REFLECTIONS REFRACTIONS

of the University Lowbrow Astronomers

December, 1999

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.

Lowbrows Will Work for Photons: A number of Lowbrows hosted a sidewalk star party downtown Ann Arbor on the late sunny November 15th afternoon to witness Mercury transit across the face of the Sun. In the top row from left to right: Bernard Friberg, David Snyder, John Wallbank, and Jim Halk. In the center: John Causland. In the bottom row from left to right: Mark Deprest and Dick Sider. More pictures inside.

This Month:

December 11 - Public Star Party at Peach Mountain Observatory – Four day old Moon – huge discount!

December 11, 1999. (10:30-11:30 am, 170 Dennison Building, University of Michigan). Saturday Morning Physics (The Milky Way, part 3 of 3).

December 16, 1999. – 1-4 p.m. Self Guided Tour of Detroit Observatory.

December 17 - Meeting at 807 Dennison - We'll see a video on spin casting large aperture mirrors at the University of Arizona's Mirror Lab.

Next ~~Month~~ Millennium :

January 1 - Public Star Party at Peach Mountain Observatory is cancelled due to the holiday.

January 8- Public Star Party at Peach Mountain Observatory – January 20 – Total eclipse of the Moon. Nicely placed for North America. First contact at 10: 01 pm with the max eclipse at 11:44 pm.

January 21 - Meeting at 807 Dennison - We'll keep you informed just as soon as we figure it out.

Mercury Transits the Sun

By Dave Synder

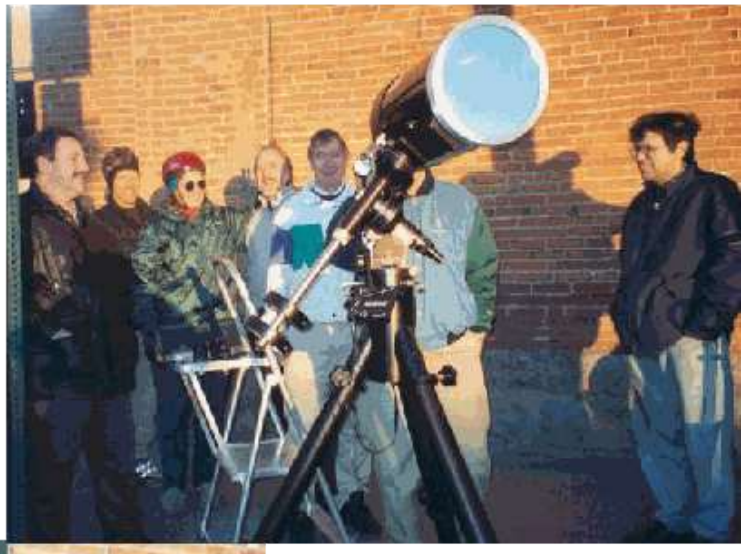
On November 15th, there was a transit of Mercury. The Lowbrows hadn't planned a star party for the transit, but Jim Halk thought it would be a good idea if someone did. Jim mentioned this to several of us. Later John Causland organized a small star party to be held on the sidewalk near the corner of Ashley and Liberty. Only a handful of people knew about this event beforehand. I knew there would be a transit, but I didn't know about this event until an hour or so in advance.

I had arrived about 4 PM, and by this time a small group had gathered on Ashley. John had already set up his 11" SCT. We only had the one telescope. At first we only observed sunspots, but at 4:15 Contact I occurred. At this point Mercury looked like a tiny bite mark at the bottom of the Sun's disk. There was quite a bit of turbulence, but Mercury was visible. Gradually, Mercury moved further inward. Contact II was about 4:30 at which point Mercury looked like a tiny black spot instead of a bite mark.

