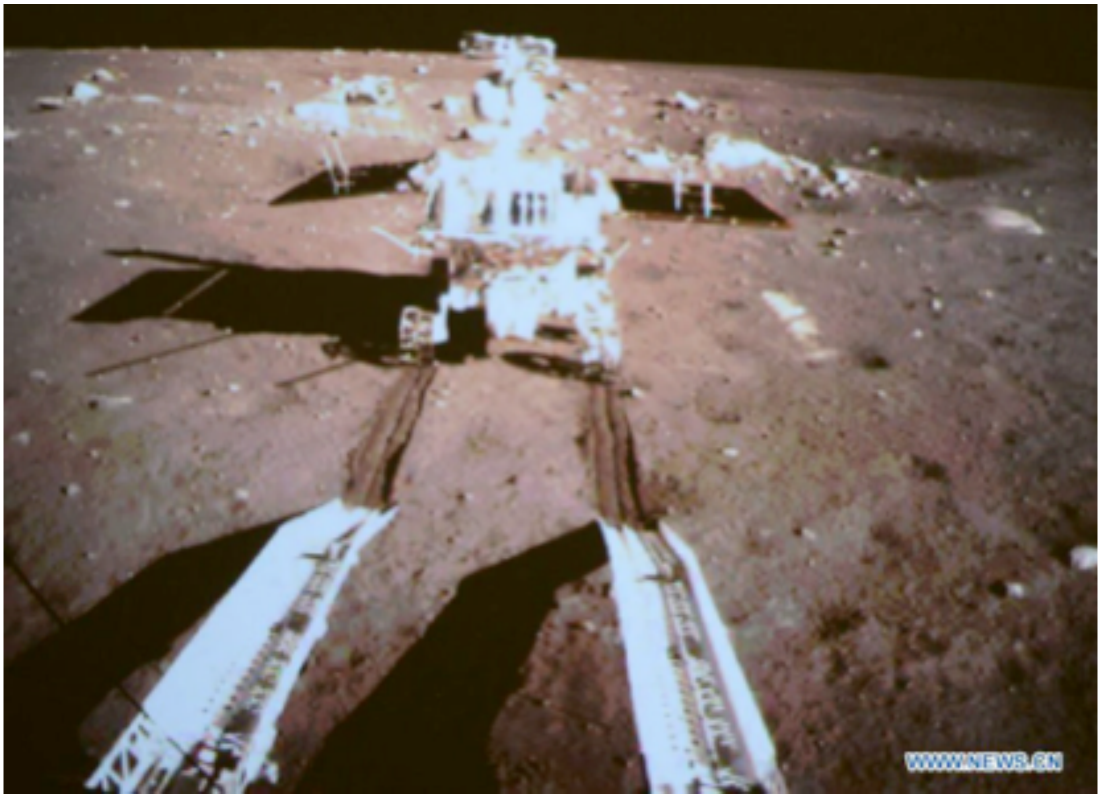
Sky WAA tch



Lunar Landing

A new, desk-sized rover has begun exploring the Moon. Launched by the Chinese National Space Administration, the Chang'e 3 spacecraft landed on the Moon on December 14th and deployed the robotic rover, Yutu, named for a folklore lunar Jade Rabbit. The rover has a scheduled three-month mission to explore several kilometers inside the Sinus Iridum (a northwestern extension to the Mare Imbrium). Yutu's cameras and spectrometers will investigate surface features and composition while ground penetrating radar will investigate deep soil structure.

Chang'e 3 achieved the first soft Moon landing since the Soviet Union's Luna 24 in 1976. For more details, see Bob Kelly's note on page 13.

Image Credit: Chinese National Space Administration, Xinhuanet

In This Issue . . .

Events for January 2014

WAA January Lecture

"The Higgs Boson has been Discovered - What is it, and are we Done?"
Friday January 10th, 7:30pm
Lienhard Lecture Hall, Pace University Pleasantville, NY

On July 4, 2012 the Large Hadron Collider experiments (ATLAS and CMS) announced the discovery of a new particle thought to be the long sought-after Higgs boson. The excitement of this discovery stems from the unique role played by the Higgs field (and the evidence of that field - the Higgs boson particle) as the mechanism that explains how elementary particles acquire their mass, one of the most fundamental of particle properties. The importance of this discovery was underscored by the award of the 2013 Nobel Prize in Physics to Peter Higgs, after whom the particle is named. Although the discovery is the culmination of decades of work searching for the Higgs, it is in fact only the start of a new era of study of the Higgs boson. Many questions remain. Is it the Higgs boson we expected? Why is it so light? - Does that mean there is new physics just around the corner? Do all elementary particles acquire their mass via the Higgs mechanism? Dr. Michael Tuts will address these questions in his presentation.

Dr. Tuts attended MIT as an undergraduate and received a PhD (1979) in Experimental Particle Physics from Stony Brook University. He joined Columbia University physics faculty in 1983 and has worked on experiments to study the fundamental particles and forces with experiments at Cornell, Fermilab and most recently CERN. He is a member of the ATLAS collaboration and until recently was the US ATLAS Operations Program Manager. Free and open to the public. Directions and Map.

Upcoming Lectures

Lienhard Lecture Hall, Pace University Pleasantville, NY

On February 7th, Brother Robert Novak will speak on Ancient Astronomy. Brother Robert is a Professor of Physics and Chair of the Physics and Astronomy Department at Iona College. He holds a PhD from Columbia. Free and open to the public.

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to periodically visit the WAA website.

Starway to Heaven

Meadow Picnic Area, Ward Pound Ridge Reservation, Cross River, NY

There will be no public Starway to Heaven observing events in January or February. Starway to Heaven events will resume in March 2014.

Renewing Members. . .

James Frost - Rye Brook
Daniel R. Poccia - Cortlandt Manor
Robert Rehrey - Yonkers
Douglas & Vivian Towers - Yonkers
David Parmet - Pound Ridge
Claudia & Kevin Parrington Family - Harrison
Peter Knipp - Bedford
Gary Telfer - Scarborough

WAA APPAREL

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:

- **Caps and Tee Shirts, $10**
- **Short Sleeve Polos,**
- **Navy hoodies for $22.**

Running Man

Courtesy of Olivier Prache is this image of the Running Man, a reflection nebula in Orion. Olivier used his 12.5" Hyperion Astrograph (5 hours total of RGB exposures processed with Photoshop).

Almanac

For January 2014 by Bob Kelly


Jan 1


Jan 7


Jan 15


Jan 24

We get another apogee Full Moon on the 15th, and the new moon near perigee on the 1st and the 30th. The moon will induce higher than normal tides for the first and last days of the month. Much of the USA will have a chance to see a very new moon at sunset on the 1st. The chance is better the further west you are located.

Another crescent starts the month very low in the southwestern sky. Venus appears larger than Jupiter and shows a very slim crescent. Some can even see the crescent shape without optical aid. Not me. Binoculars help, as does looking at Venus in a bright sky. By the end of the month, Venus rises before the beginning of morning twilight, the start of a long run, albeit low in the sky, through October.

Venus passes 5 degrees north of the Sun at inferior conjunction on the 11th, possibly visible for the careful, experienced daytime observer who can block out the Sun with a solid opaque object. On its way around in front of the Sun, Venus is the closest planet to Earth until Mars takes the title in late March.

Saturn is up at dawn in the southern sky, its rings tipped open 22 degrees toward us, making a magnificent view while trying to drown out the faint moons that accompany Saturn.

Jupiter steals the spotlight as Venus exits to the morning sky. Jupiter is up all night, at its closest to us for the year on the 5th. It's brighter than any of the stars and planets in the evening sky, and draws the eye to the twin brightest stars of Gemini and the nearby star clusters in Orion and Taurus. Any size telescope can tease out variations in the belts and track Jupiter's moons.

