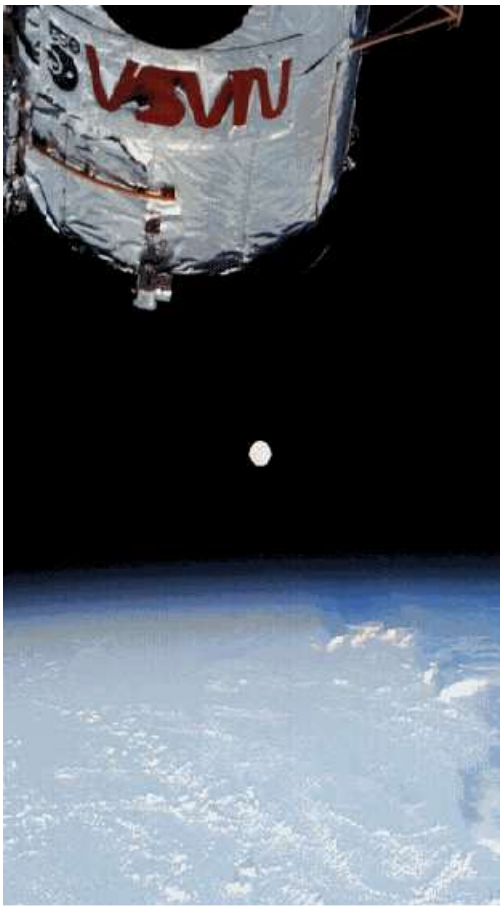
REFLECTIONS

of the University Lowbrow Astronomers

January 2000 !

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 807). Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party is canceled if it's cloudy or very cold at sunset. For further information call (313)480-4514.



Earth, Moon, Hubble Photo and Text Credit:
STS-103 Crew, NASA

Explanation: The Space Shuttle Discovery Crew was fortunate enough to witness one of the brighter full moon's from orbit two weeks ago during their mission to fix the Hubble Space Telescope. Pictured on the left, the horizon of the Earth is visible below this full Moon, which is below the edge of the Hubble Space Telescope. The full Moon on this day, last December 22, was a few percent brighter than average because it was full at nearly the same time it was at its closest to the Earth, which comes at a time when the Earth is relatively close to the Sun. The Shuttle Crew successfully showered Hubble with needed holiday gifts, including six new gyroscopes, a new computer, and new batteries.

This Month:

January 21 - Meeting at 807 Dennison - For the first meeting of a new millennium we'll enjoy a video from TLC - The Wonders of the Universe Series.

January 20 - Full Moon and Total Eclipse of the same. Umbra first contact is at 10:01 pm. Totality starts at 11:05 pm and ends at 12:22 am EST.

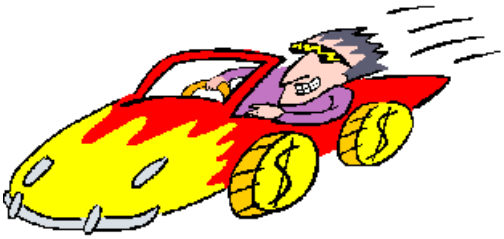
January 29 - Public Star Party at Peach Mountain Observatory - Weather will be clear, of course, and balmy with temps in the low 70's. Bring your shorts.

Next Month and beyond:

February 5 - Public Star Party at Peach Mountain Observatory

February 18 - Meeting at 807 Dennison - Just as soon as we figure it out we'll inform you.

March 4 and 11 - Public Star Party at Peach Mountain Observatory - Messier marathon from Peach Mtn anyone? I've not heard of it. Perhaps this is the year. The two best opportunities are April 1st (and that's no fool) and March 11th according to http://www.seds.org/messier/xtra/marathon/marathon.html



STICKING TO THE COSMIC SPEED LIMIT

By Lorna Simmons

I have often wished that some hapless traffic enforcement officer would ticket me for driving over the speed limit, at which time I would inform him/her that I actually was traveling much faster than that -- much, much faster. In fact, if the traffic cop really wanted to clock my velocity in the accelerating expansion of the cosmos, such recorded motion should be actually considered as ending with the speed at which my car is traveling (which, while non-zero, will forever be kept a secret). As a reference point, or "rest frame," the Cosmic Microwave Background Radiation (CMBR) herein will be considered to have a measurement of zero velocity against which all of the remaining cosmic motions are computed. Naturally, from here on in, everything being discussed actually happened sometime in the distant past, the intervening time depending upon the cosmic distance. None of the objects are actually in the positions where we now observe them. Therefore, keep in mind the changing velocities and positions in the cosmos with respect to time. Of course, there is no simple addition or subtraction involved, and the combination of velocities and/or accelerations (both positively and negatively) are much more complicated than what is being stated here.