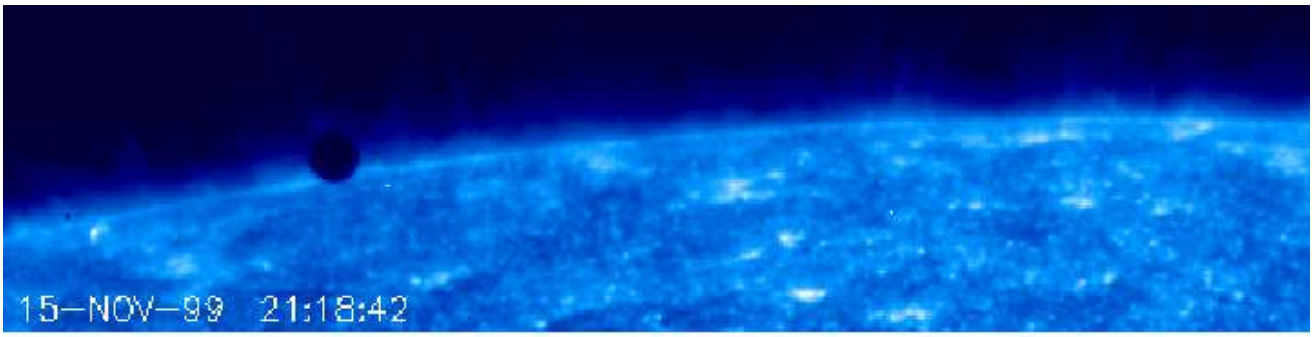
Right: John Causland (behind Bernard Friberg) lent his 11 Schmidt Cassigrain telescope (notice the full aperture solar filter) to witness a rare transit of Mercury across the Sun.

Because this was a grazing transit, Mercury stayed close to the edge of the Sun's disk. We took turns observing until about 5 PM when the bottom of the Sun's disk (and therefore Mercury) disappeared behind some trees.

During the transit, several people walked by and wondered why we had a telescope set up on the sidewalk. Anyone interested was given a chance to look through the scope. A few people asked questions either about Mercury or the upcoming Leonid Meteor shower. A large cardboard sign had been placed near the telescope that mentioned both the transit and the Leonids. None of us had observed a Mercury transit before, so that made this event unique. There were some clouds, but we were able to see most of the transit.



Left: Lowbrow President Mark Deprest uses his head as a model to explain the Sun-Mercury line up to sidewalk passerby's as Lowbrow Web Master Dave Synder looks on. The weather was clear on that November 15th as witnessed by the shadows on the wall. Clear weather in November is about as rare as a transit of Mercury across the Sun.



Mercury And The Sun
Credit: Brian Handy (Montana State Univ.), TRACE Project
Explanation: Just days before the peak of the Leonid meteor shower, skywatchers were offered another astronomical treat as planet Mercury crossed the face of the Sun on November 15. Viewed from planet Earth, a transit of Mercury is not all that rare. The last occurred in 1993 and the next will happen in 2003. Enjoying a mercurial transit does require an appropriately filtered telescope, still the event can be dramatic as the diminutive well-done world drifts past the dominating solar disk. This slow loading gif animation is based on images recorded by the earth-orbiting TRACE satellite. The false-color TRACE images were made in ultraviolet light and tend to show the hot gas just above the Sun's visible surface. Mercury's disk is silhouetted against the seething plasma as it follows a trajectory near the edge of the Sun.

Picture and text credit: Astronomy Picture of the Day, November 19, 1999

The Dark Matter Mystery

By Lorna Simmons

Although it cannot be seen, there is solid evidence that more than 90% of the total mass in the universe is composed of Dark Matter. It is there! It is there! It is simply not visible. This unseen mass has been detected through several astrophysical methods, beginning with the measurements in spiral galaxies of what are called "rotation curves," where the speed of an object in its orbital path at one place in a galaxy is measured and compared with the speeds of other orbital movement curves farther out in the spiral arms of that galaxy. Since the measured speeds of all of the so-called "rotation curves" have turned out to be surprisingly similar to each other, even at different distances from the center of the galaxy, it follows that something is distinctly unusual about these orbital speeds. These rotational speeds have not followed the time-honored astrophysical models for movement of astronomical bodies such as planets in our own Solar System where the speeds of the planets get progressively slower the farther the planets are from the Sun. What exactly is happening here in the spiral galactic model? Is there extra unseen mass which is causing the stars, etc., to maintain their orbital speed on their paths around the Milky Way, even far out from the center of the Galaxy?

In other important studies, astrophysicists have measured the mass of the gas in and around elliptical galaxies and have additionally measured the movement of galaxies in galactic clusters, detecting what they call the "velocity dispersion" or the spreading out of the velocities (directional speeds) of galaxies orbiting around the centers of the galactic clusters. The velocities of the galaxies in the galactic clusters do not seem to slow down as expected as the individual galaxies get farther out from the centers of these galactic clusters. It is very puzzling for astrophysicists. This should not be! But, regardless, it is.

