December 2007

The Observer

East Valley Astronomy Club

Volume 21 Issue 12

Inside this Issue:

From the Desk of the President
by Claude Haynes

Comet Holmes is rapidly fading and so is this year. It seems to have passed so quickly. Congratulations to our new slate of officers elected at the November meeting. I look forward to another great year for EVAC. There were many highlights in 2007. We celebrated Astronomy Day in conjunction with the Riparian Institute, passed the mark of over 10,000 visitors to the Observatory, hosted over 25 school and organization star parties, assumed responsibility for the monthly Sky Watch lectures at the library, agreed to serve as financial agent for the Burnham Memorial Fund and had a beautiful weekend of observing at the All Arizona Star Party. With that many achievements, we deserve to have a party!

Join us on December 21 at 7:00pm in the meeting room of the Southeast Regional Library in Gilbert as we celebrate Sol Invictus with a potluck dinner. EVAC will provide the drinks, tableware and a platter of meats and cheeses. Please bring an entrée, side dish or dessert to share and celebrate the feast of the unconquered sun, and the unstoppable East Valley Astronomy Club.

Have a wonderful holiday season - make a wish on a star!

Claude Haynes

The Backyard Astronomer
I Love Mare Imbrium *by Bill Dellinges*

Sometimes we hate the Moon for spoiling our dark night sky. But three positives pop into mind concerning old Luna: A) It looks cool hanging there in the sky (day or night), B) Its presence is an excellent excuse to take a night off from observing, C) For the interested observer armed with a telescope, the Moon – due to its closeness - offers more detail than any other object in the firmament.

At one time or another, every stargazer has perused the surface of the Moon with his telescope and marveled at its wealth of craters, mountains, maria, and rilles. That observer has also been, no doubt, intrigued by how shadows cast by craters and tall peaks change from night to night, bringing a kind of life back to an otherwise deceased orb.

I suspect most of us have a warm spot in our hearts for some favorite section of the Moon, a special area they keep going back to. For me, it has to be Mare Imbrium (The Sea of Rains). On a lunar map with north up (which puts the heavily cratered "Highlands" at bottom), the upper left quarter of the map pretty much encapsulates Mare Imbrium. Let's take a tour around this interesting region and see what we can find. A photograph of this region can be found at: Nov. 2007 S&T, p.64; Charles Wood's Modern Moon, p. 26; and Rukl's Atlas of the Moon, p. 22.

Mare Imbrium is prominently circular. Seeing it as a clock, we'll start at one o'clock with one of the most distinctive craters on the Moon, Plato. The two conspicuous things about this 63 mile diameter crater are its smooth floor devoid of a central peak, and noticeably oval shape. The former resulted from lava filling the crater after its formation; the latter is consistent with all craters near the edge of the Moon, a foreshortening due to perspective. This is a good time to point out an interesting aspect of crater morphology. Craters less than

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Upcoming Events:

Local Star Party at Boyce Thompson – December 1

Lecture: Origin of Solar System at ASU Polytechnic – December 3

Deep Sky Star Party at Vekol Road – December 8

Public Star Party in Gilbert – December 14

Sol Invictus Potluck – December 21

Local Star Party at Boyce Thompson – December 29

The Backyard Astronomer

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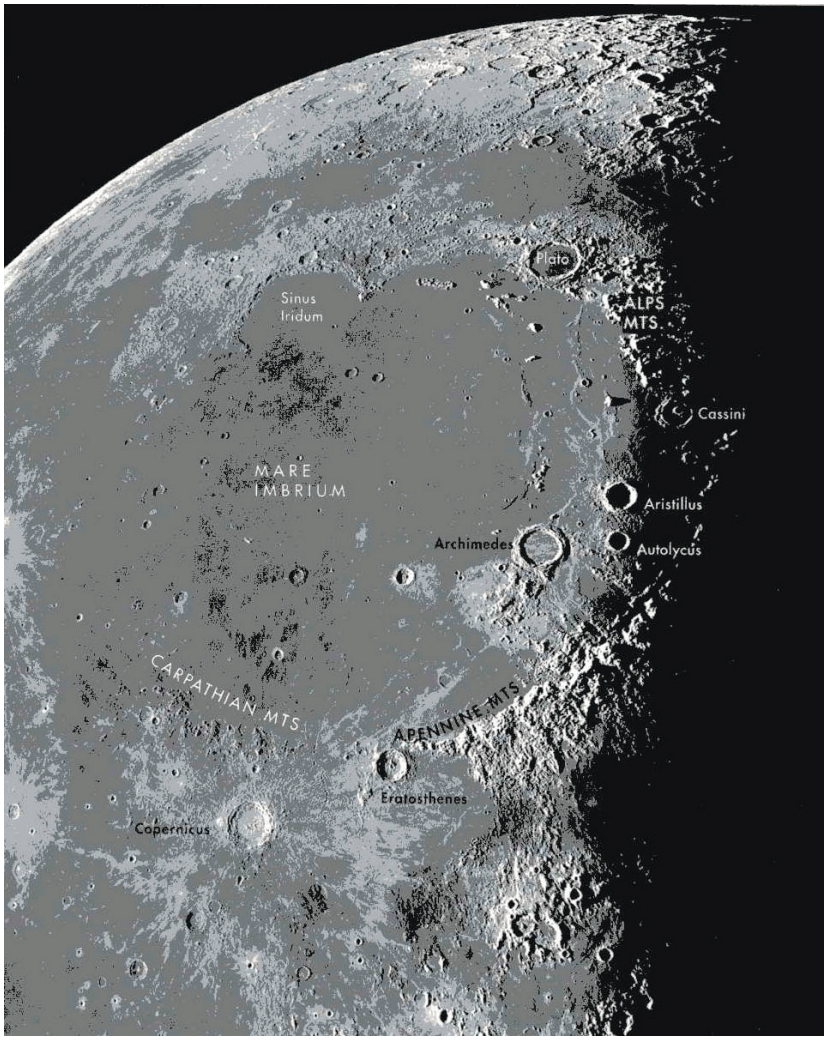
10 miles in diameter generally do not have central peaks. So where is Plato's central peak? Some time after Plato formed, magma (lava) rose through cracks in the crater's floor to a level that just covered its central peak.

While there are many small craters on Plato's floor, the largest four ranging in size from 1 to 1.6 miles (1.3 arcseconds) in diameter are an interesting challenge for small telescopes. On a recent night I could pick out two of the craters in my 11" SCT at 200x (but just barely and in moments of good seeing). How many can you pick out?



Moving clockwise from Plato, we run into the Alps Mountains. The range varies in height from 6,000 feet to 11,500 feet. Perhaps more famous than the Alps is the Alpine Valley which runs through this range. This is one of the more noteworthy 'scars' on the Moon. Running east – west for 119 miles the 6 mile wide valley is believed to be a graben, a down – faulted crust. On the southern end of the Alps sits Cassini, a 36 mile diameter crater with rather shallow 4,000 foot high walls. Interestingly, there are two craters within Cassini that give it an odd appearance. Their diameters are 5.6 and 9 miles.