Mars gets brighter; highest near sunrise. Its reddish color makes it stand out, but it's small. Adding to the difficulty, Mars is furthest from the Sun this month. Try to see if the shrinking northern polar cap is still large enough to show up in the telescope.

Mercury makes an appearance in the evening in the second half of January. It is a poor substitute for brilliant Venus, but it's an accessible apparition for fans of the innermost planet and those who haven't seen Mercury in a while or ever.

Watch the sun rise over the landing site for Yutu, China's rover, on the Mare Imbrium, around the 11th. Can you see the faint variations in gray across the Mare showing the different lava flows? The giant impact crater, Mare Orientale, peeks over the lower left limb of the Moon a bit further than usual around the 26th, allowing us to see across the rings of mountains that mark the ripples from the asteroid that hit the Moon about 3.8 million years ago.

The Quadrantid meteor shower occurs on the night of the 3rd-4th in a dark sky, but the peak of the shower is during the American afternoon and it's a sharp peak with reduced meteors during our viewing hours.

The Moon provides close company for Jupiter on the 14th/15th. Does the furthest away full moon about midnight on the 15th/16th look further away and is it less glary? The Moon glides between Mars and Spica on the morning of the 23rd. Saturn gets a close pass two mornings later and the Moon swings by Venus on the 28th and 29th. When the Moon comes back to the evening sky, it's a thin crescent below Mercury on the 31st and above Mercury on the 1st of February.

If you can pull your eyes from Orion and his neighbors, look overhead at Auriga for the Goat. The constellation is a charioteer; the goat is one star, Capella, the brightest star in Auriga). The triangle nearby is the goat's kids. Auriga is the featured constellation in the Canadian Observer's Handbook (a very useful book for the USA, as well). Auriga has a few clusters M36, 37 and 38 worth seeing. Then slide over to Perseus for the Double Cluster and M34. Just to their south, you already know M45, the Pleiades, leading us back to Taurus. If you keep moving west, you'll get back to Cassiopeia and the galaxies in Andromeda that were the stars of the fall sky. So bundle up, lay out and tour the area with binoculars or do stand up with a wide-field telescope. If you have a dark sky, check to the north for possible aurora that occasionally are visible here. At this writing, the next solar stream is coming January 3/4.

Comet Lovejoy is still a decently bright binocular object in the eastern pre-dawn sky, falling between Hercules and Ophiuchus. It's up in a dark sky, which is great for a comet this bright. Look for a finder chart on-line, which I need to find it faster and easier. Let us not speak any more of that Christmas gift that didn't come – Comet ISON. It broke up into pieces of dust before closest approach, which made it impossible for us to see it after perihelion.

The International Space Station is also a bright morning sky object for a few minutes most mornings starting on the 7th through the end of January. China's orbiting outpost, Tiangong 1, is also a morning traveler across our skies for the second half of January peaking just under magnitude +1 on the overflights with the highest azimuth in our skies.

Highlights for the Upcoming Year

by Bob Kelly

Don't forget to look due south as the ball drops on New Years' Eve – Sirius, the brightest star in the sky, is at its highest at midnight. Try again in 12 months at the next New Years' Eve 2014.

Jupiter dominates the evening sky, with our closest approach around January 5th.

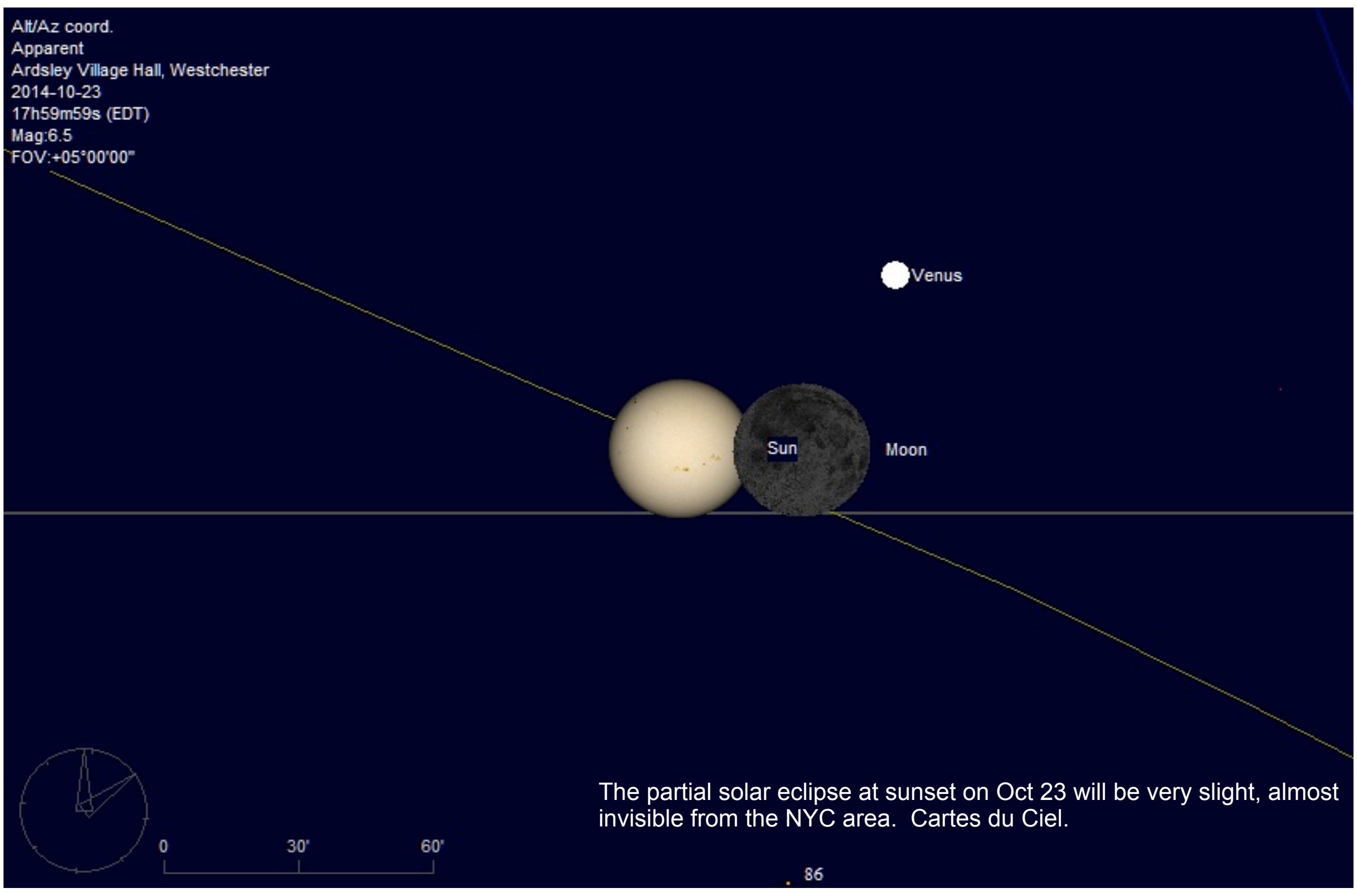
Remember Venus' long goodbye from the evening sky? In 2014, Venus seems to hover at the same distance ahead of the rising sun all the way into Fall 2014.

Mars does its version of the long goodbye in the evening sky; after staying up all night in April, it sets an hour and a half after the sun well into 2015. Mars' opposition from the Sun will garner attention with its garnet hue standing out in the evening sky. But Mars' brightness belies its small size, as even in a telescope Mars is very small.

Saturn joins the fun in the evening sky in April. April through June Saturn, Jupiter and Mars cavort across the evening sky, with Mercury joining them in May. Of the bright planets, only Venus stubbornly holds its place in the morning sky.