Additionally, astrophysicists have measured the X-ray gas in the clusters of galaxies. They have scrutinized and analyzed the gravitational lensing - the arcs of light showing the presence of a massive, but dark, body hiding a bright object which is directly behind that massive body. Using time-honored methods of calculating mass and expected velocity dispersion astrophysicists have found that there is much more mass than can be observed directly. Because the Dark Matter cannot be seen directly, the measured hidden massive objects may be composed of different material than ordinary baryons (hereinafter "stuff"). The total density of the invisible (often erroneously referred to as "missing") mass appears to be much greater than the total density of "stuff" in the universe as has been calculated using the most likely abundances in the early universe of

the light elements (hydrogen., helium, deuterium, and lithium).. Dark Matter, in the form of nonbaryons (hereinafter "non stuff"), seems to be an obvious explanation for the formation of galactic clusters, as shown by the observed temperature fluctuations presently seen in the cosmic microwave background radiation (CMBR), which is the radiation recorded at 2.7 degrees Kelvin left over from the Big Bang.

In addition, the CMBR gives evidence of fluctuations in density which, because of gravitational instability, can only relate to the present structure if it is "non stuff." Because the CMBR possesses gravitational instability due to the observed fluctuations in density, it would seem that Omega (calculated as the density of the universe divided by what is called the "critical density of the universe") is very likely equal to 1.

There are three possibilities in determining the Effective Omega (the density parameter of the universe divided by the critical density of the universe):

1. Recollapse (meaning a closed universe) if Omega is greater than one.
2. Expansion forever but gradually slowing down and stopping at infinity (meaning a flat universe) if Omega is equal to one.
3. Expansion forever (meaning an open universe) if Omega is smaller than one.

If the universe turns out to be composed only of "stuff," the amount of this "stuff" will be equal to the combined total of all of the "stuff" in the universe. Some of this unseen "stuff" will be found in what are called MACHOs (Massive Astrophysical Compact Halo Objects) which are made up of the familiar "stuff" but which are invisible to detectors, because the "stuff" does not emit light. Some of this unseen "stuff" may consist of difficult-to-detect neutral Hydrogen atoms which have recently been found in great abundance on the outskirts of galaxies.

However, if this added material is "non stuff," then there is a zoo of exotic particles waiting in the wings! The most probable "non stuff" candidates for the Dark Matter particles are: Axions (hypothetical elementary particles having low mass and zero charge), neutrinos (which are now thought to have a tiny, near vanishing, mass but no charge and which have been detected as "oscillating" - changing from one kind ("flavor") of neutrino to another kind ("flavor") of neutrino), and/or WIMPs (Weakly Interacting Massive Particles). And there are others.

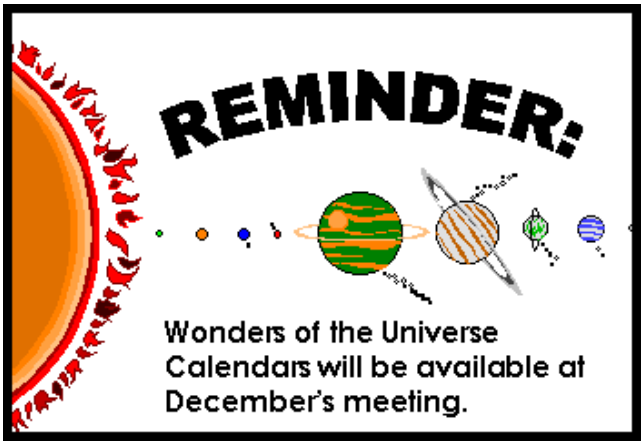
There are many, many others.

Considering the nature of Dark Matter:

1. If Dark Matter produces an Omega of less than 0.1, its structure will be "stuff": gas and dust, clumped Hydrogen 2, MACHOs, and/or hypothetical VMOs (very massive objects).
2. If the Dark Matter produces an Omega of greater than 0.1, then some of it must be "non stuff" and consist of exotic particles, such as light neutrinos, WIMPs, or extremely light Axions.

Dark Matter (DM) has basic problems. There are probably not enough MACHOs (consisting of "stuff"). Therefore, "non stuff" particles, such as the Cosmic Microwave Background Radiation (CMBR), probably must be added to make up some of the observed mass of the universe. The best additional candidates for Dark Matter are Axions, which are as yet hypothetical. Another candidate for the Dark Matter is the neutrino. At least one type ("flavor") of neutrino (which at one time was hypothetical) has recently been recorded as having an indeterminate, but extremely tiny, mass difference, which implies that at least one of the neutrino types ("flavors") has mass, even if nobody knows which type ("flavor") of neutrino is involved or the actual mass of that type ("flavor") of neutrino. Finally, there are the hypothetical WIMPs. Obviously, being hypothetical, WIMPs are yet to be detected.

