual Meeting Results

At the Annual Meeting on December 7, 2012, a new Board of Directors was elected. For 2013, the officers are:
- President: Larry Faltz
- Senior VP: Charlie Gibson
- Treasurer: Doug Baum
- VP Membership: Paul Alimena
- VP Lectures: Pat Mahon
- VP Field Events: Bob Kelly

Additional leadership positions appointed by the Board are:
- Assistant VP: Claudia Parrington
- Webmaster: David Parmet
- Newsletter Editor: Tom Boustead
- Equipment Manager: Darryl Ciucci

The annual audit will be performed by Darryl Ciucci, Bill Newell.

The membership approved Bylaws amendments that will permit official notifications from the club to be made via email.

2013 Lecture Dates

Lectures (Fridays, 7:30 pm, Miller Hall, Pace University)

Winter-Spring	Fall
January 11, 2013 (second Friday)	September 6, 2013
February 1, 2013	October 4, 2013
March 1. 2013	November 1, 2013
April 5, 2013	December 6, 2013
May 3, 2013	
June 7, 2013	

Starway to Heaven

There will be no public *Starway to Heaven* in January or February. *Starway to Heaven* events will resume in March.

New Members. . .

Stephanie Lester & John Naval - Dobbs Ferry
Gary Telfer - Scarborough

Renewing Members. . .

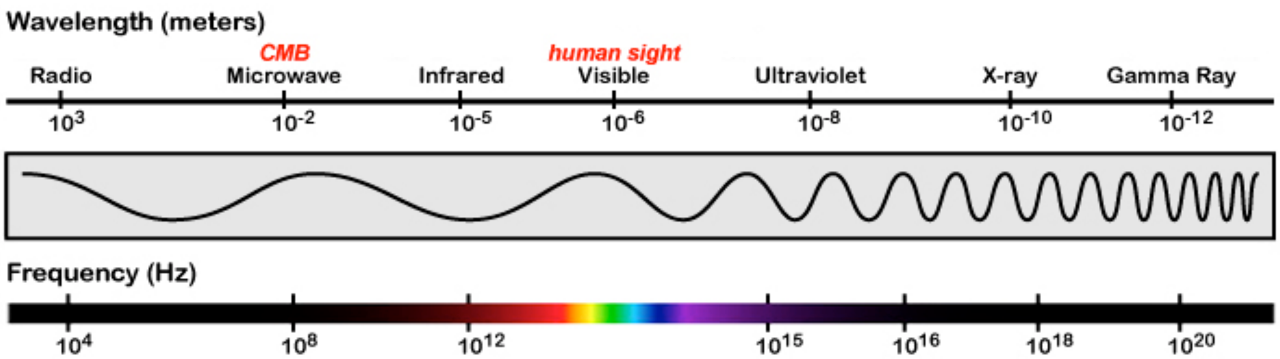
Hans Minnich - Bronx
Larry and Elyse Faltz - Larchmont
Jay Friedman - Katonah
Bob Kelly - Ardsley
Douglas & Vivian Towers - Yonkers
Mandira Roy - Hastings-on-Hudson
Anthony Sarro - Scarsdale
Michael Rinaldi - Scarsdale
Jonathan Gold - Ossining
Ron Posmentier - Croton-on-Hudson

WAA APPAREL

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:
- **Caps, $10** (navy and khaki)
- **Short Sleeve Polos, $12** (navy).

Articles and Photos

Some Discoveries by the Fermi Gamma Ray Telescope
by Larry Faltz



Gamma Rays

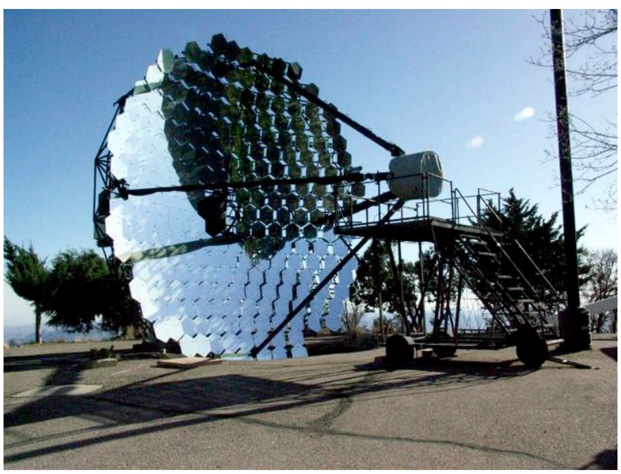
Gamma (γ) rays are the highest frequency electromagnetic waves and therefore, by the particle/wave duality of quantum mechanics, the most energetic photons in the electromagnetic spectrum. We recall the Bohr equation for the energy of an electromagnetic wave, E=hν, where h is Planck's constant ($6.626x10^{-34}$ joule-seconds) and ν (nu) is the frequency (1/seconds). If you do the algebra, the seconds cancel and we get the value in joules, a unit of energy. Since we more commonly talk about wavelengths for electromagnetic waves, the wavelength λ (lambda) is merely the speed of light in a vacuum ($c=2.99792458x10^8$ meters/second) divided by frequency (so Bohr's equation becomes E=hc/λ). Very energetic gamma radiation can have wavelengths of less than a picometer (10^{-12} meters, less than the diameter of an atom), frequencies greater than 10 exahertz (or $>10^{19}$ Hz) and energies above 100 KeV (7,300 times the energy needed to ionize a hydrogen atom). Gamma rays are so energetic that they can create matter in the form of electron-positron pairs (recall $E=mc^2$, therefore by simple algebra m=h/λc). Thank you, special relativity and quantum mechanics! And since the basic laws of physics are reversible, an electron and positron can annihilate to form a gamma ray.