This year, we get two total eclipses where the Moon passes through the Earth's shadow, during prime time on the night of April 14 - 15, and at dawn on October 8th. Remember the partial eclipse of the Sun at sunrise last year? On October 23rd, we get a repeat, but with the maximum eclipse ending at sunset, and even less of the Sun will be covered when the Sun sets.

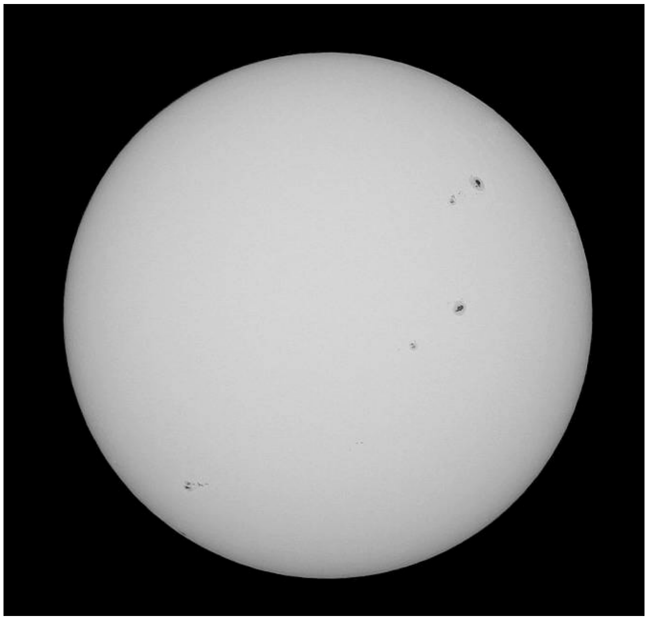
On March 20th, the NYC area gets the coolest eclipse when a 12th magnitude asteroid covers up 1st magnitude Regulus in Leo just after 2am EDT for up to 14 seconds, making the bright star seem to disappear if you are inside the 67 mile-wide shadow of the asteroid, which could be off by 13 miles or more east or west of the predicted path.



The partial solar eclipse at sunset on Oct 23 will be very slight, almost invisible from the NYC area. Cartes du Ciel.

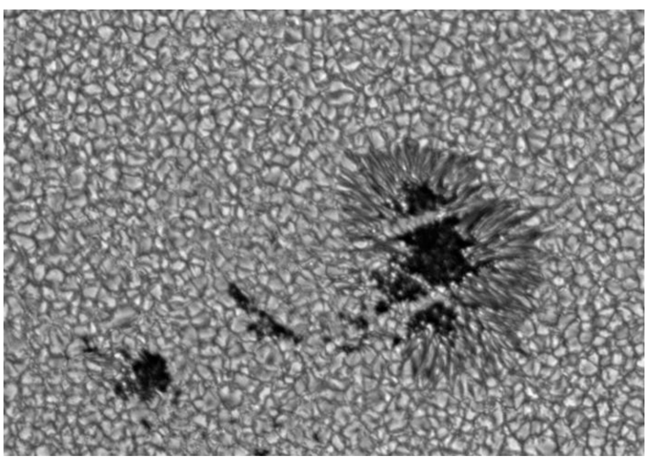
Articles and Photos

Sunspots & Solar Cycle 24
by Larry Faltz



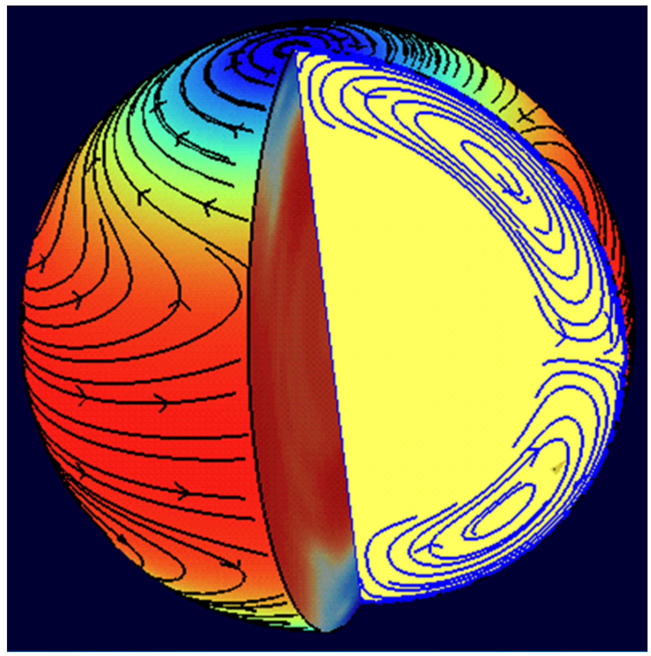
October 26, 2013, a moderately busy sunspot day (80mm f/6 refractor, mylar filter, Canon T3i, photo by the author)

We are in the middle of Solar Cycle 24, nearing or at the maximum sunspot number for this go-around. Lately the sun has been active, with a good number of sunspots and some nice prominences for viewers with hydrogen-alpha telescopes. Now is a good time to examine the solar surface (with appropriate filtering) because the prevalence of spots will soon start to diminish to a near-zero minimum around 2020. The next cycle, number 25, is predicted to peak around 2024, but may be quite underwhelming.



Solar granules surrounding a sunspot (NASA)

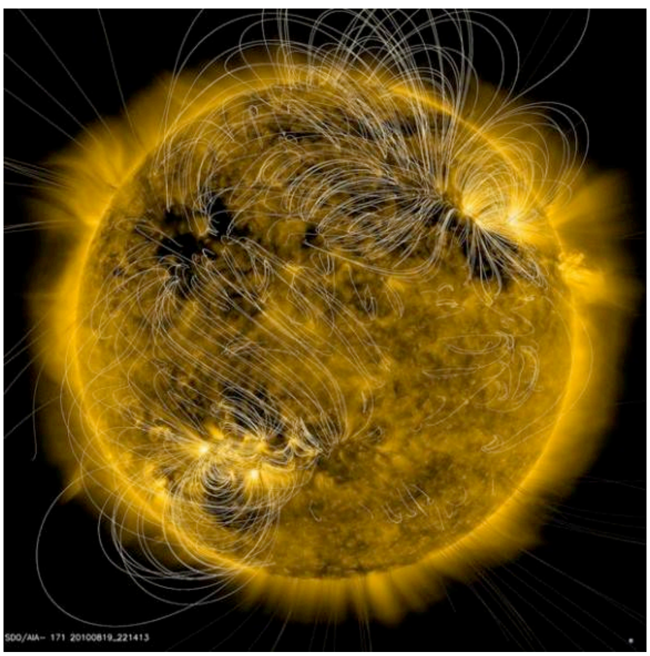
The interior of the sun can be thought of as a gigantic ball of gyrating hydrogen plasma (free protons and electrons) mixed with some helium, with a surface coating of neutral hydrogen (the photosphere) above which is a hotter chromosphere, and radiating outwards above that is the very hot but thin corona. In the solar interior, there are several distinct structural zones: the core, where fusion takes place, above it a radiative zone and under the surface a convective zone where hot plasma rises and cooler plasma sinks. This region can be thought of as being at a boil. The top edges of the boiling cells, equivalent to the bubbles at the top of a pot of boiling water on your stove, can be seen on the solar surface in white light as "granules" if you have very excellent optics and a proper filter (Herschel wedges seem to resolve these better than mylar filters in my experience).