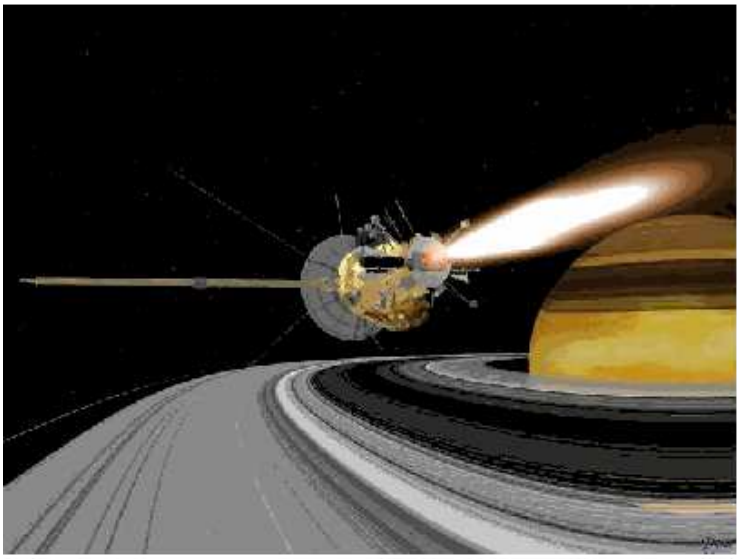
It should be emphasized that cosmology is joining the list of experimental sciences by using many techniques, including astronomy, astrophysics, particle physics, nuclear physics, condensed matter physics, low temperature physics, you-name-it physics, etc. The list continues to expand. Where will it all end? Particle Astrophysics has taken center stage. The suspense is almost too much to bear.



JPL's Solar System Simulator Web Site

http://space.jpl.nasa.gov/

Want to mock-up the solar system object of your desire before going out tonight? You need look no further than the JPL Solar System Simulator web site. Click on a few fields and hit the "Run Simulator" and volia! A rendered image of a planet pops up on your screen. Selected planets are rendered in maps developed over the years of imaging satellite fly-by missions. For your viewing pleasure, I called up Jupiter for midnight on December 11th. The giant red spot is approaching the meridian and Io is transiting the disk (see next page). Dave Seal, the webmaster, is also an accomplished space artist and maintains a separate area for images developed for JPL planetary missions. What also follows is a short history on the how and why JPL developed the Solar System Simulator. Pics and text that follows courtesy of JPL– Ed



This is a computer-rendered image of Cassini during the Saturn Orbit Insertion (SOI) maneuver, just after the main engine has begun firing. The spacecraft is moving out of the plane of the page and to the right (firing to reduce its spacecraft velocity with respect to Saturn) and has just crossed the ring plane. The SOI maneuver, which is approximately 90 minutes long, will allow Cassini to be captured by Saturn's gravity into a 5-month orbit. Cassini's close proximity to the planet after the maneuver offers a unique opportunity to observe Saturn and its rings at extremely high resolution. (P-46507AC) "Courtesy Jet Propulsion Laboratory. Copyright (c) California Institute of Technology, Pasadena, CA. All rights reserved. Based on government-sponsored research under contract NAS7-1260."

History of the Simulator - how this all got started.