On Earth, gamma radiation is emitted by certain radioactive decays, in small amounts from lightning and in large amounts from nuclear explosions. The most common natural source of terrestrial gamma radiation is the decay of potassium-40. This isotope has a half-life of $1.248x10^9$ years. Although 90% of the time it undergoes beta decay by emitting an electron and antineutrino to become calcium-40, 10% of the time it captures an electron to become argon-40, emitting a 1.460 MeV gamma ray and a neutrino. The adult human body contains about 160 grams of potassium of which about 0.0117% is potassium-40, whose decay produces about 4,400 disintegrations per second. Considering that these energetic rays can ionize atoms in biologic molecules, they are potentially hazardous. Cellular and DNA repair mechanisms can deal with most of the damage, but it is possible that some diseases, particularly cancers, could be due to unrepaired genetic injury from intrinsic potassium-40 decay. Potassium-40 decay also contributes to the heating of the Earth's core (about 20% of the total energy, the rest provided by uranium and thorium decay).

Gamma rays from nuclear disintegration can be used for medical diagnosis and treatment. The sugar analog fluorodeoxyglucose (FDG) can be made with fluorine-18. Taken up by metabolically active tissues, the ^{18}FDG emits a positron, which collides with a nearby electron to produce a gamma ray. The camera on a positron-emission tomography (PET) scanner detects the positrons and creates images. Technicium-99m is taken up by bone mineral and detected by gamma cameras to produce bone scans. The deadly gamma emitter cobalt-60 was an early radiotherapy source, but in modern medicine it finds its place in gamma knife devices for cancer radiosurgery.

Another source of gamma radiation is *bremsstrahlung*, or "braking radiation." These waves are emitted when charged particles decelerate as they follow curved paths in an electromagnetic field. Diagnostic X-ray machines produce their radiation in this manner, but gamma rays can be produced if the particles are at much higher energies.

The most energetic gamma radiation is produced by cataclysmic processes in the cosmos: supernovas, neutron stars and black holes. It is thought that most of this radiation is the result of inverse Compton scattering and synchrotron radiation. In inverse Compton scattering, low energy photons are kicked up to higher energies by interaction with electrons moving at relativistic speeds, such as in the accretion disks around black holes. Synchrotron radiation is produced when charged particles move along curved paths at ultra-relativistic speeds in a magnetic field. It's the likely mechanism for the radiation component of pulsar and black hole jets. An earthly example is radiation from the Large Hadron Collider at CERN. In the LHC, highly energetic protons travelling at 0.999999991 c are kept on their 27-km circular path by 1,600 superconducting magnets. They continuously emit gamma rays, and the flux is so high that anyone standing in the corridor next to the device would be fatally irradiated in a fraction of a second. The real problem for the experiment, though (since the device is cleared of personnel before a run) is that conservation of energy requires that synchrotron radiation carry energy away from the proton beam, reducing its intensity.



10-m Cerenkov radiation telescope, Mt. Hopkins (LLF)

We are protected from astronomical gamma rays by the blanket of Earth's atmosphere, because gamma rays interact so readily with matter. As a result, they cannot be directly observed from the ground and require space-based telescopes to be detected and studied. Some ground-based instruments can observe Cerenkov radiation. This type of radiation is created when a photon, moving at c, or a charged particle, moving near c, hits the atmosphere, where it will then be going faster than the *local* speed of light (remember that the standard value of c is its speed in a vacuum; light moves slower in other media, like air, water or glass). This creates a kind of sonic boom, generating electron-positron pairs in an "air shower" that in turn produces a cone of visible light. Special telescopes in dark sites can detect these emissions. The spectrum of Cerenkov radiation has been well-studied, allowing the source, either gamma rays (photons) or cosmic rays (charged particles) to be determined.

The first gamma-ray telescope was carried on board the American satellite Explorer 11 in 1961. Gamma-ray bursts from deep space were discovered by the Vela satellites, originally designed to detect nuclear explosions on earth. Throughout the 1970's and 80's, smaller gamma ray detectors made a number of interesting discoveries, detecting many gamma ray bursts and pulsars. The 1991 Compton Gamma Ray Observatory mapped thousands of sources. Their distribution showed that they did not arise in the Milky Way. Gamma ray bursts are now known to arise from supernovas and perhaps from the merger of two neutron stars.

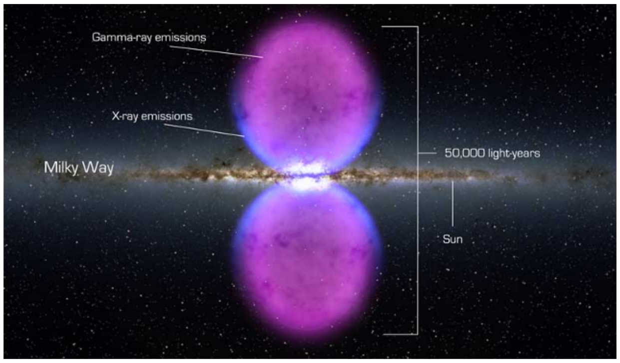
On June 11, 2008, the Fermi Gamma Ray Telescope was launched. Originally called GLAST, the Gamma Ray Large Area Telescope, Fermi has had a remarkably productive scientific life using its two instruments, the Large Area Telescope and the Gamma Ray Burst Monitor.