Circulation in the convection zone of the sun (David Hathaway, NASA)

Moving electric charges create magnetic fields, which interact with the charges and perturb them even more, further exciting the magnetic field, and so on. The complexity is increased more by the fact that the sun does not rotate as a solid ball: there is faster rotation at the equator than at the poles. This is the equivalent of stirring your pot of boiling water. The ever-changing solar magnetic field lines extend outward from the surface, but occasionally as they gyrate they collapse, locally suppressing convection of hot gas up to the surface. In these areas, the temperature is a bit lower (3000-4500 °K) than the adjacent radiating surface (5870 °K) and we see these locations as black sunspots. The radiation intensity of a thermal "blackbody," such as the surface of the sun, is related to the fourth power of the temperature, as given by the Steffan-Boltzmann Law, $E=\sigma T^4$, where σ, the Steffan-Boltzmann constant, is equal to $5.6705*10^{-5}$ erg cm^{-2} K^{-4} sec^{-1}. The blackbody peak frequency is given by the Wein Displacement Law, $\lambda_{max}=(3*10^7)/T$. If the solar surface were completely covered with sunspots, it would still be as bright as the full moon, and would probably appear blood red. But contrasted with the adjacent bright surface radiating more than an order of magnitude more energy, the spots appear black to us.

Hot gas can flow along the magnetic field lines that radiate from the sunspots, giving rise to solar prominences and coronal mass ejections. These field lines extend into the corona. In addition, the rotation of the sun casts a magnetic field out into space. Charged particles emitted from the sun follow these field lines, which form a spiral in interplanetary space.

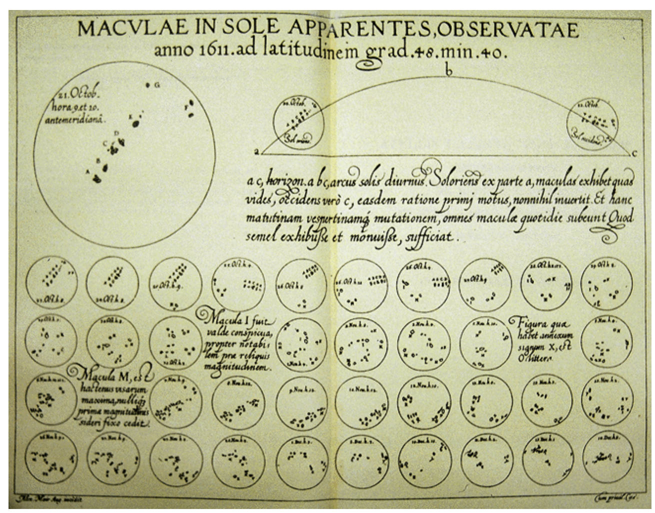


Magnetic lines on the sun, data from Solar Dynamics Observatory, 8/10/10 (NASA)

Sunspots were observed by the ancient Chinese astronomer Gan De in 364 BC, and by the Greek philosopher Theophrastus, a student of Aristotle, around 300 BC. The Benedictine monk Adelmus saw one in 807 AD but incorrectly thought he was observing the transit of Mercury. Several other medieval scholars also made observations, continuing to believe that they were planetary transits. After all, the accepted view at the time, and part of the Church's Aristotelian inheritance, was that celestial bodies were perfect and unchanging. It could simply never be imagined that the sun could have defects. How could God have made a something imperfect?

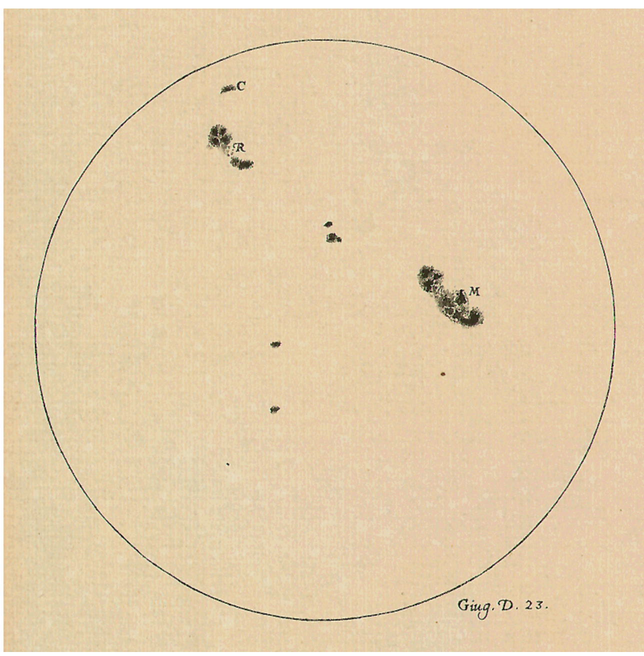
John of Worcester's drawing of sunspots, c. 1140 AD

In 1610, shortly after the invention of the telescope, the Englishman Thomas Herriott and the Frisian (Dutch-German) Fabricius brothers observed sunspots. Johannes Fabricius was first into print with *De Maculis in Sole Observatis* (On the Spots Observed in the Sun) which appeared in the autumn of 1611. Spots were also observed by Christoph Scheiner of Ingolstadt who published *Tres Epistolae de Maculis Solaribus Scriptae ad Marcum Welserum* (Three Letters on Solar Spots written to Marc Welser) in January 1612. Scheiner was a Jesuit and argued that sunspots were solar satellites, in order to preserve the "perfection" of the celestial bodies.



Scheiner's sunspots, from *Tres Epistolae* (1612)

Galileo also observed sunspots and had shown them to others by the time Fabricius' book was published, but he didn't see that work. He read Scheiner's tract shortly after it was published. He then worked with Benedetto Castelli, who invented the helioscope, a projection technique that allowed Galileo to have a much better view of the sun for longer periods than Scheiner, who had used a filter. Throughout 1612, Scheiner wrote additional reports and Galileo wrote responses in the form of his own letters to Marc Welser, a wealthy scholar and scion of a famous banking family from the important Bavarian city of Augsburg. Galileo eventually published his description in 1613 in *Istoria e Dimostrazioni Intorno Alle Macchie Solari e Loro Accidenti Rome* (History and Demonstrations Concerning Sunspots and their Properties), arguing correctly that sunspots were phenomena located on the solar surface. In response, Scheiner abandoned his view that the heavens were perfect, and eventually wrote a much longer work on sunspots, *Rosa Ursina* (The Rose of Orsini, 1626), that became a standard text for the next century. His relationship with Galileo, initially cordial, deteriorated after Galileo complained in *The Assayer* (1623) about other observers stealing his priority of discovery. He didn't mention Scheiner by name, and he may have meant someone else, but Scheiner took it personally.



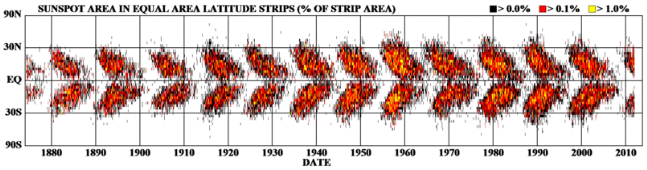
One of Galileo's drawings from a 1st edition of *Istoria e Dimostrazioni* owned by Owen Gingerich (The Galileo Project)

A helioscope is merely a telescope that projects the solar image onto a white piece of paper. Although you can do this with a small refractor, the Sunspotter folded Keplerian telescope (list price $400) is a good (and safer) way to do it. The image is 3 inches in diameter and can be viewed by several people at the same time or traced on a piece of paper.

The Sunspotter

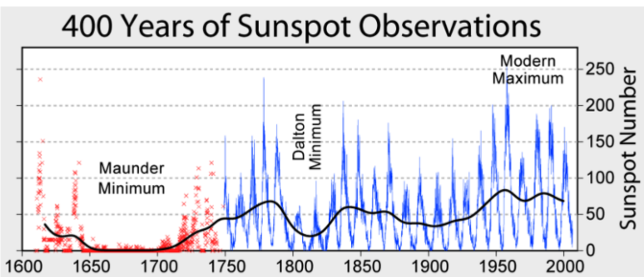
For much less money, you can get a mylar or glass filter in a cell that fits snugly over the front of your telescope. Glass filters give a yellow-orange image, while the mylar filters give a neutral image that many people prefer. Even though these filters have strong nylon thumbscrews to secure them to the front of the telescope, I always apply some tape just in case the wind picks up. Belt and suspenders, you know. The Herschel wedge is a prism/filter combination that is placed at the eyepiece end of a refractor (and *only* a refractor: it mustn't be used with any other kind of telescope). It gives a superb white-light image with good optics, but it's costly.