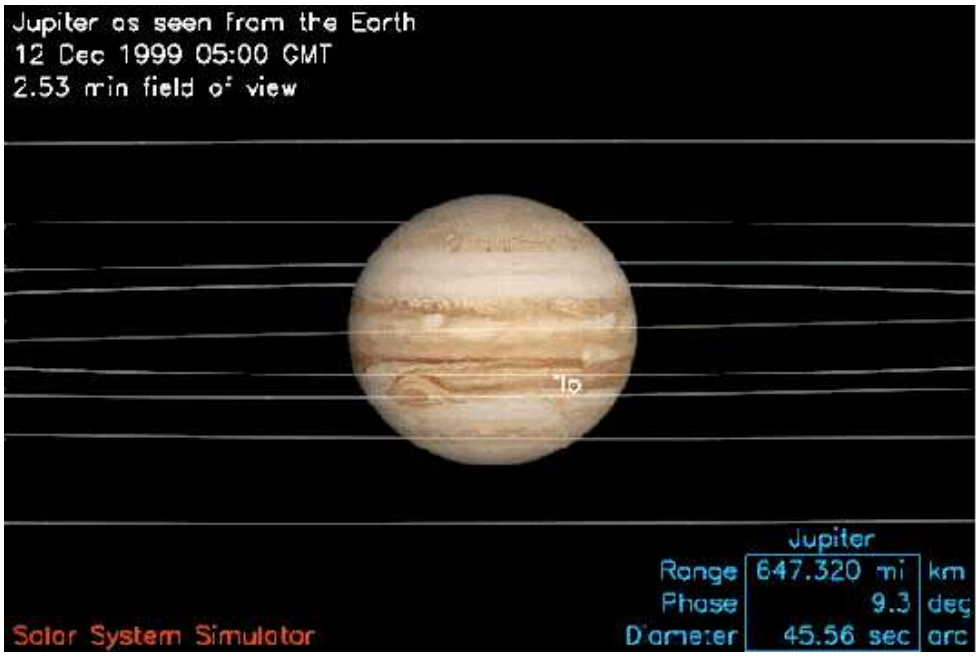
The Solar System Simulator originated as JPL's SPACE software package, which consisted of a set of computer graphics programs designed to simulate spacecraft trajectories and produce various photographic and video products. The SPACE package was specifically designed for animating space missions and was uniquely suited to JPL mission design. For the Voyager encounters, SPACE provides realistic encounter visualizations, graphical bases for the analyses of high-level problems and visual aids to trajectory design. The Jupiter, Saturn, Uranus and Neptune flyby movies which SPACE developed were greeted with great excitement, shown on NOVA programs and major TV networks, and fostered much enthusiasm for the space program around the world.

To create a mission simulation, SPACE used a spacecraft model, scientific instrument characteristics, and a conic elements file that described spacecraft and celestial body states. Planetary texture maps, observer orientation routines and orbit propagation capabilities were included in the SPACE software set. The simulation occurred on the host computer and is presented to the user in a mode called wireframe, wherein only black-and-white outlines of objects are displayed. Commands and viewpoint geometry data were shown on a second reference monitor in an easy-to-understand graphical user interface. Wireframe movies could be shown in real time at rates of up to 15 frames per second and were typically used for movie construction and debugging.

Any wireframe or frames could then be color rendered in ray-shaded form and stored as files or displayed on a separate monitor. Typical scenes could be color rendered in 20 seconds, depending on scene content. Movies were created by generating a series of key frames; SPACE propagated from one key frame to the next autonomously, making movie generation relatively simple. Color rendering used dithering, simple antialiasing, careful color space encoding and a high order depth priority algorithm.

Initially developed in the late 1970's and 80's by highly acclaimed computer graphics expert Jim Blinn, SPACE continued to serve as an outstanding mission design tool for many years. In April through June of 1997, David Seal rebuilt the SPACE software set in ANSI C, standardized its interface, input and output file formats,

added some new features, and installed it on the World Wide Web. The new software now drives the web-based Solar System Simulator, which can create a color image of any planet or satellite as seen from any point in the Solar System. The Simulator is currently being used in JPL's Mission Architecture section. The software is also being employed by the Shuttle Radar Topography, Cassini, Galileo, and other missions for trajectory animation and mission visualization. Feedback on the simulator is welcome via the feedback form.



From the Observatory

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Meteor showers for the month of December

There are a number of minor overlapping meteor showers in the month of December. On most of the evenings in December one can expect to see at least 5 meteors per hour from a dark site.

Chi Orionids are active from Nov 26 – Dec 15, peaking on the 2nd. Phoenicids are active from Nov 28 – Dec 9 peaking on the 6th. Puppids-Velids are active from Dec 1 – Dec 15 peaking on the 7th. December Monocerotids are active from Nov 27 – Dec 17 and peaking on the 9th.

Sigma Hydrids are active from Dec 3 to 15 and peaking on the 12th. Geminids are active from Dec 7 – 17 and peaking on the 14th. Coma Berenicids are active from Dec 12 to Jan 23 and peaking on Dec 20. Ursids are active from Dec 17 – 26th and peaking on the 22nd.

This shower can occasionally produce meteors at the rate of 50 per hour and the Geminids rate can be up to 140 per hour.