Therefore, for the purpose of simplicity, we will combine my car's mysterious velocity with the speed of the earth's rotation on its axis (1,610 km/hr), add that to the speed with which the earth is revolving around the Sun (30 km/sec), join that to the speed with which the Solar System is cruising in its path around the Milky Way (220 km/sec), and include the speed at which the Milky Way (a/k/a "The Galaxy") and the Andromeda Galaxy (a/k/a "M31") are charging toward each other -- approximately 300 km/sec. The Milky Way itself is recorded as traveling at 360 (+/-20) km/sec toward the constellations of Leo and Crater. In addition, there is the random motion of the galaxies within our Local Group -- 300 to 1000 km/sec. Then there is the speed with which our own Local Group of Galaxies is traveling toward the Virgo Cluster, approximately 65-70 kilometers per second per megaparsec (km/sec/Mpc), combined with the speeds at which all of these neighboring galactic clusters are hurtling in the direction of the Great Attractor (again, approximately 65-70 km/sec/Mpc). After all of that, it is necessary to consider the relative speeds of distant galaxies with respect to the Milky Way, which speeds have been reported as being approximately 2,000 km/sec for each 31 Mpc. Finally, to top things off in style, it is important to consider the speed of the expansion of space between the galactic clusters -- the extravagantly excessive speed of the accelerated expansion of the Universe itself due to Lambda, the hypothetical energy density of the vacuum. Two large groups of cosmologists, The Supernova Cosmology Project and the High-z Supernova Search Team, presently are working on the calculation of the recently found cosmic acceleration, so stay tuned. To paraphrase a once-popular song from a bygone era, a lot of this means running around in ellipses, getting nowhere, because many of these motions are directionally contrary to each other and will partially cancel each other out. Somewhere in this hodgepodge computation of confusing and contradictory calculations must be my actual cosmic speed.

Officer, I am traveling extremely fast!

Naturally, I would have to take the consequences for offering this unsolicited information and perhaps spend at least the night in the lockup at the local jail, or even worse, lose my driver's license. Would my fine be significantly increased to reflect of all of this additional cosmic acceleration?

Then, again, none of these velocities are actually that swift when compared to the speed of light (the speed of the photons of the electromagnetic spectrum) at exactly 299,792,458 meters per second (m/sec) in the "perfect vacuum of space" (although there is actually no perfect vacuum of space at all, since space has been indirectly observed as being filled with the roiling virtual particles and their antiparticles which are instantaneously coming into and out of existence through annihilation). Therefore, there is a real (not-manufactured-by-humans) speed limit, actually a "constant" which is the aforesaid 299,792,458 m/sec, exactly. This includes everything in the electromagnetic spectrum (which en

compasses all frequencies of "light" at the radio, infrared, visible, ultraviolet, x-ray and gamma ray wavelengths). Nothing containing mass (which means almost nothing except for light and other massless particles) can equal light's speed limit (299,792,458 m/sec). Nothing. Almost nothing. Relativity takes care of that, because at the speed of light, massive objects would attain infinite mass, and it would take an infinite amount of force (including fuel) to move them faster. Actually, the light-speed rule applies to "information" which cannot travel faster than the speed of light -- never, ever, well, almost never, ever. An imaginary crack must be left open for possible future discoveries concerning the speed of light. Of course, in science fiction, things like superluminal speeds (faster-than-light warp speeds) are introduced repeatedly so that the characters in these dramas can get from here to there before the end of the next Millennium (at least before the end of that particular nightly segment of the hypothetical science fiction drama in question).

There actually are particles which can be measured as traveling at superluminal speeds, however trivially. In quantum tunneling, particles have been measured as passing through a laboratory barrier and appearing instantaneously on the other side of that barrier. Sometimes light might be measured as being superluminal while it is actually measured as traveling on an angle. This makes it appear to be traveling faster than the light speed limit, until this angle is taken into account and the measured speed comes back down to, or below, the speed-of-light speed limit (299,792,458 m/sec). Trivially, shadows can be thought to travel faster than light speed, but shadows (the absence of light) are not composed of matter particles, do not contain mass, and, for that reason, cannot be thought of as information carriers. Then again, who knows what science will bring in the next Millennium (if ever people can agree upon the timing of the advent of the next Millennium)?