Fermi Gamma Ray Telescope (NASA)

Fermi's first discovery was a unique gamma ray-only pulsar in the CTA supernova remnant 4,600 LY distant. The pulsar has a period of 316.86 milliseconds. Shortly thereafter, a huge gamma ray burst was detected in the constellation Carina, calculated to be as powerful as 9,000 supernovas. The relativistic jet of this object, known as GRB 080916C, moved at 0.999999 c.

Another goal of the mission was to explore the origin of cosmic rays. Fermi LAT found that supernova remnants act as accelerators of protons and electrons, generating cosmic rays as well as gamma rays.

Fermi also mapped huge gamma ray bubbles around the Milky Way, extending 25,000 LY above and below the center of the galaxy. X-rays are generated at the edges of the bubble.



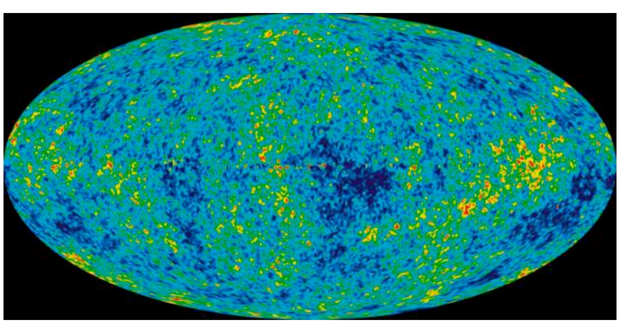
γ ray bubbles in the Milky Way (artist's rendering, NASA)

Recently, Fermi monitored gamma ray emission from terrestrial thunderstorms. Called terrestrial gamma-ray flashes, these are among the most energetic emissions on Earth and are associated with radio discharges. The mechanism is thought to be that lightning accelerates electrons at the top of the thunderclouds to near-relativistic speeds. These electrons are deflected by molecules in the upper atmosphere, giving off gamma rays by the synchrotron mechanism.

Two very recently published papers show the breadth of scientific problems that Fermi is capable of investigating.

Looking for Early Stars and Galaxies

One of the most important unresolved problems in astrophysics and cosmology is the size and distribution of the first stars and galaxies. The farthest thing we can detect by instruments is the cosmic microwave background radiation, also called the surface of last scattering, the 2.7º K blackbody radiation first detected by Penzias and Wilson and then mapped by the COBE and WMAP satellites.



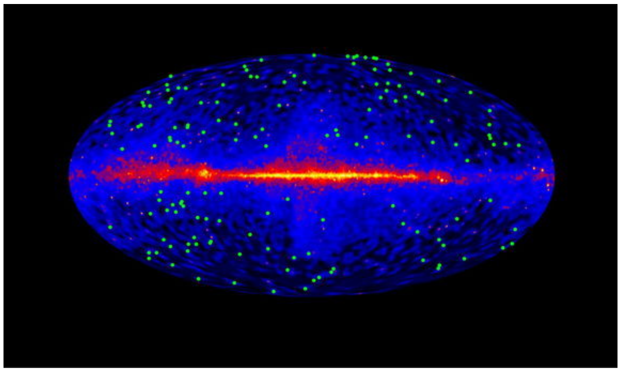
WMAP 7-year data (NASA)

About 380,000 years after the Big Bang, the universe had expanded and cooled enough for protons and electrons to combine to form hydrogen atoms, rendering it transparent to radiation since uncombined protons and electrons scatter photons. This is a surface, a spherical radiation-emitting shell nearly 13.7 billion light-years distant at a red shift (z) of about 1,096.

After recombination, the universe continued to expand and cool. The first stars and galaxies are thought to have formed about half a billion years after the Big Bang, starting perhaps at z~20. We can't see the earliest objects, but computer models suggest they were supergiant black holes or massive stars (100 or more solar masses). Stars that large would be very hot and have enormous ultraviolet radiation flux. It is thought that this UV radiation reionized much of the intergalactic medium, accounting for its current state as a hot plasma of free protons and electrons. Since the universe has dramatically expanded, the intergalactic particle density is so low (<1 hydrogen atom per cubic meter) that scattering is rare and the cosmos remains relatively transparent. The substantial amount of dark matter in the universe, whatever it is made of, does not interact with radiation, but exerts its effects only through gravity. What we know about the first objects comes primarily from extrapolation and computer modeling, but not from direct measurement.

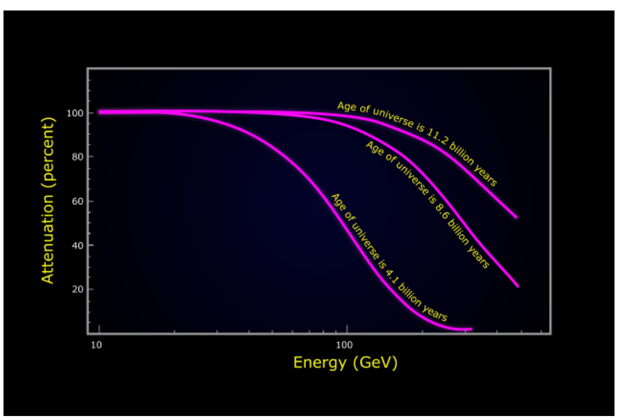
Just as there is a "surface" for the radiation emitted at 380,000 years after the Big Bang, there are other surfaces of light emitted at later epochs. All of these combine to form the "Extragalactic Background Light" (EBL), the sum of radiation in the visible light band emitted by all stars and active galactic nuclei in the universe from all times. The spectrum of the EBL at different distances varies depending on its origin in different epochs (with an easily calculated red shift from cosmological expansion.)