Dec 4, is the open house / star party at Peach Mountain. The new moon is on December 7 at 5:32pm EST. The Galileo spacecraft orbited Jupiter on this date in 1995, becoming the first craft to orbit an outer planet. Dec 11 th the second Low-brow open house of the month was well attended including many younger kids with lots of enthusiasm. On Dec 12 the moon is near Mars and Uranus. Dec 22 is the full moon, called the Moon Before Yule. The winter soltice is also on the 22nd at 2:45 EST and the sun is at its most southern point along the ecliptic. On the 29th Mars and Neptune are about 1.7 degrees apart.On Dec 30 Venus is near Spica in the morning sky. Happy New Year

Jan 1 – 5 are the Quadranids with a rate up to 200 per hour and peak on the 3rd. The Delta Cancrids peak on the 17th and are active from Jan 1 to the 24th.

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The schedule continued from the front page

February and Beyond:

February 5 - Public Star Party at Peach Mountain Observatory
February 18 - Meeting at 130 Dennison
March 4 - Public Star Party at Peach Mountain Observatory
March 11 - Public Star Party at Peach Mountain Observatory
March 17 - Meeting at 130 Dennison

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The Complete Schedule for Y2000

Open house / star party : 1/8, 1/29, 2/5, 3/4, 3/11, 4/1, 4/8, 4/29, 5/6, 5/27, 6/3, 6/24, 7/1, 7/29, 8/5, 8/26, 9/2, 9/23, 9/30, 10/21, 10/28, 11/18, 11/25, 12/23, 12/30

Meetings: 1/21, 2/18, 3/17, 4/21, 5/19, 6/16, 7/21, 8/18, 9/15, 10,20, 11/17, 12/15

Leslie Science Center: 6/9, 8/4

Deletion: Peach Mountain , January 1, 2000 open house/ star party has been removed from the schedule. This is the Saturday before the new moon.

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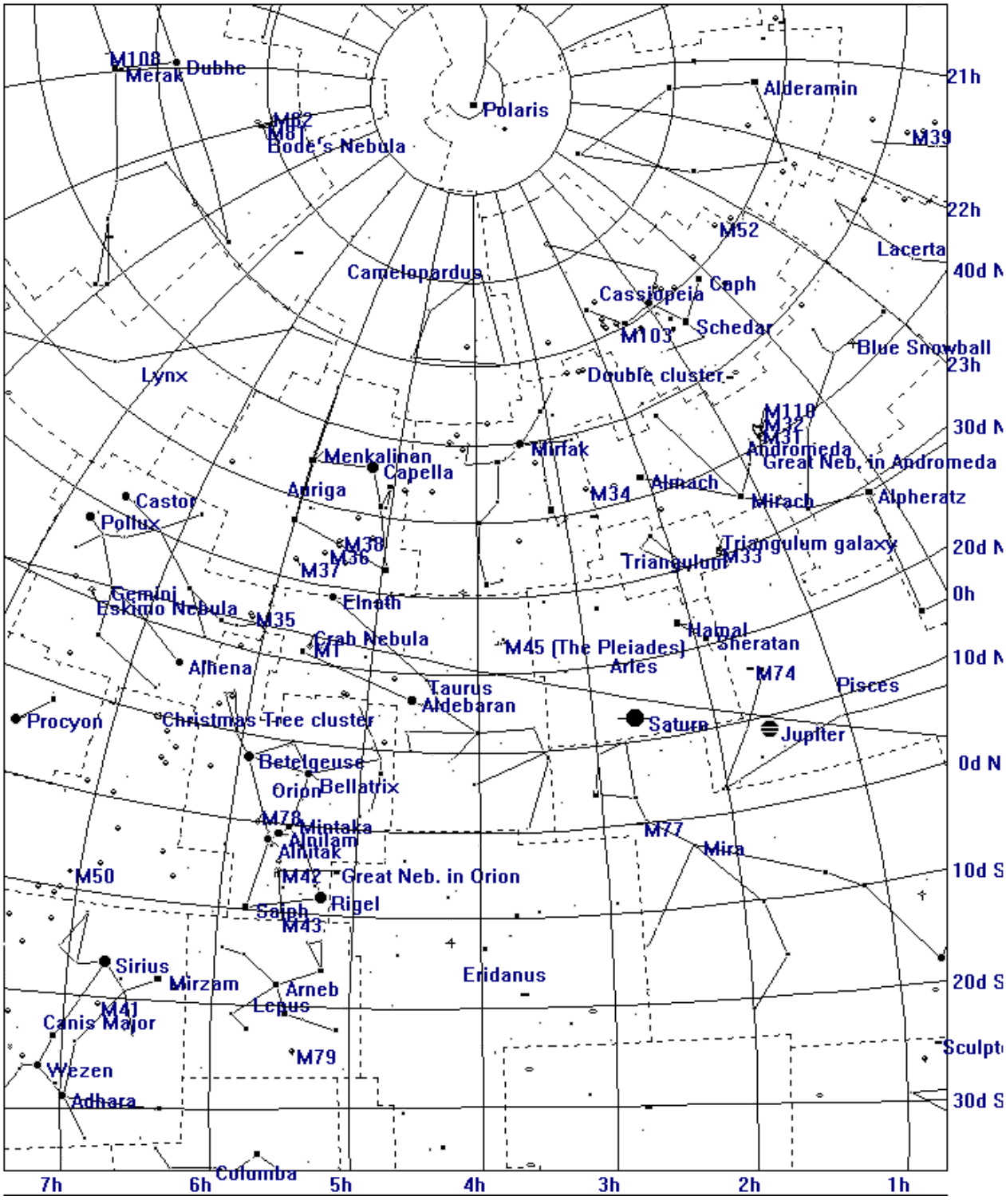
Win a Calendar Contest