Here we find a break in the continuing circular eastern half of Mare Imbrium. The Caucasus Mountains begin east of Cassini but show a 30 mile gap between both the Alps to its north and the Apennine Mountains to the south. More troublesome is the fact they run northeast to southwest, a departure from the gentle arc of Mare Imbrium. However, as we shall see, this anomaly is small potatoes compared to the missing part of this arc on the western side of Imbrium.

Next up on our great circle route at four o'clock is the grand Apennine Mountain Range, the tallest 'mountains' on the Moon. But these mountains, ranging up to 16,500 feet above the maria are not true mountains produced through plate tectonics but actually part of the crater rim of a huge impact basin – for Imbrium is really a very large crater, as are most maria. It must have been one heck of an impact! It happened early in the Moon's existence, and later was flooded with lava. On the northern end of this range, look for a little bay adjacent to Mount Hadley, where maria has intruded and made a little notch in the range. On its floor is Hadley Rille, a half mile wide (0.4") lava channel, looking like a hairline crack. I can see it with the 11" at 200x (better at 280x). In 1971, Apollo 15 landed near here (First mission to use a lunar rover).

Abutting the Apennines are the three primary craters residing on Mare Imbrium, Archimedes (52 miles wide, 5,000 feet deep), Autolycus (24mi/11,200'), and Aristillus (34mi/11,800'). To me, these three craters and the Apennines have always been the signature landmarks of Mare Imbrium. Archimedes lacks a central peak; like Plato, it has been flooded with lava - its central peak buried forever. Between these craters and Plato to the north are two intriguing spires punching through the maria that cast long pointed shadows, Pico (8,000') and Piton (7,400'). The former is below Plato, the latter west of Cassini.

Continuing to follow the southwestern arc of the Apennines, the range tapers to an end at Eratosthenes, a 36 mile diameter symmetrical crater with a central peak and depth of 11,700'.This crater fascinates me because of the graceful way the Apennines' thinning mountains seem to wrap themselves around it as they peter out. It's as if the crater is a period at the end of a sentence.

At our six o'clock position we find what I think is the most beautiful crater on the moon – Copernicus. It has everything you'd want in a crater: size – 58 miles, depth – 12,300' (whoa!), inner terraced walls, central peaks, rays (some over 400 miles long), numerous surrounding craterlets from ejecta, and a volcanic dome area to its southwest. Copernicus has a commanding presence. Whether looking at a map of the moon or the real thing, one's eyes are invariably drawn to it. Resistance is futile.

What is its secret? Youth. Since Copernicus is less than a billion years old, not enough time has passed for it to degrade or be smothered by subsequent impacts.

Except for the modest Carpathian Mountains to the north of Copernicus, the arc of Mare Imbrium suddenly ends. There is a large gap, from seven o'clock to about ten o'clock that astronomers can't explain. Oh well, let's move then!

Next up – and our last stop on our great circle route is Sinus Iridum, the Bay of Rainbows. This half-moon shaped bay is actually a 163 mile wide crater made after the Imbrium impact but before magma flooding period (which buried the central peaks of Plato and Archimedes and eventually filled Sinus Iridum). On its eastern point is Cape Laplace, an interesting looking high bright promontory. Wrapping around Sinus Iridum are the Jura Mountains, a low nondescript mountain range that represents the northwestern and northern rim of Mare Imbrium. Bounding a few more steps east in the Moon's 1/6th gravity, we're back to Plato where our journey began. We've seen some captivating things along the way. Now you may understand why Mare Imbrium holds so much allure for me. You can observe this area a day or two after first or last quarter.

Did you hear about the new restaurant on the Moon? The food is great but it has no atmosphere.

UV Radiation from the Sun

by Henry De Jonge IV

The popularity of sun tanning in the Southwest and the effects of prolonged sun exposure we see are caused mainly by UV radiation. Here is a short article on electromagnetic radiation and in particular UV radiation, produced by our sun. In future articles we will examine this topic in more detail.

UV, (ultra violet) radiation is a form of electromagnetic radiation. The full array of electromagnetic radiation is called the electromagnetic spectrum. It extends from the longest wavelength radio waves to the shortest wavelength gamma rays.

UV radiation, like all electromagnetic radiation (including light), consists of oscillating electric and magnetic fields, (waves) that move through space, (or a vacuum) at a constant speed, called the speed of light, (3 x 108 m/s). The distance between two successive wave crests is called the wavelength of the radiation and the number of wave crests, (or complete cycles of the wave) that pass a fixed point in one second, is called the frequency. This is all related in the famous equation "frequency" times "wavelength" = c, (the constant speed of light). Thus, from this equation, we see that radiation that has a longer wavelength will have a shorter frequency, and that radiation that has a shorter wavelength will have a higher frequency.

Either a wave motion or a particle motion can describe electromagnetic radiation. The particle description uses photons, which are massless bundles of energy, to describe radiation that travel through space with the speed of light. Each photon would have its own unique frequency (or wavelength), which would correspond to a unique energy. This combination of descriptions is called the wave particle duality theory of electromagnetic radiation. It is often said that electromagnetic radiation travels like a wave but interacts like a particle.

The wavelengths we are discussing here are very, very, small. If we define a nanometer, (nm) as 10-9 meter, then we would classify red light for example, as having a wavelength of about 700nm. We also can define another unit of wavelength, (or length) as the angstrom. We say that an angstrom is 1/10 of a nanometer or 10-10 meter. Scientists usually go back and forth with these units in describing electromagnetic radiation. The visible range of light is usually defined as about 400nm, (violet) to about 700nm, (red), while the UV range is defined as about 10nm to 400nm. Below the UV range are X-rays and gamma rays, while above the visible range are the infrared and radio regions.

The energy of electromagnetic radiation is also a function of its wavelength, (and therefore also its frequency) and is related by the equation, Energy = (h x c)/wavelength. Here h is a constant called Planck's constant and c is the speed of light. In terms of frequency, the energy of electromagnetic radiation is related by the equation, Energy = (h x frequency). We see for example, that red light with a wavelength of 633nm has an energy value lower than that of violet light with a wavelength of 400nm. Thus we see that UV radiation because of its higher frequency (or shorter wavelength) is more energetic than ordinary visible light. This is an important factor in discussing UV radiation. In fact when an atom absorbs the high energy UV radiation it can cause an electron to escape, and the atom is then said to be ionized. Ionization can occur when an atom either loses or gains electrons.

Radiation with wavelengths less than those of violet light is called ultraviolet radiation, (UV). It can be subdivided into 3 main bands or components (see figure 1 below). The UV-A band is roughly 315-400nm, the UV-B band is roughly 280-315nm, and the most energetic UV band UV-C, is less that 280nm. The UV-B band is the most dangerous band that can reach ground level. Lucky for us, atmospheric ozone shields us from most of the UV-B band and almost the entire UV-C band. Scattering in the atmosphere reduces UV-A and UV-B also, while cloud cover reduces all UV bands.