A recent paper in *Science*, "The Imprint of the Extragalactic Background Light in the Gamma-Ray Spectra of Blazars" by M. Ackermann, et. al. (30 November 2012; 338:1190-1192), sought to determine the content of the earliest stars by looking at how the EBL affected gamma rays from distant blazars, which are active galactic nuclei (quasars) thought to be powered by supermassive black holes with relativistic jets pointed nearly directly at us. They are among the most powerful objects in the universe, and because of their intrinsic brightness they can be mapped out to very high red shifts. The prototype blazar is BL Lacertae, which is why these are often called “BL Lac” objects. The authors used data from Fermi to analyze the gamma ray spectra of blazars at different distances.



Location of the blazars used in Ackermann, et. al. (NASA)

As the gamma rays travel through the universe towards us, they encounter lower-energy photons from the EBL, and they will occasionally interact, forming electron-positron pairs. The energy at which these interactions occur depends on the spectrum of the blazar and on the spectrum of the EBL at the distance of the interaction. More distant blazars will encounter photons of a slightly different spectrum (and therefore energy) than closer ones. This results in a different absorption spectrum depending on blazar distance and this allows extrapolation of the content of the EBL back to the earliest star-forming epochs.



Attenuation of gamma radiation at different epochs

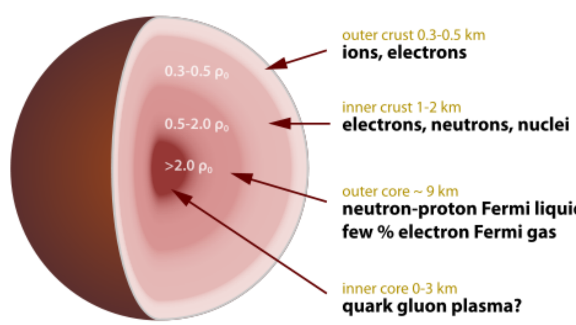
The results depend on many calculations and extrapolations from other measurements, which are heavily referenced and discussed in the paper. That the analysis is complex is attested to by the fact that Ackermann has 140 co-authors! They conclude:

> Zero-metallicity population-III stars or low-metallicity population-II stars are thought to be the first stars to form in the universe and formally marked the end of the dark ages when, with their UV light, these objects started ionizing the intergalactic medium. These stars, whose mass might have exceeded 100 times the mass of our Sun (M⊙), are also believed to be responsible for creating the first metals and dispersing them in the intergalactic medium.... Our measurement constrains the redshift of maximum formation of low-metallicity stars to be at $z \geq 10$ and its peak comoving star-formation rate to be lower than 0.5 M⊙ Mpc^{-3} year^{-1}. This upper limit is already of the same order of the peak star-formation rate of 0.2 to 0.6 M⊙ Mpc^{-3} year^{-1}… and suggests that the peak star-formation rate might be much lower….

In other words, the authors have established a maximum rate of stellar formation in the earliest epochs. As additional data is obtained, some of it expected to come from the James Webb Space Telescope, the model of early star formation reionization will be refined. A detailed cartoon from NASA that shows the relationship of blazars to gamma ray absorption spectra is presented at the end of this article.

Neutron Stars and Pulsars

Neutron stars are remarkable and fascinating objects. They form when stars between 4 and 8 M⊙ use up their nuclear fuel and undergo a supernova explosion, collapsing to an object just 12 km in radius but maintaining most of their mass (perhaps 1.4-3.2 M⊙) in the form of neutrons. The density of a neutron star is $3.7\text{-}5.9\times10^{17}$ kg/m^3, a little greater that of an atomic nucleus and approximately that of my paternal grandmother’s inedible matzoh balls, of blessed childhood memory. To achieve that density, compress all of humanity into a sugar cube.



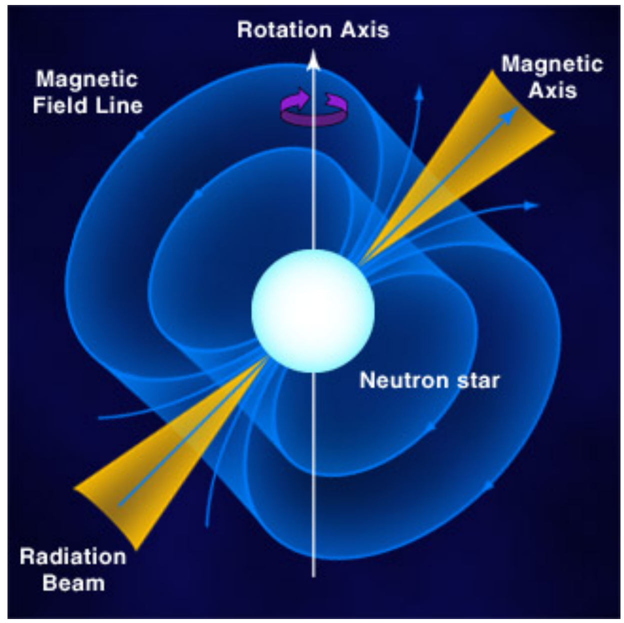
Neutron star structure

When they form, neutron stars are very hot (around 10^{11} ºK) but the release of enormous numbers of neutrinos carries away enough energy in a few yeas to cool them to about 10^{6} ºK. They do not undergo nuclear fusion. The further inward pressure of gravity is resisted by "quantum degeneracy pressure", the result of the Pauli exclusion principle, which states that fermions (such as quarks, neutrons and protons) cannot occupy the same quantum state (which includes physical location). At the surface, a neutron star has immense gravity, more than 10^{11} times that of Earth. There is still structure within the neutron star, with the core possibly being a quark-gluon plasma.