Guess the attendance at the Leonid meteor shower event at Hudson Mills Metropark. The most accurate guess will receive a free calendar. This is not just any calendar, it's a "Y2000 Wonders of the Universe" calendar. E-mail me your guess, Bfriberg@aol.com, or call 480-4514 and leave a message.


M108
Merak
Dubhe
Polaris
Alderamin
21h
M82
M81
Bode's Nebula
M39
22h
M52
Lacerta
Camelopardus
Cassiopeia
Caph
40d N
Schedar
M103
Blue Snowball
23h
Lynx
Double cluster
M110
M32
M31
30d N
Andromeda
Great Neb. in Andromeda
Menkalinan
Capella
Mirfak
Auriga
Almach
M34
Alpheratz
Castor
Pollux
Mirach
M38
M36
M37
Triangulum galaxy
M33
Triangulum
20d N
Gemini
Eskimo Nebula
Elnath
0h
M35
Crab Nebula
M1
Hamal
Sheratan
M45 (The Pleiades)
Aries
10d N
Athena
M74
Pisces
Taurus
Aldebaran
Procyon
Christmas Tree cluster
Saturn
Jupiter
Betelgeuse
0d N
Orion
Bellatrix
M78
Mintaka
Alnilam
Alnitak
M77
Mira
M50
M42
Great Neb. in Orion
10d S