Get your solar instrumentation soon, because we're heading for the back end of the solar cycle and sunspot prevalence will be decreasing rapidly. Sunspots come and go in a rhythmic cycle of approximately 11 years' duration (although there can be some variation in the peak-to-peak interval). This periodicity was first recognized by Heinrich Schwalbe and later Rudolf Wolf in the first half of the 19th century. Wolf researched historical reports of sunspot activity back to the year 1700 and confirmed the 11-year cycle. Towards the end of the century, English astronomer Edward Maunder, using new photographic techniques that became available by the 1880's, noted that the latitudes at which sunspots appeared varied in a regular way over the course of the cycle. Early in the cycle, spots were more likely to be found farther away from the solar equator, and this displacement decreased, on the average, as the cycle progressed. We see this in the "butterfly diagram" which plots sunspot position above and below the solar equator at various times.

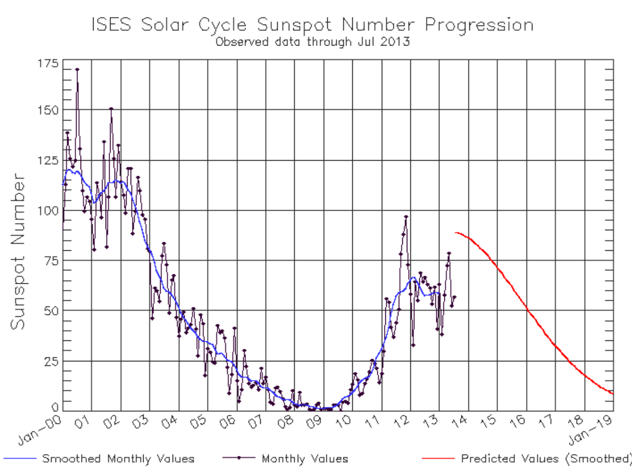


"Butterfly" diagram of sunspot positions (NASA)

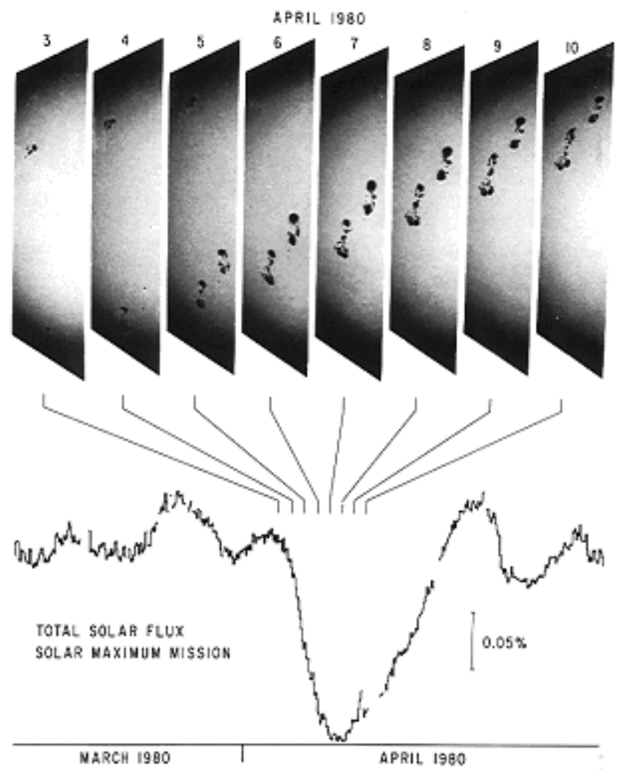
Maunder also confirmed that there were very few sunspots between 1645 and 1717, a period now known as the "Maunder Minimum". During that interval, there were few auroras and even solar eclipses lacked significant coronas.



Solar cycles are numbered starting from 1700. The past half century has been an epoch of strong maxima, with peak sunspot numbers of more than 150. The current cycle, number 24, had been predicted by NASA in 2006 to be fairly strong, with a peak number between 150 and 200 in 2011. But the arrival of a large number of spots was delayed and is only now reaching a peak, which is likely to max out at less than 100 in 2013 and 2014. There are suggestions that cycle 25 will be a real dud, and we may be entering another prolonged minimum which could last for a number of cycles.

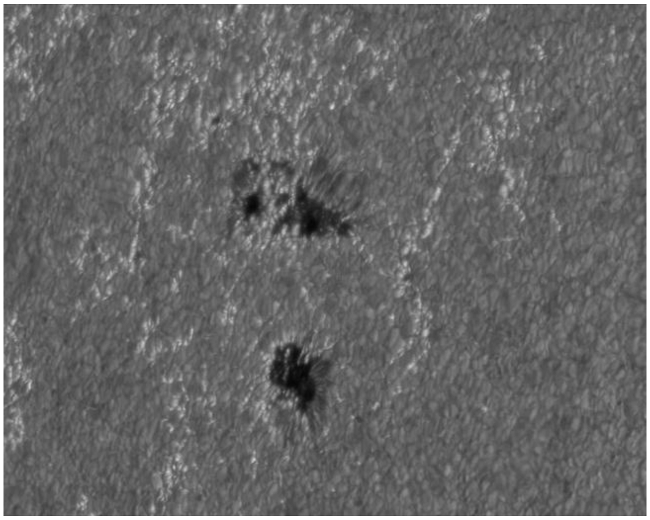


Sunspots last between days and months. They can be tracked across the sun as it rotates. There are many web sites and iPhone and Android apps that download real-time satellite images of the sun at a variety of wavelengths, so you don't have to break out your telescope and solar filter to be able to follow them. As sunspots decay, they alter the magnetic field lines. Eventually, magnetized decay products accumulate at high solar latitudes (at either pole) resulting in polarity reversal of the entire solar magnetic field. This event doesn't happen exactly at one moment or even at one place on the sun and it has to be retrospectively determined from solar magnetic observations. It appears to be in progress in late 2013. The underlying cause of the solar cycle isn't known, but two theories seem to be most favored: tidal disturbances from Jupiter and Saturn or inertial motion within the sun itself.



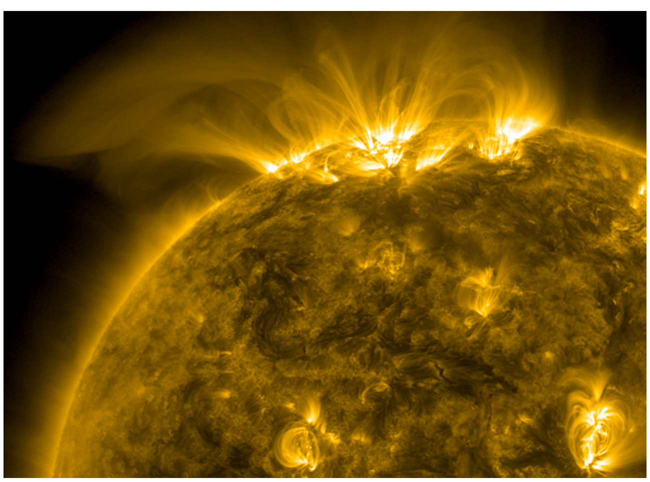
Solar Irradiance related to sunspot groups (Active Cavity Radiometer Irradiance Monitor)

Another solar phenomenon that varies with the solar cycle is solar irradiance, the amount of solar energy that strikes the upper atmosphere of Earth. Over the course of the 11-year cycle, irradiance at all wavelengths varies about 0.1%, with short-term variances caused by large sunspot groups (which decrease irradiance) and large faculae (which increase irradiance). Faculae are bright areas where the solar magnetic field is concentrated in smaller bundles than in sunspots. They make the sun appear brighter. Since they can be numerous near sunspots, they can paradoxically raise total solar brightness during the periods of sunspot maxima.