When they collapse, neutron stars maintain their angular momentum. Because they are so small they have short rotational periods, generally from 1.4 msec to 30 seconds. Predicted by Walter Baade and Fritz Zwicky in 1934 (just one year after James Chadwick discovered the neutron), Anthony Hewish identified a neutron star as the source of intense radio emissions in the Crab Nebula in 1965.

Combined Optical and X-ray image of the Crab Nebula, showing synchrotron emission from the central pulsar

Some neutron stars are magnetized. Their rapid rotation accelerates particles near the magnetic poles, generating beams of radiation, generally radio waves and X-rays. These are pulsars, a contraction of the term "pulsating star." We can observe a pulsar beam if it's angled so that it intercepts the earth. The first pulsar, with a period of 1.33 seconds, was detected by graduate student Jocelyn Bell in 1967. Although it was her mentor, Antony Hewish, who received the Nobel Prize for it in 1974, posterity will always acknowledge her role. When first detected, one credible explanation for the regularity of the signal was that it was an emission from an alien civilization, and so it was nicknamed LGM-1 for "little green men". The discovery of additional pulsars, the analysis of their signals and measurements in other wavelengths showed that they had to be coming from very compact, dense rotating stars. The first suggestion that they were neutron stars was made in 1968 independently by Thomas Gold and Franco Pacini. Hewish's Crab Nebula neutron star turned out to be a 33-millisecond pulsar.

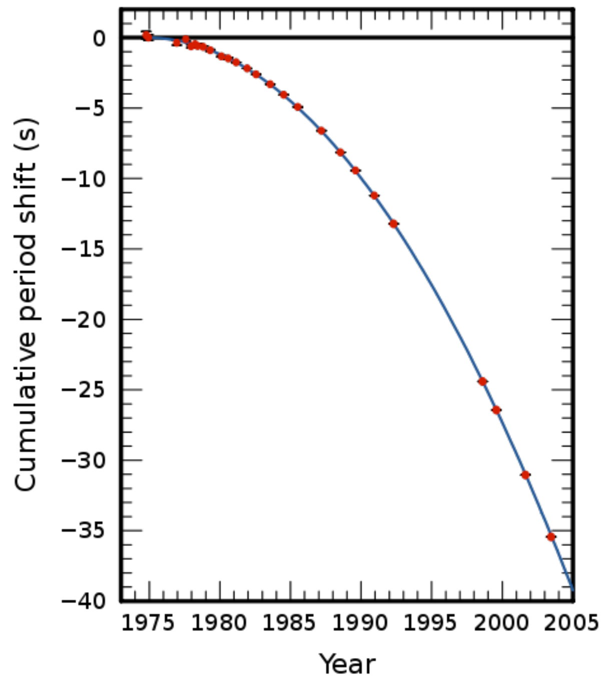


Pulsar structure

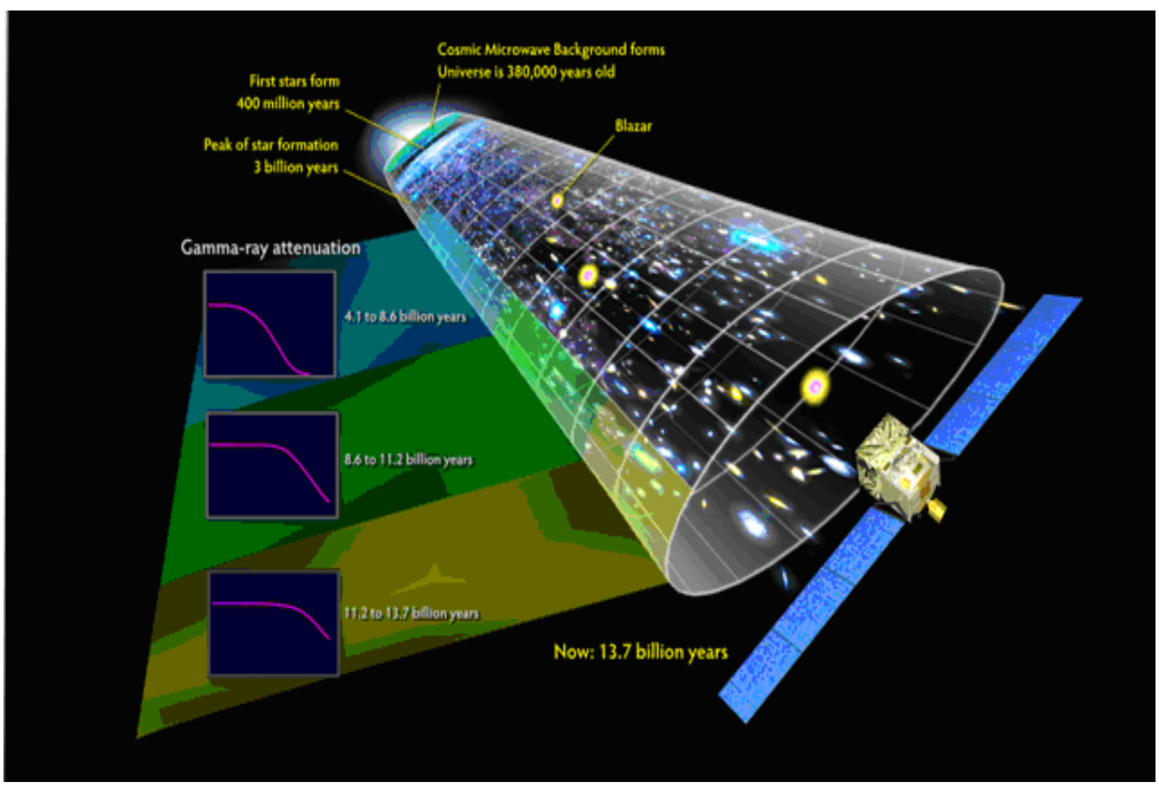
In 1974, the first binary pulsar was detected. This system, PSR 1913+16 in Aquila, has two neutron stars in orbit around a common center of mass (the companion in a binary pulsar does not have to be another neutron star). General relativity predicts that because their gravitation is so intense, this pair of dense objects will emit gravitational radiation, causing their orbits to decay and changing the rate of pulsations. The actual data exactly fits the predictions (see graph next page).