Gravitons (gravitational force particles), having no mass, travel at the speed of light. In fact, as stated previously, all particles with zero mass travel at the speed of light. Neutrinos and antineutrinos are said to travel at light speed. Scientists have measured a very slight difference in mass between at least two of the six kinds (a/k/a "flavors") of neutrino (electron neutrino, muon neutrino, tau neutrino and their anti-neutrinos), because at least two kinds of neutrinos have been detected as "oscillating" (the act of changing from one kind of neutrino to another), thereby possessing mass. However, it has not yet been determined just which particular neutrino kinds are doing the oscillating and, therefore, have mass. The difference in kinetic energies recorded between neutrino kinds shows a difference in their mass squared which demonstrates that at least one, if not all, of the neutrinos studied probably has an extremely tiny mass (expected to be between 2 electron volts (2eV) and 30 electron volts (30eV). Particles of the weak force, W+, W-, and Z0 (W plus, W minus, and Z naught), each of which has zero mass, also travel at light speed. The door is left wide open (a large crack) for future particles which, as yet, are only figments of some theoretical physicists' fertile imaginations.

Actually, light sometimes travels more slowly than other particles. For instance, it slows down in water and in glass. Therefore, sometimes things can travel faster than light, but only if light is traveling more slowly than "light speed." Details, details. Confusing? Recently, light was extremely slowed down in the laboratory to approximately 61.2 kilometers per hour (which, eventually, ought to end up earning at least one Nobel Prize for the scientists involved). So, the speed of light is not always "the speed of light." It is just a speed limit at its upper end -- at least until physicists come along with new evidence. That, naturally, is a gigantic "if"!

Confusing? Whatever.

So, next time you receive a speeding ticket, resist all silly impulses which will get you into trouble (like attempting to educate the local constable). Take the ticket. Keep your mouth shut about your own projected cosmic velocity and/or cosmic acceleration in traversing the universe. Do not insist upon arguing your case before a judge, because this reasoning would probably get you into more hot water and you would end up paying a stiffer fine. Add to that your court costs and attorney fees.

There probably are specially-constructed jail cells in the "slammer" ready for foolish drivers who want to make inane little remarks that would probably be over the heads of their local traffic enforcement officers. So be silent, take the ticket, take your medicine, and shut up! And forget that I ever mentioned this subject.

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NOTE: All calculations in this article are in "metric" units, in somber memory of the recent Mars Climate Orbiter tragedy.

3 X 2 = More Naked Eye Double Stars

by Christopher Sarnecki

In last October's *REFLECTIONS* I listed three naked eye double stars for your observing challenge well placed for autumn viewing. One pair Omicron 1 Cygni (mag 3.8) and 30 Cygni (mag 5) were separated by 338 arcmins. Which means if you can split this pair using only your keen eyesight then you have got 5.5 arcmins resolution. Not too shabby. This season we have three new doubles to test your observing skills. All three pairs are easy to find and, for the record, are not true gravitationally bound binary stars but close visual doubles. You should be able to split these from moderately light polluted suburban skies. So get yourself outside, if only for a few moments of winter observing, and don't forget to bring your dark-adapted eyesight.

Lets start with the most challenging pair first. This pair forms the stubby handle of the Pleiades (the seven sisters, M45) open star cluster and is just over 400 light years away, in the constellation Taurus. Many people can count six of the seven sisters in this famous star formation, but it takes some effort to find the seventh. Knowing were to look helps. Begin by forming a tiny dipper asterism of this cluster. The open portion of the bowl points generally north. The stubby handle is oriented east and the easier of the two stars, 27 Tauri, or *Atlas* at mag 3.6 is seen. Look north of this star, or in the same direction of the open bowl for a 5th mag star known as 28 Tauri, aka *Pleione*. Burnham's list the separation of these stars at 5 arcmins apart. Guide confirms Burnham's separation. Position angle (PA) is 3 – 5 degrees or basically north-south (Hey this is a mini set of pointer stars!). These stars, like the rest of the Pleiades, have a large common proper motion which is a fancy way of say they are all moving in the same direction within the galaxy at about 5.5 arc**secs** per century. So when you split this pair you can contemplate how far the Pleiades will move in the year 7454 (on July 17th at 3 in the afternoon, it will sunny followed by a brief period of darkness, I think…).