Faculae near sunspots (NASA)

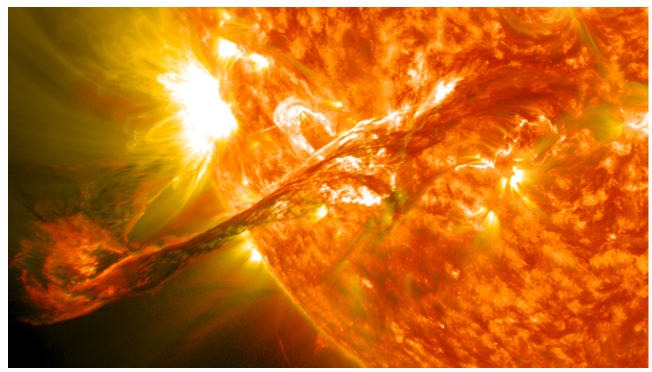
Electromagnetic emissions from the sun also vary with the solar cycle. Hotter regions emit higher frequency (higher energy, shorter wavelength) radiation and the hottest emitting regions in the sun are in the chromosphere and corona. These areas have complex and changing magnetic structure. Very high energy coronal emissions of extreme ultraviolet and X-ray radiation also vary locally over short times frames and with the 11-year cycle. The Solar Dynamics Observatory sends out continuous images of the sun in a number of energetic bands, showing the torrid solar atmosphere under the influence of magnetic fields.



The sun in extreme UV in early November 2013 (SDO)

At the other end of the electromagnetic spectrum, radio wave emission also shows periodicity over the solar cycle. Radio waves at centimeter wavelengths (measurements are made at 2800 MHz) are emitted by coronal plasma trapped and heated over active regions. There is a good correlation of this emission with solar activity, as might be expected from its source above sunspots.

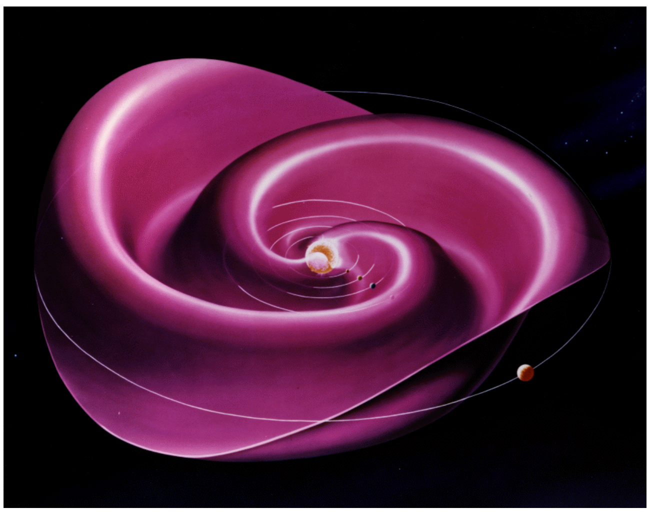
Flares and coronal mass ejections (CME) occur when the magnetic field in the corona breaks down locally. Both energy, in the form of high-frequency UV and X-rays, and matter, as energetic charged particles, are released into space. A flare is caused by release of a large amount of energy on the sun's surface, which can be equivalent to hundreds of trillions of megatons of TNT. The flare is followed by a CME which ejects massive clouds of ions, electrons, neutral atoms and electromagnetic waves into space. Even if a CME is not directed at Earth, it can connect with the magnetic environment around our planet and result in auroras and radio and power grid disruptions.



Solar flare and CME, 8/31/12 (combined 304 & 171 Å images) causing an aurora on Earth 4 days later (SDO, NASA)

Cosmic rays, charged particles originating outside the solar system moving at relativistic speeds, are diverted by magnetic field lines in the inner solar system emanating from the sun. During periods of high solar activity, with more electromagnetic energy being pushed out into the inner solar system, the rays have a tougher time heading straight at us, and so the cosmic ray flux goes down during the height of the solar cycle. Rather remarkably (and cleverly) scientists can deduce variations in the solar cycle going back 10 millennia by looking at ice cores. When high energy cosmic rays impact matter, they can create new elements by nucleosynthesis or fission, a process called "cosmic ray spallation." This is thought to be the mechanism of origin of most of the light elements (lithium, beryllium and boron) made after the Big Bang. In the solar system, atoms such as tritium, aluminum, carbon-14, chlorine, iodine and neon can arise by cosmic ray spallation, and can be used to date the origin of meteorites. The concentration of ^{14}C and ^{10}Be at different depths in ice cores resulting from cosmic ray spallation in the Earth's atmosphere at different times in the past suggests that recent solar activity has been among the highest in 10,000 years, and that there have been many Maunder minima over that time.

Emanating from the solar equator throughout the entire heliosphere is a structure called the heliospheric current sheet, a tiny electrical current (10^{-10} amps/meter^2) that is powered by the rotating solar magnetic field. This structure, the largest in the solar system, influences the paths of the outgoing solar wind and incoming cosmic rays. When the polarity reverses, the structure of the heliospheric current sheet becomes more complex. This actually has a beneficial effect on the Earth by increasing the interaction with incoming cosmic rays, diverting them and perhaps even slowing them down.

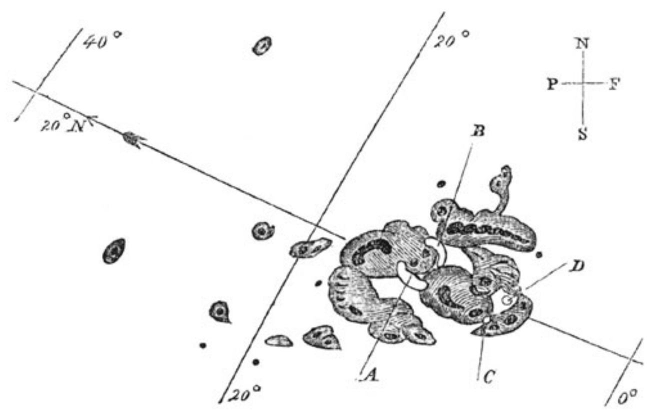


The heliospheric current sheet (NASA)

The impact of the solar cycle on terrestrial climate is less clear. Decreased particle flows during periods of low solar activity reduce the ozone concentration in the atmosphere, which can increase UV transmission to the surface. This has potential biologic impact, but not necessarily an impact on weather itself. The small (0.1%) reduction in solar irradiance difference between solar maximum and minimum probably alters global temperatures by about 0.1°C. Changes in cosmic ray flux might impact the amount of cloud cover on the Earth, which certainly could have weather and biologic/geologic impacts.

Transient solar electromagnetic phenomena are most commonly experienced as the *aurora borealis* or *australis*, as disruptions in the radio band or in the extreme case as damage to the electrical grid following coronal mass ejections. During the maxima of the solar cycle, there is increased ionization in the ionosphere, which can alter the propagation of radio waves, sometimes enhancing and sometimes disrupting communications, particularly in marine and aircraft communications bands.

On September 1, 1859, an enormous solar flare was observed by English astronomer Richard Carrington. By that night, numerous auroras were seen around the world, as far south as Cuba and Hawaii. Telegraph systems across Europe and the US failed, some operators receiving electric shocks in the process. Compasses and other instruments were affected. A similar Carrington Event, so-called, is expected to occur about once every 500 years (which doesn't mean it can't happen tomorrow!). Less intensive storms in 1921 and 1960 caused widespread radio interference, and on March 13, 1989 power was knocked out in the northeast US and Canada by a CME. In 2013, it was estimated that a Carrington Event-sized disruption would cost the world economy at least $2.6 trillion.