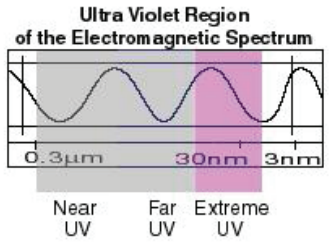


Figure 1: This shows the UV portion of the electromagnetic spectrum and the 3 UV bands.

Our sun is a fairly typical star and produces electromagnetic radiation at all wavelengths, although the peak output is in the visible region at about 555nm, (see figure 3 below). The sun also generates considerable UV radiation, (see figure 2 below).

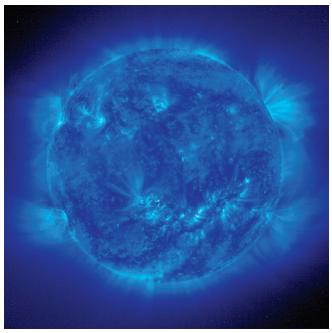


Figure 2: Here we see the sun in UV light.

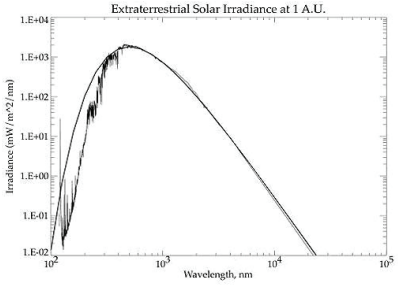


Figure 3: Here is the spectral output, (solar flux) of the sun reaching Earth's atmosphere showing the peak in the visible. The smooth curve is the ideal blackbody curve for the sun at a temperature of 5700 degrees K.

Continued on page 4

UV Radiation from the Sun

Continued from page 3

This solar output, (as in figure 3 above) is called the solar flux, which is defined as the amount of solar energy falling perpendicular to a surface of one square meter. Here we see it as milli-watts per square meter, per nanometer. The term "irradiance" is also used to describe the flux of solar radiation. We see the greatest height or intensity is in the visible range with strong side components in the UV and IR, (above and below the visible band). In fact about 99% of the total electromagnetic radiation coming from the sun is in the UV-Visible-IR region of the spectrum. This includes a bit more radiation expected in the far UV range due to temperature variations on and in the sun, as well as the absorption and emission of energy by the many chemicals on and around the surface of the sun. Overall all, UV-A, UV-B, and UV-C radiation comprise about 8.3% of the total energy output from the sun, while the critical UV-B band comprises about 1% of the solar UV band.

The radiation from the sun in the visible region and surrounding regions is fairly constant day to day. At wavelengths over 260nm the solar cycle has hardly any variable effect on our atmosphere while the stratospheric ozone layer is most affected at wavelengths near 200nm. However the radiation in the x-ray and radio regions does vary at times day to day, due to solar storms and other solar disturbances. These variations may cause large effects on the upper regions of our atmosphere.

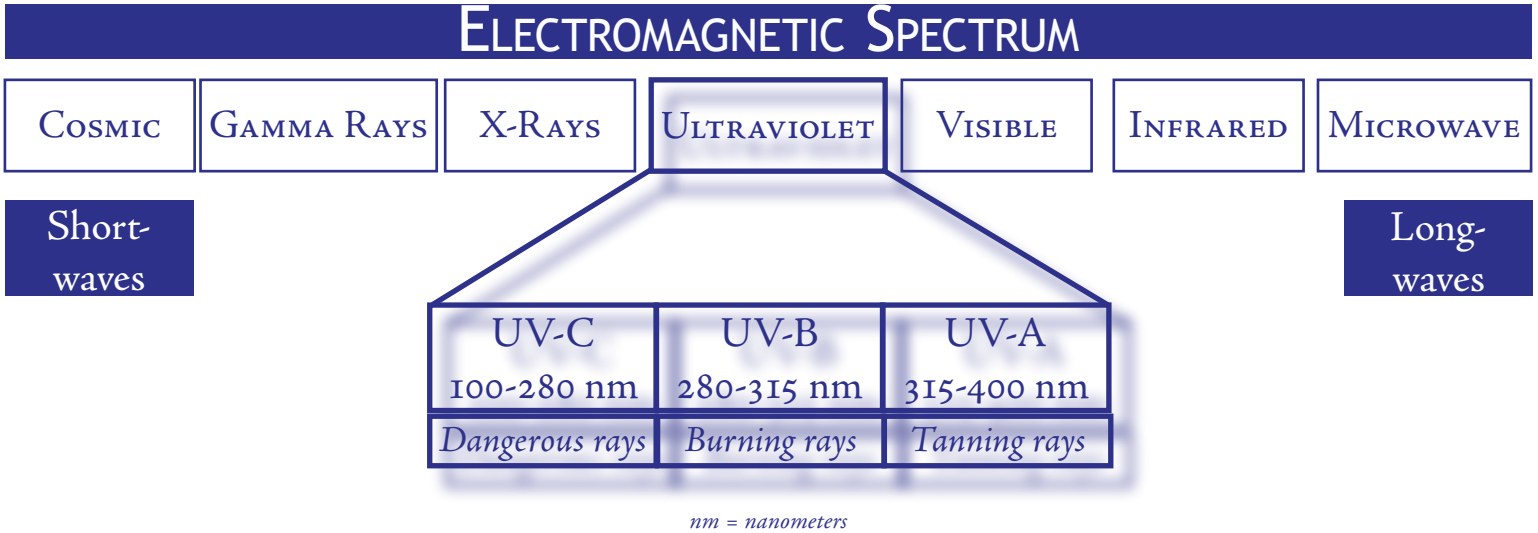
There are other causes for variations in the amount of electromagnetic energy the earth receives from the sun. The 23.5-degree tilt of the earth's axis to the plane of the ecliptic and its elliptical orbit, add seasonal changes to the solar radiation received. The radiant solar energy incident on earth above the atmosphere is about 1390 W/m2, with an annual variation of about +/- 3.5% due to the variations in the earth's orbit. This is called the solar constant. This +/- 3.5% variation is due to the earth-sun distance, (aphelion to perihelion changes in irradiance) changes which causes the southern hemisphere to receive about 7% more solar radiation, (overall) during the summer than the northern hemisphere does during the summer.

There are other variations in the solar output (and the solar constant) over time. The sun's solar rotation cycle, (27 days) with the varying temperature and surface conditions exposed to earth can cause small variations in the solar constant. The 11-year solar sun spot cycle, solar storms and flares, can also cause variations in the solar constant. Overall these factors are thought to cause no more than about a 3% variation in the output of the sun.

The variation in the solar output due to solar storms and sunspots can also affect the upper atmosphere including the ozone layer. Scientists have decided to use the changes in the radio flux of the sun at 2800 MHz, (or a wavelength of 10.7 cm) as an indicator of solar activity, especially that which may affect the ozone layer. This wavelength has a strong correlation to the sunspot cycle. Studies show that there is an ozone variation of about 5% in the upper stratosphere that is due to variations in solar output.