Moving east but still in the constellation of Taurus (and that's no Bull) we come to the Hyades open star cluster which forms the recognizable "V" of the bull's head/horns. The Hyades is very similar to the Pleiades in that the stars are both open clusters with a large common proper motion. The Hyades are a third of the Pleiades distance, or only about 130 light years away from us making them the second closest cluster to the Earth. Only the Ursa Major moving cluster is closer at 75 light years away. The Hyades are moving in the direction of Betelgeuse at 11 arcsecs **per year**. So these stars are cruising past our position space. The double star of our envy is Theta 2 (78 Tauri) at mag 3.3 and Theta 1 (77 Tauri) at mag 4 and are found half way down the east side of the "V" or the same side as the bright first mag star Aldebaran (which is <u>not</u> a Hyades member and approximately 65 light years away). Theta 2 & 1 are separated by 337 seconds of arc or 5.5 arcmins (PA = 347 degrees). These two stars (spectral types A7 & K0) are easy to split owing to their equal brightness. Not so easy as the previous pair which are farther apart in magnitude (1.5 mag vrs 0.5 mag for this pair). Something one learns when splitting binary stars in a telescope is the bigger the magnitude difference for equal separations of arc, the more difficult it is to "split em".

Moving to our last pair we look at the bottom star in Orion's sword. I'll bet you never thought to look at this star in that it being so close to the famous Orion nebula and all the attention directed towards it. I didn't either. In a desperation effort to find a third naked eye double for this report I happened upon this pair accidentally. One night while searching the winter sky for a third pair, I kept telling myself there must be another pair here when I looked up and there it was. Iota Orionis, *Na'ir al Saif*, "Bright one of the Sword", shining at mag 2.8. Just southwest (PA = 225 degrees) is a 4.7 mag little star at 8 arcmins away. At a magnitude difference of almost two this pair is almost as difficult to split as the Pleiades pair. Iota itself is a triple star system for small telescopes with a 7th mag star at 11 seconds of arc away and an 11th mag star at 50 arcsecs. Burnham's list the colors as white, pale blue, and grape red. I gotta check this one out with the scope.

All these pairs are a beautiful sight to behold and I hope you take the time to hunt these stars down and enjoy the view.

Press Release
Total Lunar Eclipse: January 20-21, 2000
Fred Espenak, NASA/GSFC

sunearth.gsfc.nasa.gov/eclipse/SEextra/TLE2000Jan20.html

On the evening of Thursday, January 20, 2000, a total eclipse of the Moon will be visible from all of North and South America including the USA and Canada. The event will also be visible from western Europe on the morning of January 21.

An eclipse of the Moon can only take place at full Moon, and only if the Moon passes through some portion of the Earth's shadow. The shadow is actually composed of two cone-shaped components, one inside the other. The outer or penumbral shadow is a zone where some portion of the Sun's rays are blocked. In contrast, the inner or umbral shadow is a region devoid of all direct sunlight.

Astronomers recognize three basic types of lunar eclipses:

1. Penumbral Lunar Eclipse

- The Moon passes through the Earth's penumbral shadow.
- These events are of academic interest only since they are subtle and quite difficult if not impossible to observe.

2. Partial Lunar Eclipse

- A portion of the Moon passes through the Earth's umbral shadow.
- These events are easy to see, even with the unaided eye.

3. Total Lunar Eclipse

- The entire Moon passes through the Earth's umbral shadow.
- These events are quite striking for the vibrant range of colors the Moon can take on during *totality*.

As the Moon orbits the Earth every 29.5 days, it usually passes north or south of Earth's shadows so no eclipse takes place. But every once in a while, the Moon passes through some portion of the Earth's penumbral or umbral shadows and one of the above three types of eclipses occurs.

During a total lunar eclipse, the Earth blocks all direct sunlight from the Moon. Astronauts on the Moon would then see the Earth eclipsing the Sun. While the Moon remains completely within Earth's umbral shadow, indirect sunlight still manages to reach and illuminate it. However, this sunlight must first pass deep through the Earth's atmosphere which filters out most of the blue colored light. The remaining light is a deep red or orange in color and is much dimmer than pure white sunlight. The Earth's atmosphere also bends or refracts some of this light so that a small fraction of it can reach and illuminate the Moon.

The total phase of a lunar eclipse is so interesting and beautiful precisely because of the filtering and refracting effect of Earth's atmosphere. If the Earth had no atmosphere, then the Moon would be completely black during a total eclipse. Instead, the Moon can take on a range of colors from dark brown and red to bright orange and yellow. The exact appearance depends on how much dust and clouds are present in Earth's atmosphere. Total eclipses tend to be very dark after major volcanic eruptions since these events dump large amounts of volcanic ash into Earth's atmosphere. During the total lunar eclipse of December 1992, dust from Mount Pinatubo rendered the Moon nearly invisible.