In the December 7, 2012 issue of *Science*, the same group from Fermi reported detection of a binary millisecond pulsar (Pletsch, et. al., "Binary Millisecond Pulsar Discovery via Gamma Ray Pulsations", 338: 1314-1317). The Large Area Telescope on Fermi has already detected gamma ray emissions from many previously known millisecond pulsars, with energies of 0.1-100 GeV. Fermi also found 36 young gamma ray pulsars with rotation rates of 2-20 Hz, only 4 of which were radio emitters (unlike usual radio-intense pulsars). Finding periodicity in pulsars is difficult without the radio signals. In this study, the Fermi team investigated PSR J1311-3430, one of the brightest sources in the Fermi gamma ray catalog. It had previously been spotted by earlier gamma ray telescopes EGRET and Compton, but its properties had never been explored. This very complex study (this time with 153 co-authors!) required 4 years of data acquisition (1,437 days of observations) and a vast amount of computational analysis to extract and characterize the periodic signal. The authors found PSR J1311-3430 to be pulsating every 2.5 milliseconds and were able to describe many characteristics of the pulsar and its companion. It is calculated to have a circular orbit with a period of only 93 minutes, which is the shortest of any spin-powered pulsar ever found. The pulsar is irradiating its companion, calculated to have a mass of around 0.0082 M⊙, just 8 times the mass of Jupiter, and slowly evaporating it.

Fermi is slated to operate at least until 2018, so expect many interesting results to come from this remarkable device.



Change in period of PSR 1913+16 due to emission of gravitation waves (data, red points, prediction of general relativity, solid curve). Data from Weisberg & Taylor. 2004



Cartoon of the observation of blazar gamma radiation by Fermi, and its attenuation by intermediate radiation from the Extragalactic Background Light (NASA)

What's Up for 2013?
by Bob Kelly

Here's a few interesting astronomical sights coming up in 2013.

Nov 3's eclipse of the Sun is total in the Atlantic Ocean and Africa. But at 6:31am the Sun rises 50% covered for the NYC area. The Moon slides away over the next 40 minutes. The Sun will rise at the same point on the horizon around Feb. 5th. Watch that sunrise to see what foreground objects will make a great photo on Nov. 3rd.

The next total lunar eclipse for our part of the world is on the morning of April 15 in 2014.

Comet C/2011 L4 (PanSTARRS), passes closest to the Sun on March 10, visible just above the western horizon 30 minutes after sunset, predicted to be a bright magnitude zero. Higher in the sky each night, it may stay above 4th magnitude through the end of March.

Will Comet ISON be historic like its prototype, the Great Comet of 1680? Or not so bright, like Kohoutek (which I did see in 1973)? ISON is predicted to be brighter than magnitude 5 by early October; staying visible to the unaided eye in December in the morning sky. It will pass 680,000 miles of the Sun's surface on November 28th, perhaps visible in daylight if you can block out the Sun, 1.3 degrees away.

Sunspots, and solar activity in general, is expected to peak this year, but at lower than typical peaks.

Mercury is easiest to see in mid-Feb., low in the western sky after sunset.

Venus is really low in the morning sky, but is brilliantly visible through mid-Feb. Venus shows up in the evening sky from mid-May though the rest of the year.

Mars is low in the southwest in the evening until mid-Feb. Mars shows up in the morning sky by summer. We don't catch up to Mars again until April 2014, so Mars will be tiny, even in a telescope, in 2013.

Jupiter is great now through April. The Moon makes very close passes in January, March and April. Jupiter returns to the evening sky in the last quarter of the year; we are closest again in January 2014.

Saturn's rings are open 18 degrees wide now and 21 degrees by the end of the year; brightest and largest in April.

Uranus and Neptune will be best in the latter half of 2013.

Asteroids Vesta and Ceres start out 2013 well placed for viewing in Taurus.

A Shadow Transit of Io
by Larry Faltz

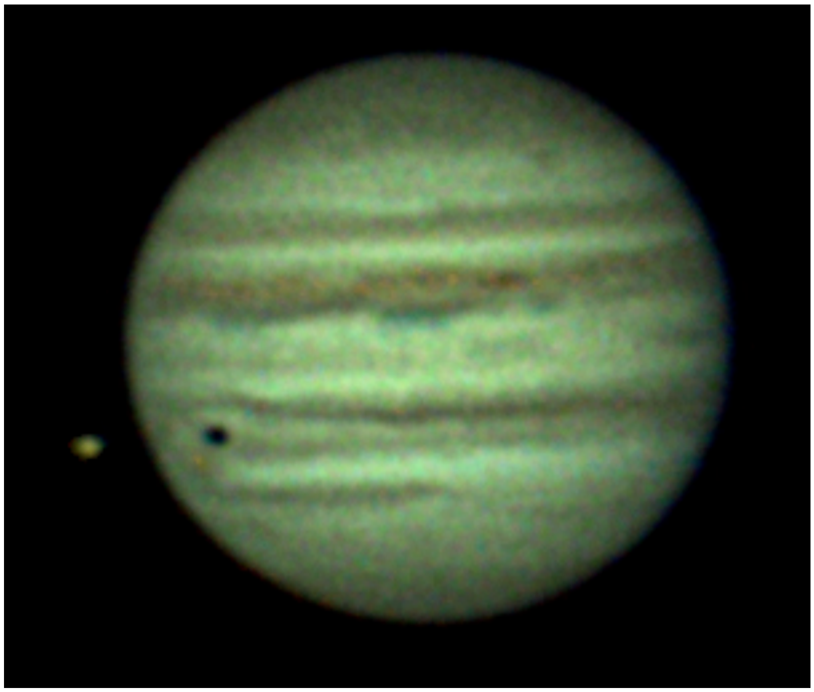
A sad fact for most of us is that it's hard to find time to observe, what with the vagaries of the weather, getting to an appropriate site, setting up equipment and staying up late, not to mention, most of the time, the specter of work the next day.