There are also recent discussions about the UV radiation received on earth that is produced by sources besides direct UV radiation from the sun, namely from x-rays and gamma rays produced by the sun, (especially during solar storm periods) and other astrophysical sources. These x-rays and gamma rays first produce secondary electrons by Compton scattering, (photon collisions with electrons) and x-ray photo absorption, which then ionize other atoms and molecules in the atmosphere, resulting in an aurora like spectrum which includes UV radiation. On the earth today with an ozone-absorbing shield the calculated increase in UV radiation, (UV-C and UV-B bands) is about 0.2%. This incoming ionizing radiation from outer space can also produce UV radiation, some of which can reach the surface, although it is relatively weak and not considered enough to cause any damage by exposure at present.

Thus we see that the solar output is not quite constant and has both regular and random variations. The UV radiation output can vary as well as the solar outputs in other regions, that can affect our atmosphere and in particular the ozone layer.



Robert Burnham Jr. Memorial Fund

You can be a part of history as people from all walks of life coordinate their efforts to pay tribute to one of the most influential people in amateur astronomy. The East Valley Astronomy Club is proud to serve as fiduciary agent for a drive to place a permanent memorial to Robert Burnham Jr on the grounds of Lowell Observatory in Flagstaff, Arizona. It is estimated the memorial will cost approximately $20,000. Any additional funds raised will be contributed to the Northern Arizona University scholarship fund for the benefit of astronomy students.

Robert Burnham compiled his three volume Celestial Handbook while working at Lowell Observatory as part of the Stellar Proper Motion Survey. This grassroots effort began on a Cloudy Nights discussion forum, and with the guidance of Burnham's sister, Viola Courtney, and her daughter Donna Cox, has grown to include numerous members of the astronomy community, including the honorary chairman of our fundraising committee Jack Horkheimer of the Miami Science Museum, better known for his PBS Star Gazer series.

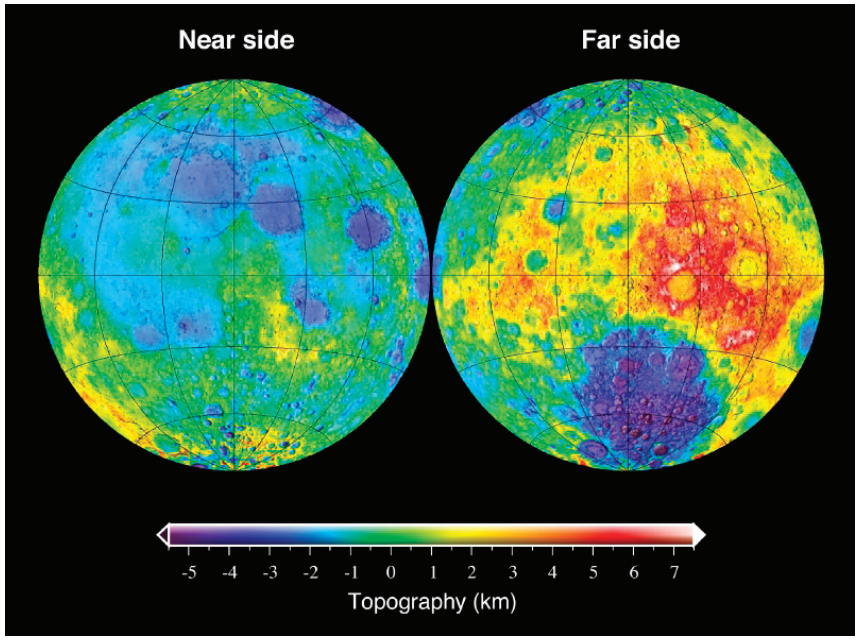
For more information on Robert Burnham Jr please visit the official memorial website www.rbjm.org .

If you wish to make an online donation, please use the PayPal link here:

http://www.eastvalleyastronomy.org/rbjm.htm

If you wish to make a donation by mail, please make check payable to Burnham Memorial Fund and mail it to EVAC, PO Box 2202, Mesa, Az., 85214-2202... or you can donate at a club meeting.

Robert Burnham Sr and Robert Burnham Jr at the telescope



The topography of the Moon referenced to the lunar geoid. The topogographic model is derived from the spherical harmonic model USGS359, and the lunar geoid was obtained from the gravity model LP150Q. The color coded topography is overlain on a shaded relief map. Image credit: Mark A. Wieczorek

Last Quarter Moon on December 1 at 05:45

New Moon on December 9 at 10:41

First Quarter Moon on December 17 at 03:18

Full Moon on December 23 at 18:16

Classified Ads

SBIG ST-402ME

SBIG ST-402ME with Class 1 sensor and CFW402 internal color filter wheel installed and a set of RGBC filters. Same Microlensed, Blue Enhanced, Full Frame KAF-0402ME CCD as the ST-7XME camera. The array is 765 x 510 pixels at 9 microns square. Peak QE is nearly 85%. Also has enhanced cooling and USB-2. Asking price $1200. Also have a set of SBIG BVI filters for photometry, $250.

Marty Pieczonka 480-983-0915
martyp@sybase.com

Your ad could have appeared here.

Contact the Editor for details.

Orion StarMax
102mm Maksutov-Cassegrain

1300mm focal length F12.7
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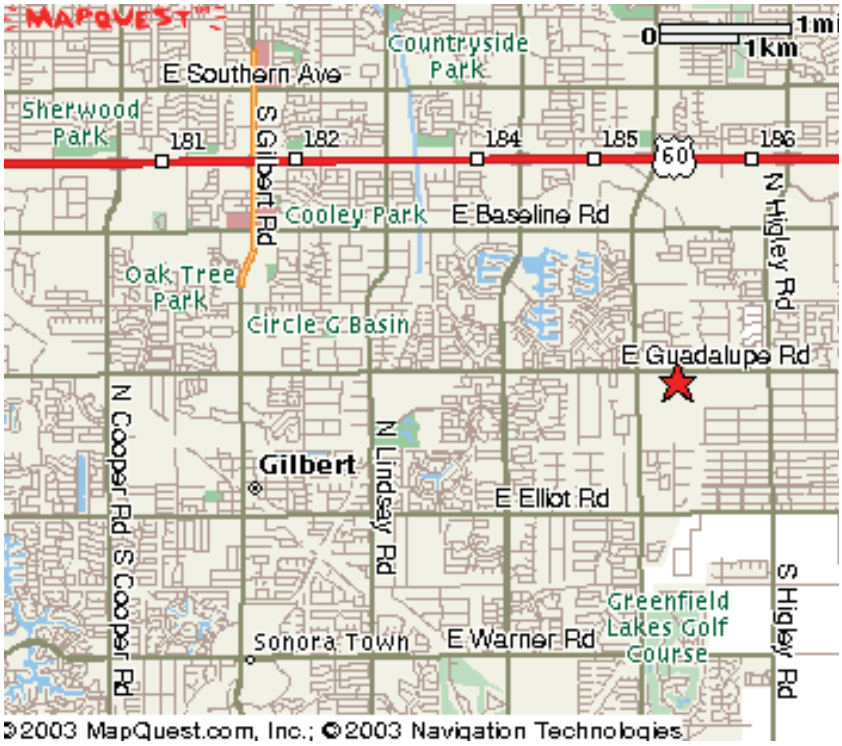
www.eastvalleyastronomy.org/grco/obs.asp