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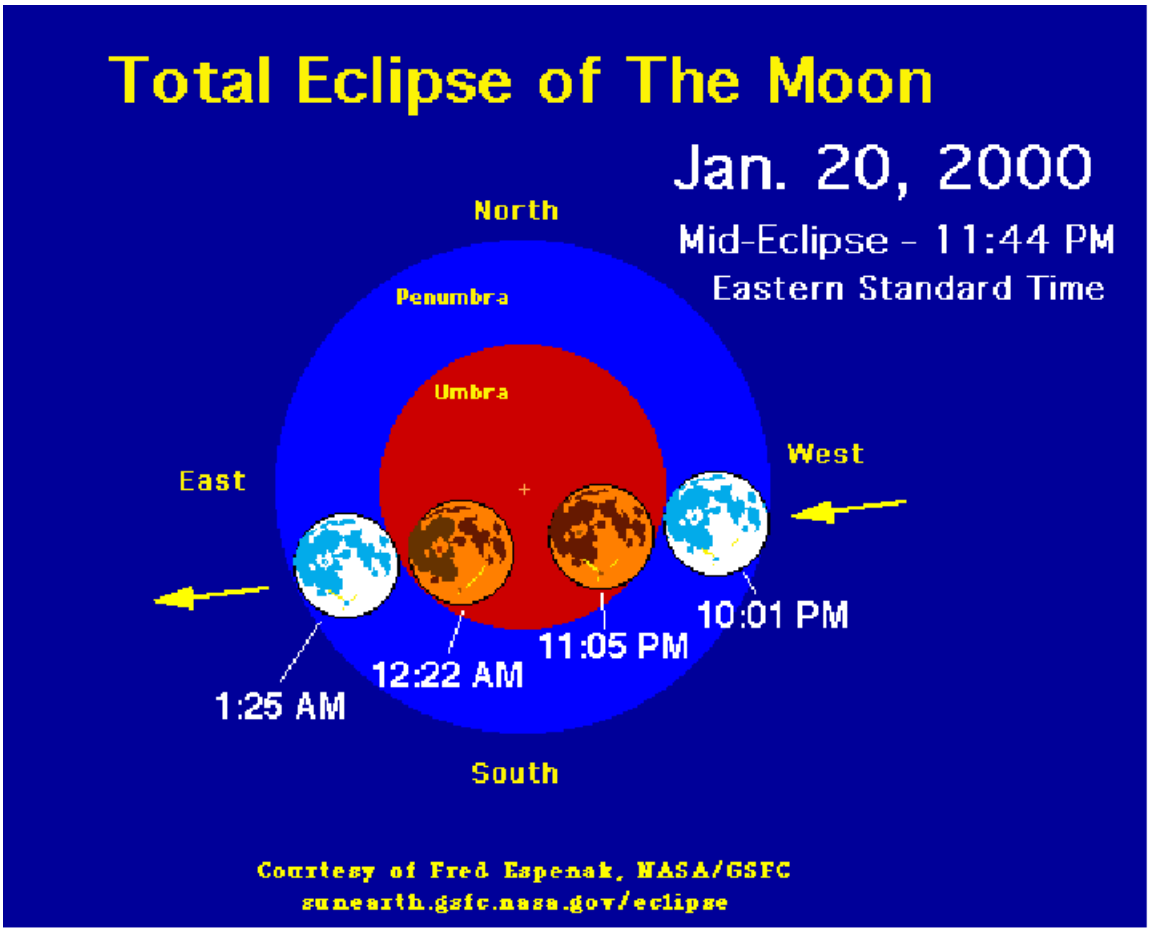

All total eclipses start with a penumbral followed by a partial eclipse, and end with a partial followed by a penumbral eclipse (the total eclipse is sandwiched in the middle). Since the penumbral phases of the eclipse are so difficult to see, we will ignore them.

From start to finish, January's lunar eclipse lasts nearly three and a half hours. The partial eclipse begins as the Moon's eastern edge slowly moves into the Earth's umbral shadow. During the partial phases, it takes just over an hour for the Moon's orbital motion to carry it entirely within the Earth's dark umbra. Since no major volcanic eruptions have taken place recently, the Moon will probably take on a vivid red or orange color during the 77 minute long total phase. After the total phase ends, it is once again followed by a partial eclipse as the Moon gradually leaves the umbral shadow.

PEACH MOUNTAIN WILL BE OPEN 1/20 FOR LOW-BROWS, STUDENTS, FACULTY AND GUESTS. THE GATE WILL BE UNLOCKED A FEW MINUTES BEFORE 9:00 PM. ITS EXPECTED TO BE QUITE COLD, SO DRESS VERY WARMLY.