I took Christmas Eve off, and so planned to observe Sunday night, December 23rd, when a shadow transit of Io would start just after 10 pm. Since the moon and planets usually tolerate light-pollution and the sky was clear with excellent transparency, it seemed reasonable to observe from my front yard in Larchmont. After letting my 8" SCT cool for a couple of hours, I did a "solar system align", which is moderately accurate for tracking a planet in alt-az mode. I used a Televue Nagler T6 9mm eyepiece (225x) but unfortunately the seeing was pretty awful, with moments of steadiness in the minority. Alas, this is often typical for planetary observing at high power in our area. The seeing didn't improve as the evening went on, so it appeared to be due to heat radiating from surrounding houses (outside temperature was 32º F) night as well as atmospheric turbulence preceding a front due in less than 24 hours, rather than persistent heat currents in the scope's tube or the corrector plate dew heater (which has temperature feedback-control). When the image was stable, many smaller bands and details in the cloud structure could be observed, with scalloping on the bottom edge of the North Equatorial Band and a nicely defined pinkish Great Red Spot at the lower edge of the South Equatorial Band.

Io merged with Jupiter's disk at 10:04 pm, with the pinpoint shadow starting its crossing at 10:36, on a course tracking the SEB and moving towards the

GRS. The satellite emerged at 14 minutes after midnight, with the shadow exiting the disk at 12:48 am. It's particularly dramatic to watch the movement of a Jovian satellite on and off the planet's disk. There's a clear perception of movement, even at a distance of 385 million miles or more.

I captured some avi files with the Celestron Neximage 5 solar system CMOS imager. Because of the poor seeing, the video files show the planet's disk jumping all over the frame, gyrating like a hula dancer, and going in and out of focus. Registax can do wonders to maximize image quality but there are inherent limitations when too many of the baseline frames record planetary jiggles. Here's one of the better files, captured at f/10 towards the end of the event, best 200 of 1,778 (640x480) frames, aligned, stacked and crudely wavelet-processed in Registax. I tweaked the contrast in Photoshop.



Partnering to Solve Saturn's Mysteries
by Diane K. Fisher

From December 2010 through mid-summer 2011, a giant storm raged in Saturn's northern hemisphere. It was clearly visible not only to NASA's Cassini spacecraft orbiting Saturn, but also astronomers here on Earth—even those watching from their backyards. The storm came as a surprise, since it was about 10 years earlier in Saturn's seasonal cycle than expected from observations of similar storms in the past. Saturn's year is about 30 Earth years. Saturn is tilted on its axis (about 27° to Earth's 23°), causing it to have seasons as Earth does.

But even more surprising than the unseasonal storm was the related event that followed. First, a giant bubble of very warm material broke through the clouds in the region of the now-abated storm, suddenly raising the temperature of Saturn's stratosphere over 150 °F. Accompanying this enormous "burp" was a sudden increase in ethylene gas. It took Cassini's Composite Infrared Spectrometer instrument to detect it.

According to Dr. Scott Edgington, Deputy Project Scientist for Cassini, "Ethylene [C2H4] is normally present in only very low concentrations in Saturn's atmosphere and has been very difficult to detect. Although it is a transitional product of the thermochemical processes that normally occur in Saturn's atmosphere, the concentrations detected concurrent with the big 'burp' were 100 times what we would expect."

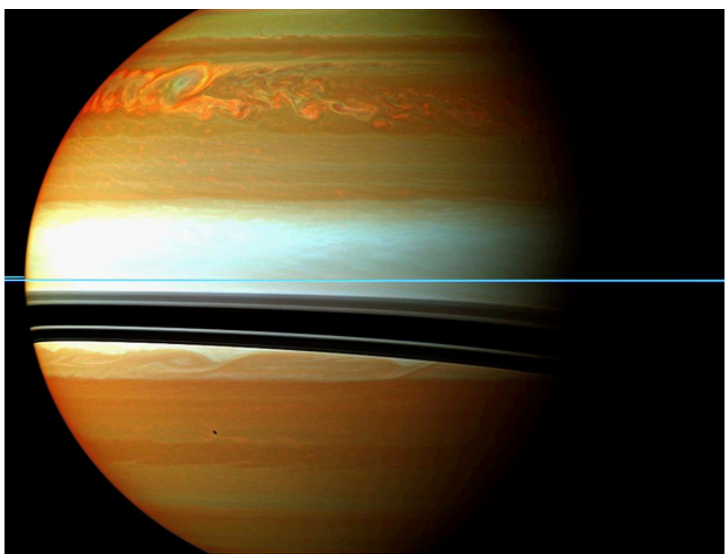
So what was going on? Chemical reaction rates vary greatly with the energy available for the process. Saturn's seasonal changes are exaggerated due to the effect of the rings acting as venetian blinds, throwing the northern hemisphere into shade during winter. So when the Sun again reaches the northern hemisphere, the photochemical reactions that take place in the atmosphere can speed up quickly. If not for its rings, Saturn's seasons would vary as predictably as Earth's.