2008 Meeting Dates

January 18

February 15

March 21

April 18

May 16

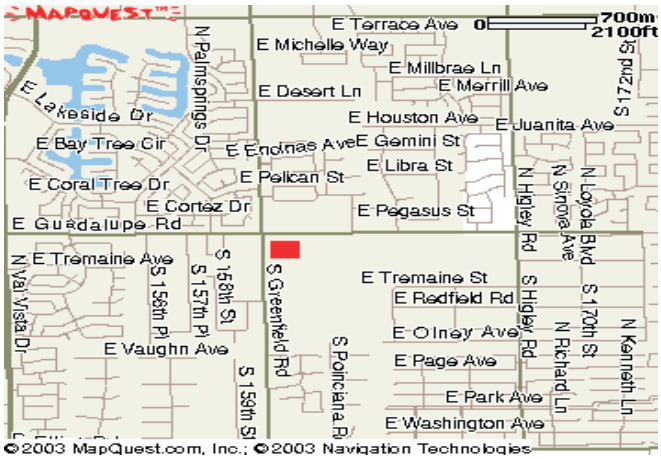
June 20

The monthly general meeting is your chance to find out what other club members are up to, learn about upcoming club events and listen to presentations by professional and well-known amateur astronomers.

Our meetings are held on the third Friday of each month at the Southeast Regional Library in Gilbert. The library is located at 775 N. Greenfield Road; on the southeast corner of Greenfield and Guadalupe Roads.

Meetings begin at 7:30 pm.

Visitors are always welcome!



Southeast Regional Library
775 N. Greenfield Road
Gilbert, Az. 85234

All are welcome to attend the pre-meeting dinner at 5:30 pm. We meet at Old Country Buffet, located at 1855 S. Stapley Drive in Mesa. The restaurant is in the plaza on the northeast corner of Stapley and Baseline Roads, just south of US60.

Old Country Buffet
1855 S. Stapley Drive
Mesa, Az. 85204

Likewise, all are invited to meet for coffee and more astro talk after the meeting at the Village Inn restaurant located on the northeast corner of Gilbert and Baseline Roads in Mesa.

Village Inn
2034 E. Southern Avenue
Mesa, Az. 85204

December 2007

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	**3**	4	5	6	7	**8**
9	10	11	12	13	**14**	15
16	17	18	19	20	**21**	22
23	24	25	26	27	28	**29**
30	31					

December 1 - Local Star Party at Boyce Thompson Arboretum

December 3 - Lecture: Origin of the Solar System at ASU Polytechnic

December 8 - Deep Sky Star Party at Vekol Road

December 14 - Public Star Party at Riparian Preserve in Gilbert

December 21 - Sol Invictus Pot Luck

December 29 - Local Star Party at Boyce Thompson Arboretum

Announcement: Sol Invictus Pot Luck

Celebrate the Solstice (and the holiday season) with a potluck dinner.
Friday December 21 at 7:00 pm in the meeting room of the Southeast Regional Library in Gilbert. This celebration is in lieu of a December meeting.
EVAC will provide drinks, tableware and a platter of meats and cheeses. Please bring an entrée, side dish or dessert, and celebrate with the East Valley Astronomy Club. Please remember that alcoholic beverages are not permitted in the facility.

The Romans held a festival on December 25 called Dies Natalis Solis Invicti, "the birthday of the unconquered sun." The use of the title Sol Invictus allowed several solar deities to be worshipped collectively, including Elah-Gabal, a Syrian sun god; Sol, the patron god of Emperor Aurelian (AD 270-274); and Mithras.
Emperor Elagabalus (218-222) introduced the festival, and it reached the height of its popularity under Aurelian, who promoted it as an empire-wide holiday.
The repoussé silver disc of Sol Invictus pictured below, Roman, 3rd century, was found at Pessinus (British Museum). December 25 was also considered to be the date of the winter solstice, which the Romans called bruma. It was therefore the day the Sun proved itself to be "unconquered" despite the shortening of daylight hours. (When Julius Caesar introduced the Julian Calendar in 45 BC, December 25 was approximately the date of the solstice. In modern times, the solstice falls on December 21 or 22.)

Image credit: Marie-Lan Nguyen

The Sol Invictus festival has a "strong claim on the responsibility" for the date of Christmas, according to the Catholic Encyclopedia. Solar symbolism was popular with early Christian writers as Jesus was considered to be the "sun of righteousness." More recent Christian sources suggest that the identification of Christ's birthday predates the Sol Invictus festival.

East Valley Astronomy Club -- 2008 Membership Form

Please complete this form and return it to the club Treasurer at the next meeting or mail it to EVAC, PO Box 2202, Mesa, Az, 85214-2202. Please include a check or money order made payable to EVAC for the appropriate amount.

IMPORTANT: All memberships expire on December 31 of each year.

Select one of the following:

☐ New Member ☐ Renewal ☐ Change of Address

New Member Dues (dues are prorated, select according to the month you are joining the club):

☐ **$30.00 Individual** January through March

☐ **$35.00 Family** January through March

☐ **$15.00 Individual** July through September

☐ **$17.50 Family** July through September

☐ **$22.50 Individual** April through June

☐ **$26.25 Family** April through June

☐ **$37.50 Individual** October through December

☐ **$43.75 Family** October through December

Includes dues for the following year

Renewal (current members only):

☐ **$30.00 Individual** ☐ **$35.00 Family**

Magazine Subscriptions (include renewal notices):

☐ **$34.00** Astronomy ☐ **$33.00** Sky & Telescope

Name Badges:

☐ **$10.00** Each (including postage) Quantity: _____

Name to imprint: _____

Total amount enclosed: _____

Please make check or money order payable to EVAC

☐ Payment was remitted separately using PayPal ☐ Payment was remitted separately using my financial institution's online bill payment feature

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Name: _____ Phone: _____

Address: _____ Email: _____

☐ Publish email address on website

City, State, Zip: _____ URL: _____

How would you like to receive your monthly newsletter? (choose one option):

☐ Electronic delivery (PDF) *Included with membership* ☐ US Mail **Please add $10 to the total payment**

Areas of Interest (check all that apply):

☐ General Observing ☐ Cosmology

☐ Lunar Observing ☐ Telescope Making

☐ Planetary Observing ☐ Astrophotography

☐ Deep Sky Observing ☐ Other

Please describe your astronomy equipment:

Would you be interested in attending a beginner's workshop? ☐ Yes ☐ No

How did you discover East Valley Astronomy Club? _____

PO Box 2202
Mesa, AZ 85214-2202
www.eastvalleyastronomy.org

All members are required to have a liability release form (waiver) on file. Please complete one and forward to the Treasurer with your membership application or renewal.