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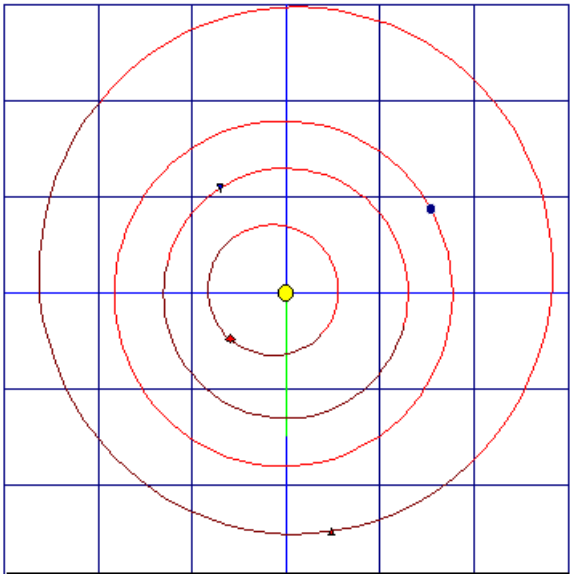
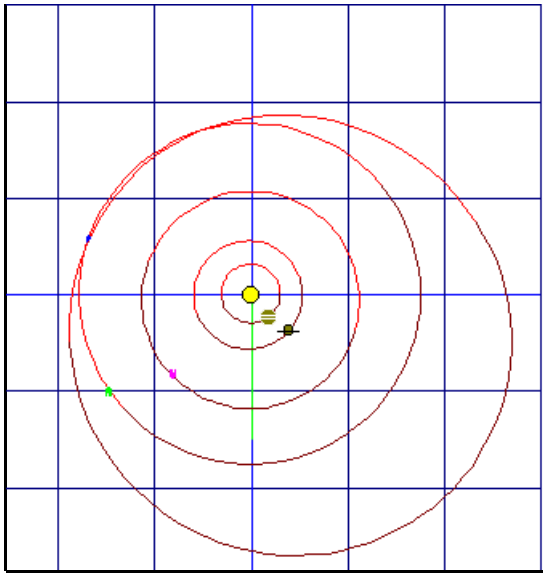
Our Solar System - The left figure includes four planets ending with Mars. The right figure includes five outer planets starting with Jupiter and ending with Pluto.





Some information about the planets on 1/20 /2000

Solar System Obj: Mercury
Phase: 99.4%, Apparent Mag: -1.2
Distance (au) : 0.421939
Heliocentric Lng: 311.23
Apparent angular diameter: 4.8
RA, Dec: 20h 25m 21.4s , 21d 24m 15s S
Rise: 8h 22m Transit:13h 2m Set:17h 42m

Solar System Obj: Venus
Phase: 81.3%, Apparent Mag: -4.0
Distance (au) : 0.722627
Heliocentric Lng: 214.05
Apparent angular diameter: 13.3
RA, Dec: 17h 39m 48.0s , 22d 2m 10s S
Rise: 5h 39m Transit:10h 16m Set:14h 53m

Solar System Obj: Mars
Phase: 94.0%, Apparent Mag: 1.1
Distance (au) : 1.403698
Heliocentric Lng: 11.55
Apparent angular diameter: 4.8
RA, Dec: 22h 58m 52.0s , 7d 24m 20s S
Rise:10h 1m Transit:15h 36m Set:21h 12m

Solar System Obj: Jupiter
Phase: 99.0%, Apparent Mag: -2.4
Distance (au) : 4.968040
Heliocentric Lng: 38.07
Apparent angular diameter: 39.9
RA, Dec: 1h 40m 38.8s , 9d 11m 41s N
Rise:11h 42m Transit:18h 18m Set: 0h 58m