Rigel
Saiph
M43
Sirius
Eridanus
Mirzam
Arneb
20d S
M41
Lepus
Canis Major
M79
Sculpt
Wezen
Adhara
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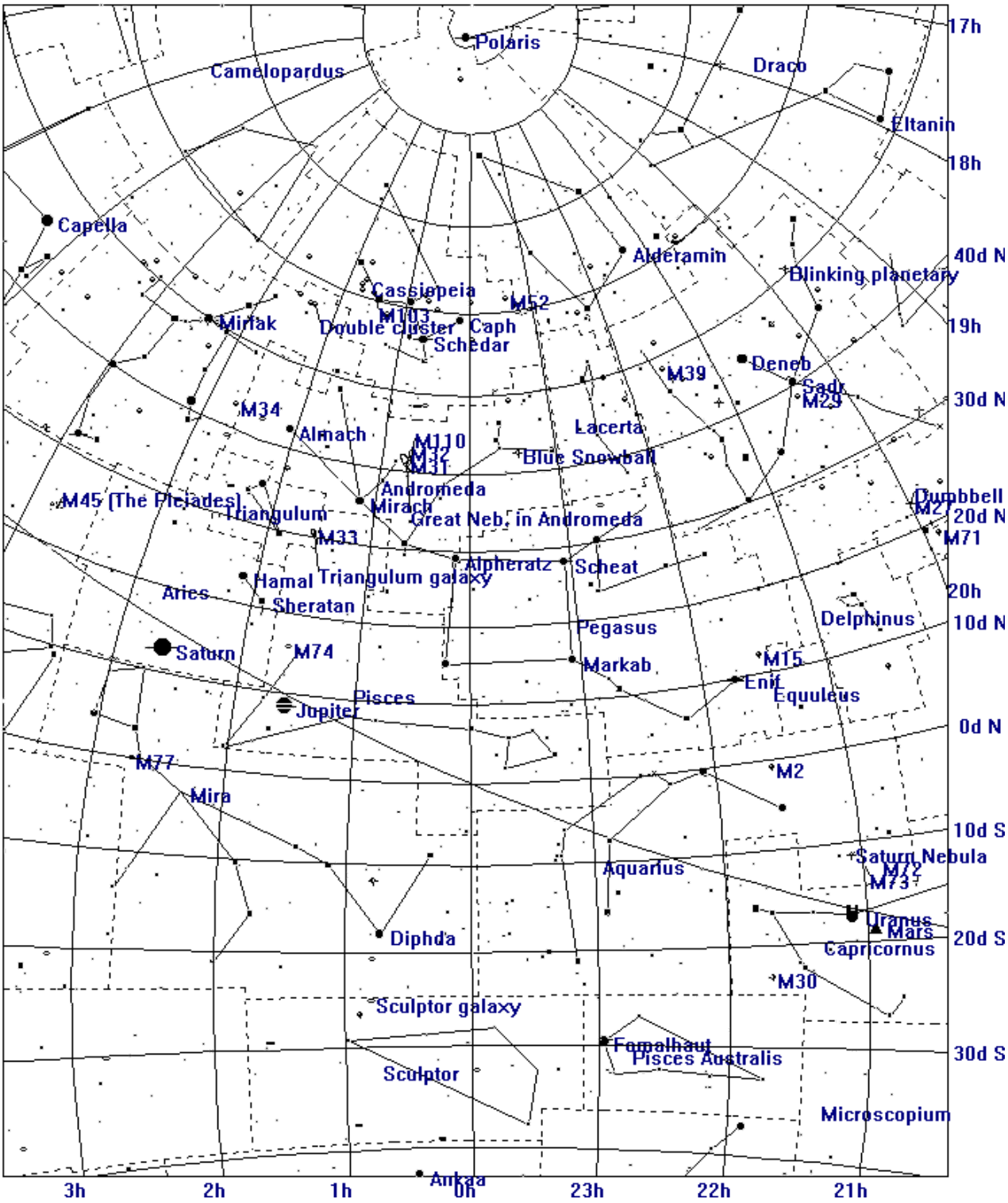
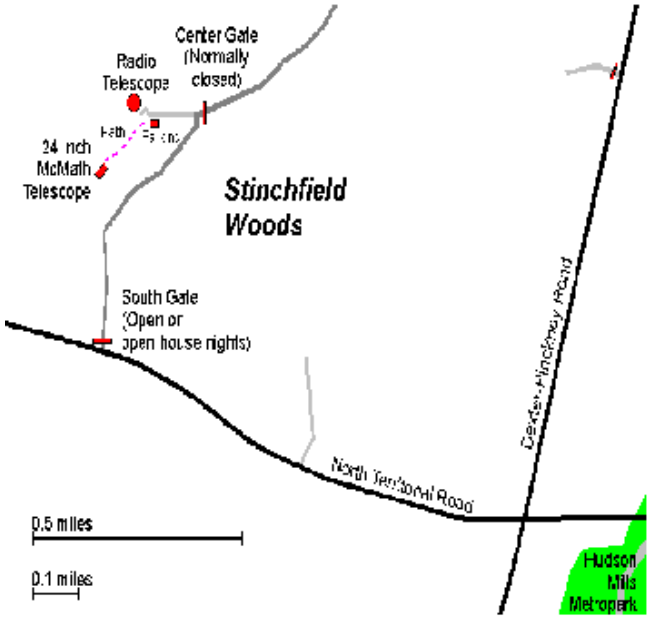
Th cThe Sky Software



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
December 17, 1999, 7:30 pm
Room 807 Dennison Hall
Physics & Astronomy Building
The University of Michigan

Video on spin casting large aperture mirrors at the University of Arizona's Mirror Lab.

(Video Provided by Clay Kessler)

The moon at the height of the lunar eclipse on March 23, 1997. Taken by Bernard Friberg at prime focus using the 6" refractor at Peach Mountain. Get ready for the next total lunar eclipse that will be seen from North America on January 20th.

UNIVERSITY LOWBROW
ASTRONOMERS
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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 !