Liability Release Form

In consideration of attending any publicized Star Party hosted by the East Valley Astronomy Club (hereinafter referred to as "EVAC") I hereby affirm that I and my family agree to hold EVAC harmless from any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), which may directly or indirectly be connected to EVAC and/or my presence on the premises of any EVAC Star Party and related areas.

I further agree to indemnify any party indicated above should such party suffer any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), caused directly or indirectly by my negligent or intentional acts, or failure to act, or if such acts or failures to act are directly or indirectly caused by any person in my family or associates while participating in an EVAC Star Party.

My signature upon this form also indicates agreement and acceptance on behalf of all minor children (under 18 years of age) under my care in attendance.

EVAC only recognizes those who are members or invitees and who also have a signed Liability Release Form on file as participants at an EVAC Star Party.

Please print name here ***Date***

Please sign name here

PO Box 2202
Mesa, AZ 85214-2202
www.eastvalleyastronomy.org

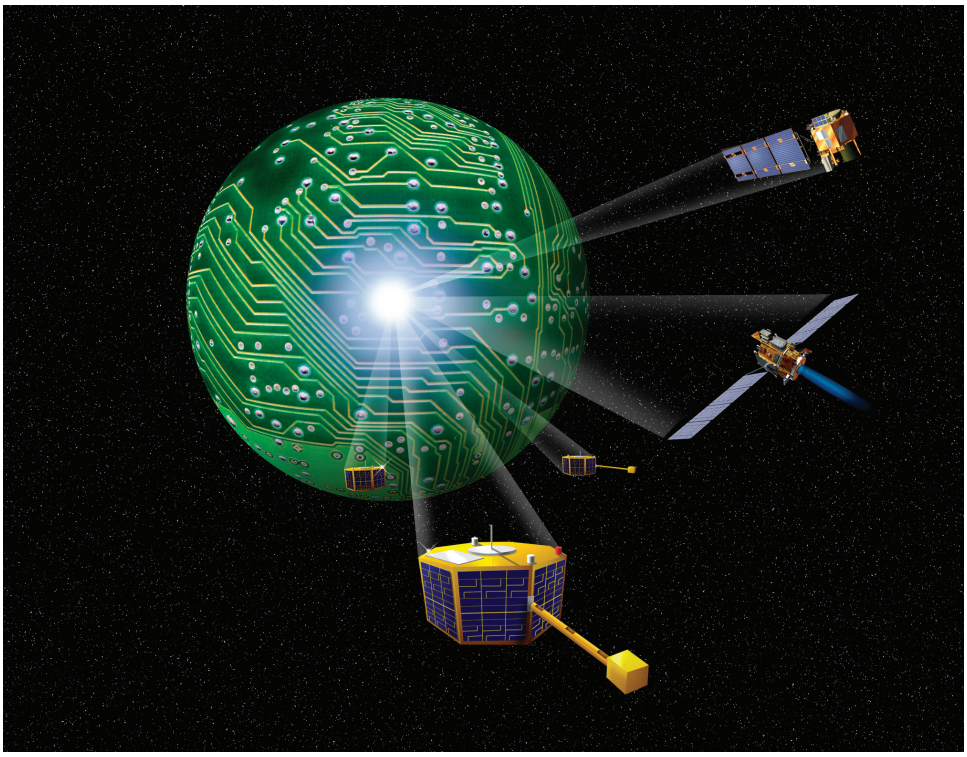
NASA's Space Place

Going My Way?
by Diane K. Fisher

Not many endeavors require that you plan the mode of transportation before you even know what it is you are transporting. But weighing the physics and economics of getting any sort of cargo to space is a major part of designing a space mission.

It's one of the first issues that NASA's New Millennium Program (NMP) considers when planning a new mission. NMP has the forward-looking job to identify promising new technologies for space exploration. It then helps to mature the technology so it will be available to space missions of the future. If the technology cannot be tested adequately on Earth, the last part of this process is to actually send the technology into space. With carefully documented test results, future mission planners can confidently incorporate the new technology into their designs.

But where to begin? On call from the start, Linda Herrell is the New Millennium Program Architect. Given a list of proposed technologies, she has the job of figuring out the feasibility of wrapping a mission around them.



NASA's New Millennium Program selects breakthrough technologies that will be of the greatest use to future space and Earth science missions and that are perceived to be risky to the first user.

"We might be considering six or more technologies, anything from solar panels to imagers to masts for solar sails to more intelligent software. Of those, we may choose four. My job is to answer the question—can the selected technology be transported to and operated in space within the constraints of a low-cost technology validation project?"

Along with the list of possible mission payloads (the technologies), Linda also has a list of spacecraft to put them on, as well as a list of launch vehicle parameters. All she has to do is try them out in every possible combination (of which there are thousands) and see what might work.

"Fortunately, we have a software tool to help with this analysis," says Linda. When it comes down to it, her job is primarily to figure out how to get the technologies into space.

"Sometimes, it's like figuring out how to get across town when you don't have your own car. You have to get creative."

She keeps a database of all possible options, including riding piggyback on another spacecraft, hitching a ride on a launch vehicle as a secondary payload, or sharing a launch vehicle with other NASA, Department of Defense, or even commercial payloads.

Her assessment is but one of a gazillion factors to be considered in planning a mission, but it is indeed one of the very first "details" that forms the foundation for the rest of the mission.

Find out some of the technologies that NMP has already validated or is considering at nmp.nasa.gov/TECHNOLOGY/innovative-tech.html. Kids will enjoy watching Linda's cartoon alter-ego talk about her job at spaceplace.nasa.gov/en/kids/live .

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

If It's Clear...

by Fulton Wright, Jr.
Prescott Astronomy Club

December 2007

Shamelessly stolen information from Sky & Telescope magazine, Astronomy magazine, and anywhere else I can find info. When gauging distances, remember that the Moon is ½ a degree or 30 arc minutes in diameter. All times are Mountain Standard Time unless otherwise noted.

December is a good month to observe Mars. On the 1st it rises at 7:14 PM and on the 31st at 4:24 PM. It is 15 arc seconds in diameter for the whole month, the biggest it will be for the next 8 years. It is also very high in the sky when it crosses the meridian. The bigger the telescope for observing, the better. See Sky & Telescope, Nov. 2007, p. 66 for details.