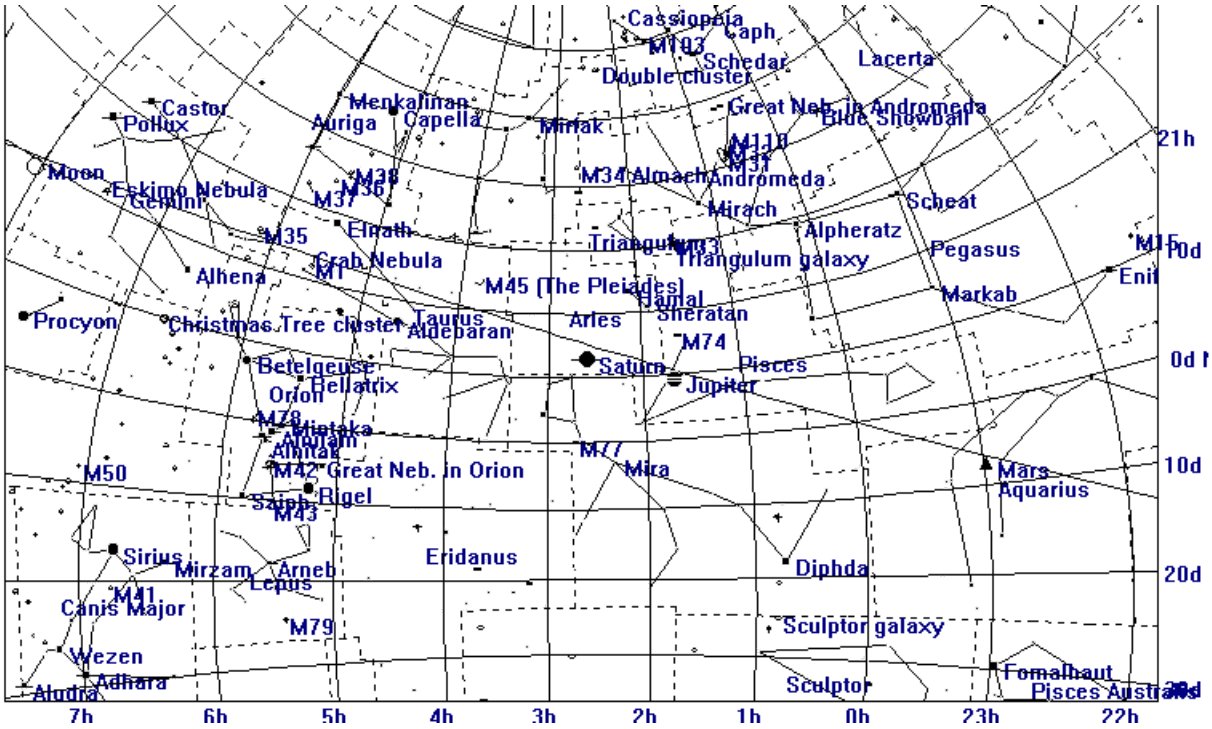
Solar System Obj: Saturn
Phase: 99.7%, Apparent Mag: 2.0
Distance (au) : 9.179552
Heliocentric Lng: 46.43
Apparent angular diameter: 18.5
RA, Dec: 2h 34m 48.4s , 12d 41m 43s N
Rise:12h 22m Transit:19h 12m Set: 2h 5m

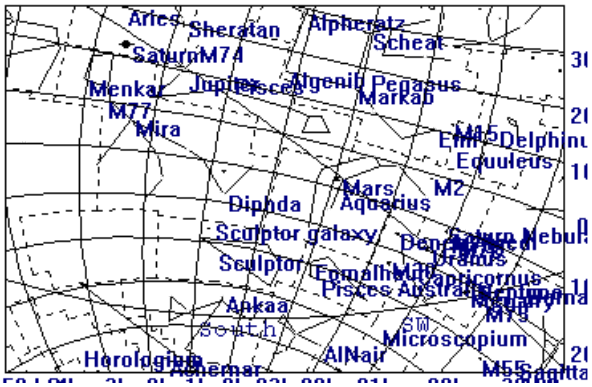
Solar System Obj: Uranus
Phase: 100.0%, Apparent Mag: 5.9
Distance (au) : 19.925874
Heliocentric Lng: 316.63
Apparent angular diameter: 3.4
RA, Dec: 21h 14m 5.3s , 16d 42m 25s S

Solar System Obj: Neptune
Phase: 100.0%, Apparent Mag: 8.0
Distance (au) : 30.119850
Heliocentric Lng: 304.04
Apparent angular diameter: 2.2
RA, Dec: 20h 24m 42.7s , 19d 2m 57s S

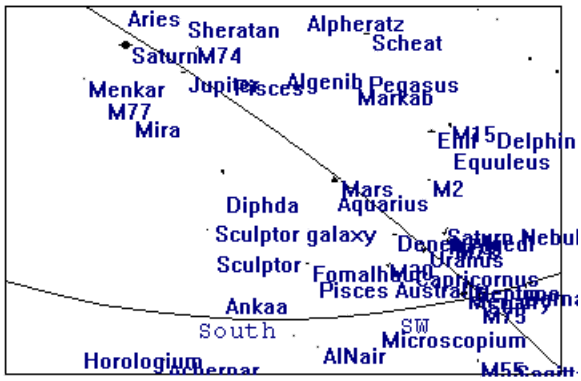
Solar System Obj: Pluto
Phase: 100.0%, Apparent Mag: 13.8
Distance (au) : 30.229354
Heliocentric Lng: 250.67
Apparent angular diameter: 0.1
RA, Dec: 16h 48m 11.1s , 11d 25m 41s S
Rise: 4h 7m Transit: 9h 27m Set:14h 46m