Carrington's drawing of sunspots on Sept. 1, 1859. They changed over a period of 5 minutes.

Satellites and astronauts are particularly vulnerable since shielding needs to be minimized on spacecraft to save launch weight. The effect of a coronal mass ejection is a critical plot element in the worthwhile space movie *Europa Report* (2013). NASA has addressed the risk to the power grid with its satellite-based "Solar Shield" forecasting system, which is still considered experimental. Recent assessments suggest the power grid is more vulnerable than ever due to its complexity and society's widespread dependence on electric power.

Were a Carrington Event to occur, society would go crazy, but I suppose that amidst the chaos of an electrically bereft planet at least we'd have auroras, followed by dark night skies, to be enjoyed by urban and suburban amateur astronomers whose hobby suffers from the light-pollution that attends modern progress.

Some Thoughts on Comet ISON C/2012 S1
by Larry Faltz

Friends, Astronomers, WAA'ers, lend me your ears;
I come to bury ISON, not to praise him.
The evil that comets do lives after them;
The good is oft interred with their bones;
So let it be with ISON. The noble Bortle
Hath told you ISON was ambitious:
If it were so, it was a grievous fault,
And grievously hath ISON answer'd it.
Here, under leave of Bortle and the rest--
For Bortle is an honourable man;
So are they all, all honourable men--
Come I to speak in ISON's funeral.
He was my friend, faithful and just to me:
But Bortle says he was ambitious;
And Bortle is an honourable man.
He hath brought many captives home to Astronomy vendors
Whose ransoms did the general coffers fill:
Did this in ISON seem ambitious?
When that the poor have cried, ISON hath wept:
Ambition should be made of sterner stuff:
Yet Bortle says he was ambitious;
And Bortle is an honourable man.
You all did see that on the Internet
I thrice presented him a kingly crown, calling him "Comet of the Century",
Which he did thrice refuse: was this ambition?
Yet Bortle says he was ambitious;
And, sure, he is an honourable man.
I speak not to disprove what Bortle spoke,
But here I am to speak what I do know.
You all did love him once, not without cause:
What cause withholds you then, to mourn for him?
O judgment! thou art fled to brutish beasts,
And men have lost their reason. Bear with me;
My heart is in the coffin there with ISON,
And I must pause till it come back to me.

(Apologies to Shakespeare and comet expert John Bortle, who really is an honourable man!)

It's been a while since we've had a beautiful comet, so anticipation for ISON was enormous even though it was to be a morning object. Morning comets are generally appreciated only by astronomy enthusiasts, the marginally interested being relatively unwilling to get out of bed just to see a blotch in the sky. I recall getting up excitedly at 3 am in March 1976 to see the glorious Comet West over my house in Bethesda, Maryland. West was one of the brightest comets ever, but coming three years after the over-hype of Comet Kohoutek, the media was having a big yawn and so there was little of the breathless daily reportage that surrounded ISON.

Comet West in March 1976

Evening comets in the last 15 years haven't been much of a show either, because they were unfavorable for the northern hemisphere (for example McNaught in 2006) or simply because they didn't live up to their brightness predictions (PanStarrs in 2013). Most of us remember the two wonderful evening comets in the 1990's, Hyakutake and Hale-Bopp. They passed fairly close to Earth and were ideally positioned in the evening sky early in the year for our hemisphere (Hyakutake in March 1996, Hale-Bopp in March 1997).

Comet Hale-Bopp in March 1997

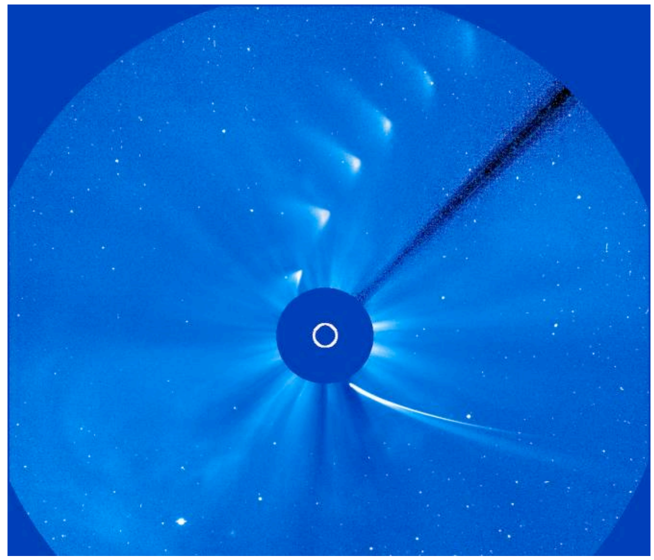
Growing light pollution means that comets have to be extremely bright for anyone living in civilization to see them. Predictions for ISON were based on its brightness at discovery on Sept. 21, 2012, when its apparent magnitude was 18.8, which suggested it would be very bright when it entered the inner solar system, and it quickly got hyped to "Comet of the Century," although the possibility that it would be a bust was always acknowledged (but like the details in an advertisement, relegated to the easily-ignored fine print). We all really wanted to believe.

Two objective pieces of data should have been taken seriously. Early estimates of the size of its nucleus ranged from 0.8 to 5 km, with the smaller measurements coming later and from more accurate space-based telescopes. It was clear from the orbital elements that it would pass extremely close to the sun, just over 1.1 million miles from the solar surface (less than one solar diameter), so the possibility of tidal disruption, or even a crash right into the sun like so many other sun-grazers, was highly likely, especially if the nucleus was 2 km or less.

ISON on November 15, 2013

In early November ISON didn't brighten as expected, and it remained a telescopic object with a tiny tail. I observed it on November 20th from Manor Park in Larchmont on a frigid morning at 5 am. With 9x60 binoculars it was a tiny, fuzzy bluish star about magnitude 5.5 halfway between Mars and Spica. It never brightened much beyond that until about 2 days before perihelion (November 28th) when it was essentially impossible to see visually because of the sun's glare. When it entered the field of the LASCO C3 camera aboard NASA's Solar and Heliospheric Observatory, interest was so great their web site slowed down.

Popular interest in ISON stimulated NASA to hold a live webcast at perihelion on November 28th with comet experts and live images from the LASCO C2 camera, which was expected to show the nucleus rounding the sun. But nothing was to be seen. ISON had broken up. Coming out the other side, its remnants were seen as a fading smudge in the wider-field C3 camera. It reached the edge of the camera's field on November 30th. NASA officially declared it disrupted, but some observers were still reporting sightings of the faint nucleus, sans tail, in early December.



Composite of SOHO LASCO C3 coronagraph images of ISON at and after perihelion (Nov. 28-30th)

As an Oort Cloud object making its first (and only) pass through the solar system, ISON was never likely to survive its trip. It wasn't large enough and, like the mythical Icarus, it came too close to the sun. Born 4.5 billion years ago at a distance of perhaps 50,000 astronomical units (~1 light-year), ISON was sent sunward about a million years ago most likely from the gravitational perturbation of a passing star. It's sad to think that it made that enormous journey for nothing. But that's the way the comet crumbles.

Although bright comets are rare, telescopic ones aren't, and even when ISON was unjustifiably capturing the public's attention, many amateurs were observing Comets Lovejoy and Encke in the same part of the sky, although they still required binoculars or a telescope. Dark clear skies always help. There is almost always a comet somewhere in the sky. You can find a list of the brightest currently visible comets, with finder charts, at:

- http://www.aerith.net/comet/weekly/current.html
- http://www.heavens-above.com/ (click on "Comets" on the left-side menu).