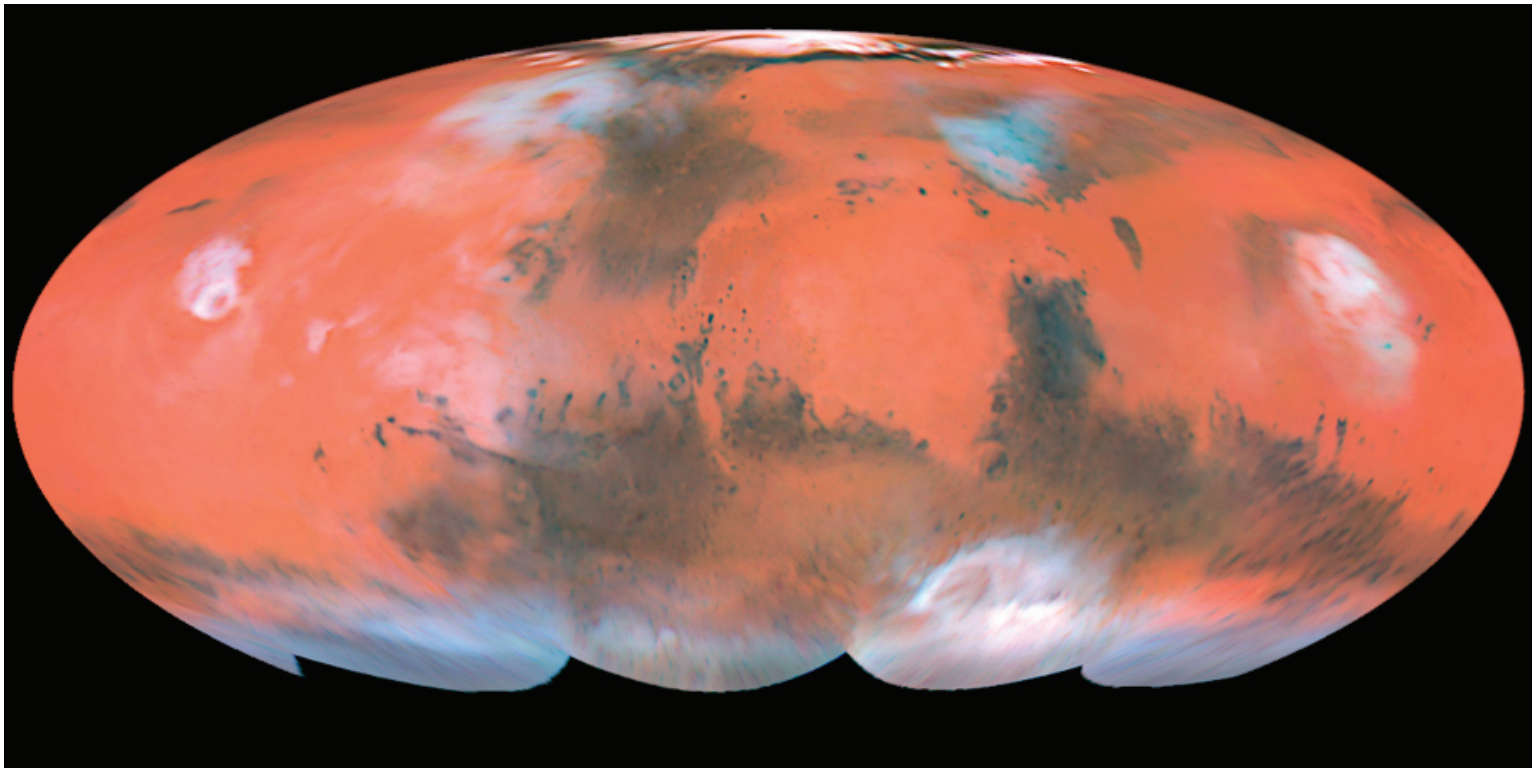
On Sunday, December 9, it is new moon so you can hunt for faint fuzzies all night.

On Thursday, December 13, you might be able to see some Geminid meteors. You could start observing as soon as it gets dark (about 6:30 PM), but the conditions will improve somewhat during the night till dawn (about 6:00 AM) interferes. Dress warmly, go to a dark site, lie down, look up.

On Sunday, December 23, you can see the full Moon near Mars. At 5:04 PM the Moon rises in the northeast. At 5:10 PM Mars rises. At 5:23 PM the Sun sets in the southwest. About 6:30 PM Mars and the Moon are closest (about 1/4 degree). No faint fuzzies tonight, but a nice conjunction.

On Wednesday, December 26, about 5:00 AM, you can see the Moon move in front of the Beehive cluster. After about 6:00 AM twilight begins to interfere. As usual, a big telescope and high power will help you see the stars in the Moon's glare.

A Global Mars Map



The four hemispheric views shown above have been combined into a full-color global map (called a Mollweide projection), showing the regions of Mars imaged by the Hubble telescope during the planet's closest approach to Earth. Latitudes below about 60 degrees south were not viewed by the telescope because the planet's north pole was tilted towards Earth during this time. This image is a composite of pictures taken with three filters: blues (410 nanometers), green (502 nanometers), and red (673 nanometers). The Hubble telescope's resolution is 12 miles per pixel (20 kilometers per pixel) near the Martian equator.

Photo Credit: Steve Lee (University of Colorado), Jim Bell (Cornell University), Mike Wolff (Space Science Institute), and NASA

National Air & Space Museum
by Peter Argenziano

The Steven F. Udvar-Hazy Center near Washington Dulles International Airport is the companion facility to the Air and Space Museum on the National Mall in our nation's capitol. The building opened in December 2003, and provides enough space for the Smithsonian to display the thousands of aviation and space artifacts that cannot be exhibited on the National Mall. The two sites together showcase the largest collection of aviation and space artifacts in the world.

The Center was named in honor of its major donor, and features the large Boeing Aviation Hangar in which aircraft are displayed on three levels. Visitors can walk among aircraft and small artifacts in display cases located on the floor, and view aircraft hanging from the arched ceiling on elevated skywalks. Many engines, helicopters, ultra-lights, and experimental flying machines are on display in a museum setting for the first time. Among the aviation artifacts on display are the Lockheed SR-71 Blackbird, the fastest jet in the world; the Boeing Dash 80, the prototype of the 707; the Boeing B-29 Superfortress Enola Gay; and the deHavilland Chipmunk aerobatic airplane.

The James S. McDonnell Space Hangar opened in November 2004 and displays hundreds of famous spacecraft, rockets, satellites and space-related small artifacts. The centerpiece of the space hangar is the Space Shuttle Enterprise. Other space artifacts include the Gemini VII space capsule; the Mobile Quarantine Unit used upon the return of the Apollo 11 crew; and a Redstone rocket.

In addition, the Donald D. Engen Observation Tower provides an excellent location from which visitors can watch air traffic at Dulles Airport.

The Center also offers an IMAX® Theater; flight simulators; food service; and a museum store.

On a recent business trip I finally got the opportunity to visit this marvelous facility. The museum is open from 10:30 am until 5:00 pm - I arrived shortly after it opened on a cold Saturday in November, and departed as the overhead speakers thanked all in attendance for visiting. Like all of our national museums, entrance to the Center is free. However, parking is $12. Still, it is quite a bargain! I encourage everyone to visit this museum the next time you find yourself in the Washington DC area.

A replica of the plaque left behind on the Moon by the crew of Apollo 11.

Spacesuit worn on the surface of the Moon by an Apollo 15 astronaut.

Big Joe, one of the unpiloted Mercury capsules used for testing systems before the first Mercury flight. Project Mercury was the first human spaceflight program of the United States. It ran from 1959 through 1963 with the goal of putting a man in orbit around the Earth.