But there may be another cycle going on besides the seasonal one. Computer models are based on expected reaction rates for the temperatures and pressures in Saturn's atmosphere, explains Edgington. However, it is very difficult to validate those models here on Earth. Setting up a lab to replicate conditions on Saturn is not easy!

Also contributing to the apparent mystery is the fact that haze on Saturn often obscures the view of storms below. Only once in a while do storms punch through the hazes. Astronomers may have previously missed large storms, thus failing to notice any non-seasonal patterns.

As for atmospheric events that are visible to Earth-bound telescopes, Edgington is particularly grateful for non-professional astronomers. While these astronomers are free to watch a planet continuously over long periods and record their finding in photographs, Cassini and its several science instruments must be shared with other scientists. Observation time on Cassini is planned more than six months in advance, making it difficult to immediately train it on the unexpected. That's where the volunteer astronomers come in, keeping a continuous watch on the changes taking place on Saturn. Edgington says, "Astronomy is one of those fields of study where amateurs can contribute as much as professionals.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with NASA.



This false-colored Cassini image of Saturn was taken in near-infrared light on January 12, 2011. Red and orange show clouds deep in the atmosphere. Yellow and green are intermediate clouds. White and blue are high clouds and haze. The rings appear as a thin, blue horizontal line.

Members Classified

As a service to members, the WAA newsletter will publish advertisements for equipment sales and other astronomy-related purposes. Ads will only be accepted from WAA members and must relate to amateur astronomy. Please keep to 100 words, include contact info and provide by the 20th of the month for inclusion in the next issue. The newsletter is subject to space limits; so ads may be held to subsequent issues. The WAA may refuse an ad at its sole discretion. In particular, price information will not be accepted. Members and parties use this classified service at their own risk. The Westchester Amateur Astronomers (WAA) and its officers accept no responsibility for the contents of any ad or for any related transaction.

Send classified ad requests to: waa-newsletter@westchesterastronomers.org.

Almanac

For January 2013 by Bob Kelly

Jan 4 Jan 11 Jan 19 Jan 26

Welcome to the arbitrarily-selected start of our next trip around the Sun!

(i.e., Happy New Year). Now that we have survived the odometer flips of the Gregorian (back in 2000) and Mayan (13.0.0.0.0) calendars, we can relax until someone finds another calendar that is about to run out of pages.

Watching the wealth of detail - belts and spots and moons - on and around Jupiter during our present close approach can really spoil us for other, smaller objects in our solar system. Watch out for stars that pass in back of Jupiter waltzing by with his moons. It's just another great month with this gem high in the evening sky. Did you see the Moon next to Jupiter Christmas night? The two get even cozier on the 21st. Check out the Hubble-like photos of Jupiter that earth-bound amateurs are posting on the internet.

Now, Mars may be dim, but gets the prize for persistence. It's still hanging low in the southwestern sky after sunset for another month or so. Because it's smaller, and on the other side of the Sun from us, Mars is only 1/10 the apparent size of Jupiter. Uranus is still well placed just after dark. It's a tiny bit smaller than Mars in the telescope. I wish they were closer together so we could compare their salmon and bluish colors more readily.

Oh, how the mighty have fallen in the morning sky! Venus is ending its long, outstanding run in the morning sky. Venus gets no higher in a dark sky than Mars, but Venus has the advantage of being so bright. It's pretty amazing how bright Venus gets, since Venus is only 2½ times the apparent size of Mars. But being larger and closer to the Sun does wonders for the second planet.

Smaller and further away, the brightest members of the asteroid belt twinkle in Taurus, in Jupiter's neighborhood in the evening sky. A good finder chart gives directions to Vesta and Ceres, both at 7th magnitude. While they are bright enough to be seen in binoculars or telescope, they don't look different from the stars seen near them, so make more than one visit to see how they move over several nights against the fixed stars in the background. Hey, you're out there to see Jupiter anyway, why not just hop over to give our brightest minor planet and brightest small solar system body some attention.

Saturn rewards early morning risers with its precious rings, now opened up with an 18 degree tilt towards Earth. It's located well to the upper right of Venus before sunrise.

Earth, with 7 billion passengers on board, passes through perihelion overnight on the 1st/2nd at 98.3 % of our mean distance from the Sun. It's not noticeable to the casual observer, although there are some nice photos on the internet comparing the perihelion and aphelion sizes of the Sun, taken with solar telescopes.

Satellites are often visible in twilight skies as they reflect sunlight in a dark sky. The International Space Station is as bright as magnitude -2 in the evening sky through the 3rd and in the morning sky from the 6th through the end of January. The Chinese space station, Tiangong, is smaller and less bright, reaching magnitude 1 in the evening sky though the 8th and the morning sky starting the 19th. The U.S. Air Force has re-launched its X-37B space plane; it might be seen as bright as magnitude 2, mostly in the evening sky this month. Charts from sites like heavens-above.com help sight these and many other satellites.

The Moon poses with Saturn on the 6th, Venus on the 10th, Mars on the 13th, in addition to surprising many casual observers right next to Jupiter on the 21st .

Bob's Heads UP blog is at bkellysky.wordpress.com.