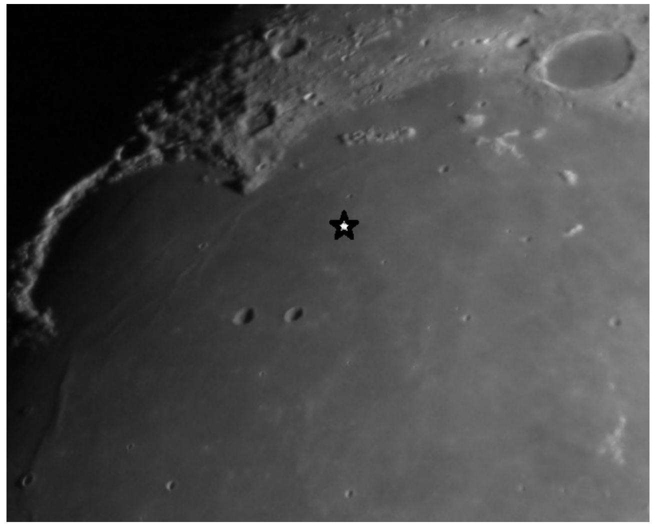
A Jade Rabbit Roams the Moon's Sea of Rains
by Bob Kelly

Ever look at a full moon and see a jumping rabbit? In China's mythology the rabbit is a friend of the moon goddess Chang'e. China's moon exploration program took a leap forward when the Chang'e 3 spacecraft landed a rover "Jade Rabbit" ("Yutu") on the moon in December. The Jade Rabbit is solar powered with small radioisotope heaters to help it survive the 14-day lunar night.

The location in Mare Imbrium where Chang'e landed is in the northern part of the dark Mare. This region is where two different shades of gray meet. Scientists are hoping that the Jade Rabbit's ground-penetrating radar might be able to see the layers underground and learn more about the history of the gargantuan lava flows that coursed across the moon billions of years ago.

Area of Mare Imbrium where Chang'e 3 landed (upper left or northwest corner of the moon)

Yutu has cameras for photographing the lunar surface and an Ultraviolet Telescope (LUT) and an Extreme

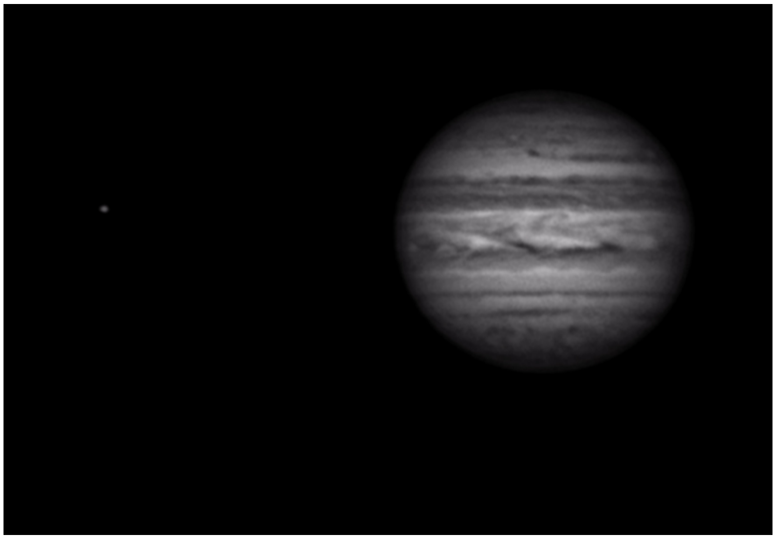


Excerpt from larger photo of the moon to show the landing location. Note the subtle changes in Mare darkness just to the east of the landing area. Photo: 8-inch dobsonian,

Ultraviolet Imager (EUV). The LUT will look at celestial objects to measure their variability in the ultraviolet part of the electromagnetic spectrum. EUV will watch the Earth's ionosphere for changes related to space weather. The earth is always visible from this side of the moon, making it easier to track.

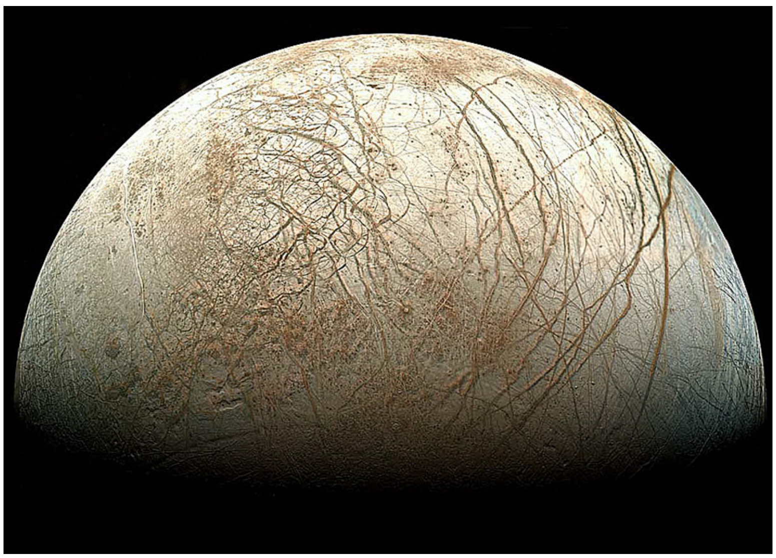
There's a good article on the Chang'e 3/Yutu at http://www.nasaspaceflight.com/2013/12/china-jade-rabbit-lunar-arrival/

Westchester Amateur Astronomers



◀Jupiter

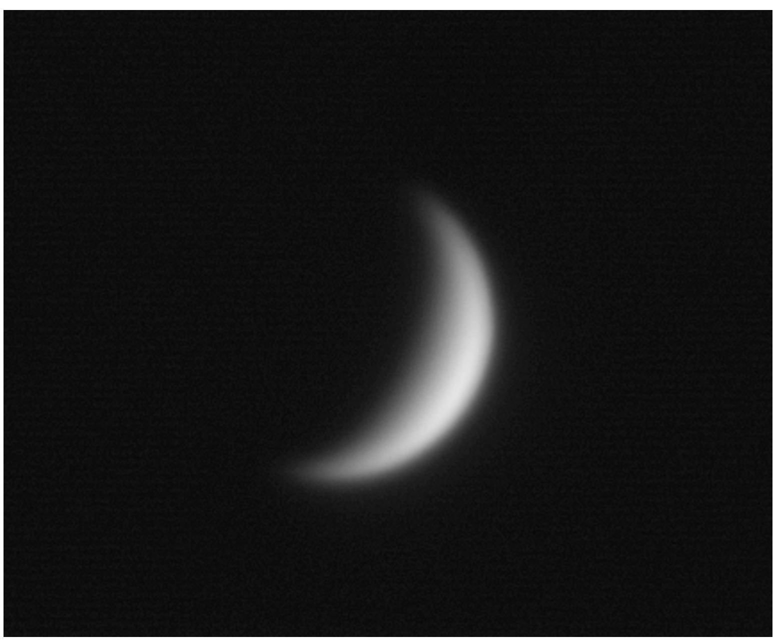
John Paladini used a Chameleon Point Grey camera (black and white) and an a Celestron 9.25 SCT to capture this image of Jupiter. He took the picture through a red filter.



◀Gibbous Europa

Although the phase of this moon might appear familiar, the moon itself might not. In fact, this gibbous phase shows part of Jupiter's moon Europa. The robot spacecraft Galileo captured this image mosaic during its mission orbiting Jupiter from 1995 - 2003. Visible are plains of bright ice, cracks that run to the horizon, and dark patches that likely contain both ice and dirt.

Image Credit: Galileo Project, JPL, NASA; reprocessed by Ted Stryk



◀Daytime Venus

Larry Faltz used an Orion 127 Mak-Cass (1540 mm FL/ f/12.1, no Barlow) on an iOptron Minitower, and a Celestron NexImage 5 camera to capture this daytime image of Venus.

Notes Larry: The image was jumping like crazy, so I took only 125 of 2500 frames from this particular avi pass. No wavelets...that seemed to bring out a lot of noise and artifact.