Continued on page 15

Deep Sky Object of the Month

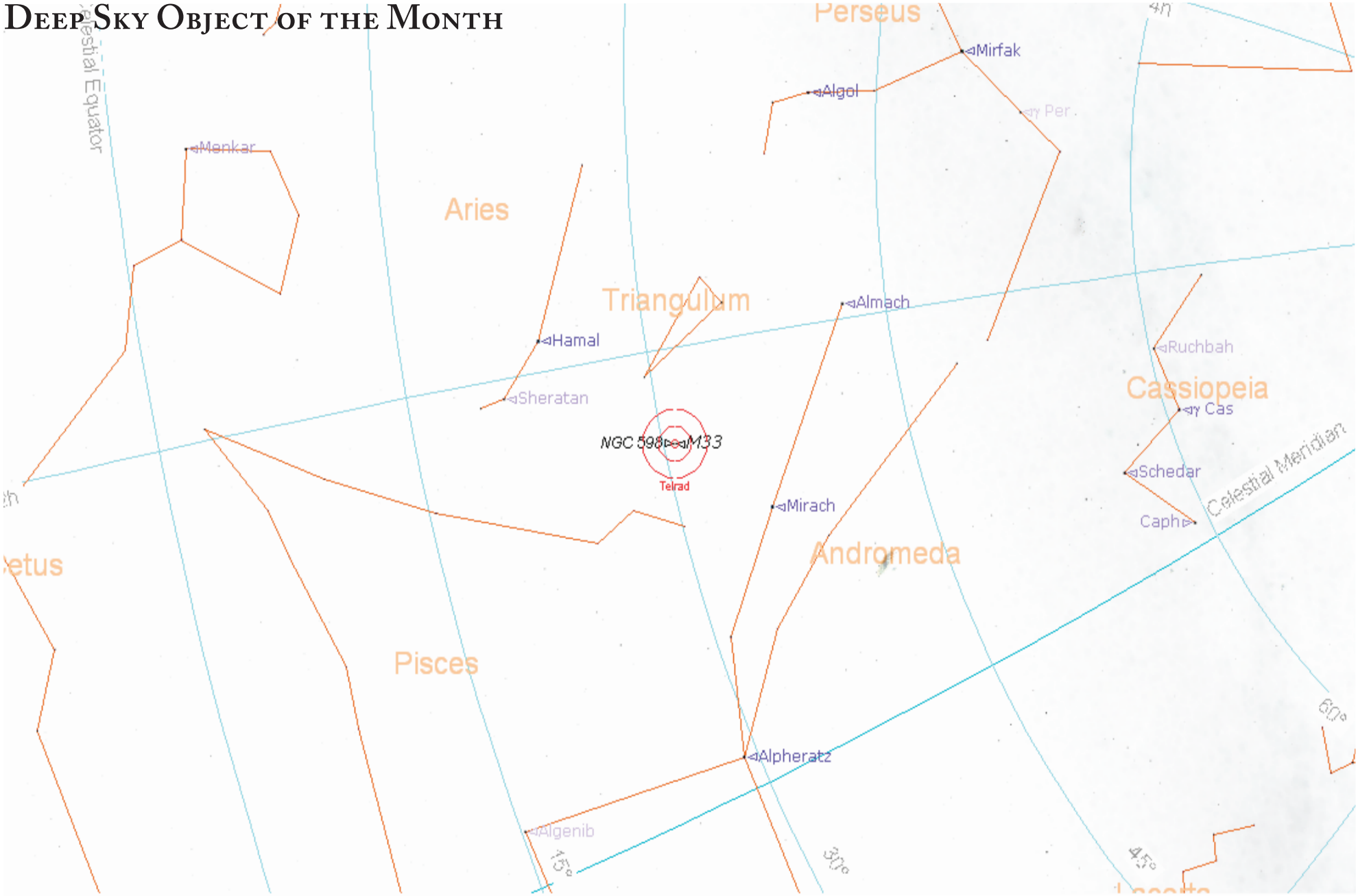
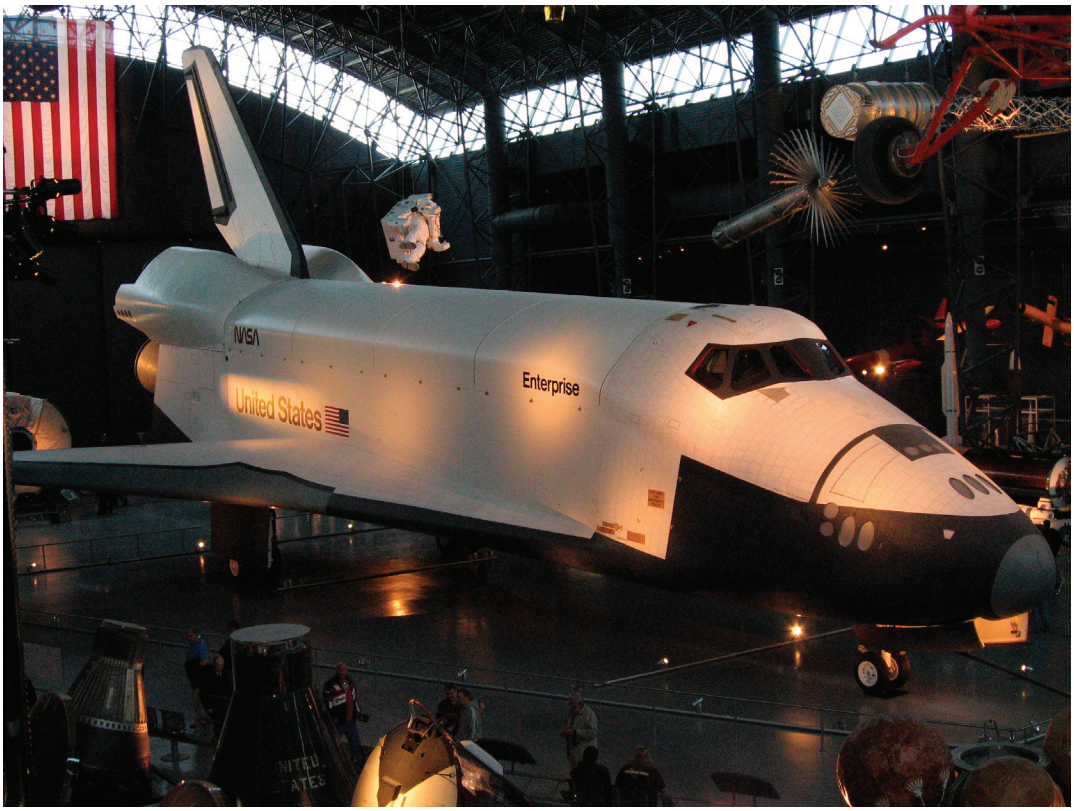


Chart generated with Starry Night Pro

NGC 598 (M33 Triangulum Galaxy) Spiral Galaxy in Triangulum

RA 01h 33m 51s DEC +30° 39' 37" Size: 66.1' x 39.8' Magnitude: 6.3

Continued from page 13



The space shuttle Enterprise is the centerpiece in the James S. McDonnell Space Hangar.

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Keep Looking Up!

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