This page assembled by Bernard Friberg using the Sky Program

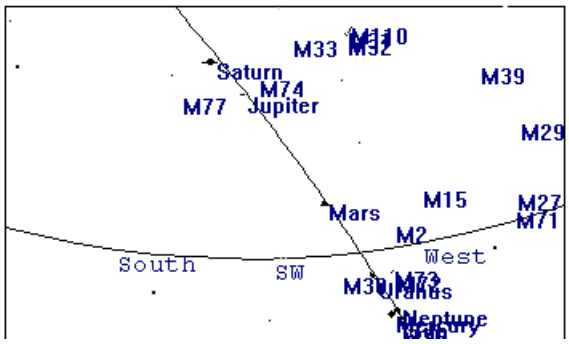




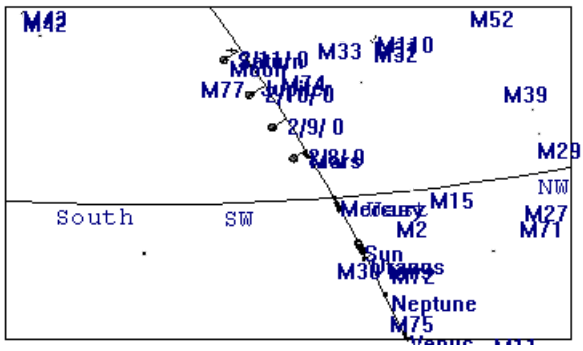
January 20, 2000 5:30 pm The Sky Software



January 20, 2000 5:30 pm



January 20 7:30 pm

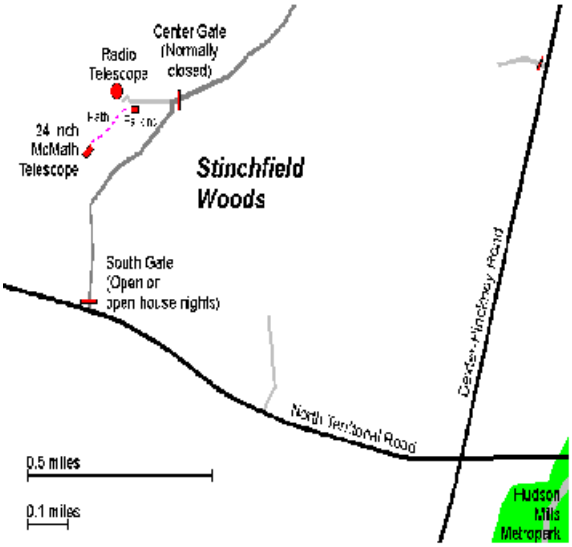


February 8 7:30 pm The Moon near Mars 2/8

(This page constructed by Bernard Friberg using The Sky Software)

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 807. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly !

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Doug Scobel at the monthly meeting or by mail at this address:

1426 Wedgewood Drive
Saline, MI 48176

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

President: Mark Deprest (734)662-5719
Vice Presidents: Lorna Simmons (734)525-5731
Dave Snyder (734)747-6537
Paul Walkowski (734)662-0145
Treasurer: Doug Scobel (734)429-4954
Observatory Director: Bernard Friberg (734)761-1875
Newsletter Editors: Chris Sarnecki (734)426-5772
Bernard Friberg (734)761-1875
Keyholders: Fred Schebor (734)426-2363
Mark Deprest (734)662-5719

Lowbrow's Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html

Dave Snyder, webmaster
http://www-personal.umich.edu/~dgs/lowbrows/

Monthly Meeting
January 21, 2000,
7:30 pm

Room 807 Dennison Hall
Physics & Astronomy Building
The University of Michigan

The Wonders of the Universe Series TLC video titled:

Shadows & Signs

This is a multiple exposure of the partial lunar eclipse of March 23, 1997. Taken by Lowbrow Doug Scobel on Kodak Ektachrome ISO 400 film with a Nikon N8008s mounted on a tripod, with a 300 mm lens at f/5.6 No motor drive was used. A total lunar eclipse will occur over North America on the evening of January 20th.

UNIVERSITY LOWBROW
ASTRONOMERS
3684 Middleton Drive
Ann Arbor, Michigan 48105

Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html

Check your membership expiration date on the mailing label !