Reflections

Reflections

of the University Lowbrow Astronomers

March 1997

The Aurora Borealis near Fairbanks, Alaska, on February 8, 1997. Photos by Jan Curtis <jcurtis@gi.alaska.edu>. More of Jan's aurora pictures can be found at http://climate.gi.alaska.edu/Curtis/aurora/aurora.html

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 each month, weather permitting, at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinckney Road; see inside for directions) on the Saturday evenings before and after the new Moon. For more information call (313) 480-4514.

Important Dates

This Month:

Mar 8 - Public Open House at Peach Mountain Observatory

Mar 15 - Public Open House at Peach Mountain Observatory

Mar 21 - Meeting at 807 Dennison: All About Comets, Part II (i.e. we're not sure who will be talking yet, but we know what they'll be talking about!)

Mar 23 - Amateur Telescope Makers Group will meet at 2 PM at Kurt Hillig's house; call 663-8699 for directions

Next Month and Beyond:

Apr 5 - Public Open House at Peach Mountain Observatory

Apr 12 - Public Open House at Peach Mountain Observatory

Apr 18 - Meeting at 807 Dennison

Apr 20 - ATM group meeting

Apr 25 & 26 - Comet Party at Kensington Metropark

May 1-3 - Huron County Star Party near Port Austin, MI.

We Sail for Far Centaurus

Jay Reynolds Freeman <freeman@netcom.com>
Palo Alto, CA

"Avast, ye scurvy swabs, the solar wind be fair! 'Tis for far Centaurus we sail!" Thus I replied to a friend's E-mailed comment, that with the eye patches we often wear, deep-sky observers look like pirates. Yet though a chorus of hearty "Arrrgh!"s greeted me at Fremont Peak on January 10, 1997, I had better things to do than hoist the Jolly Roger.

What a night! The air had quieted after frontal weather earlier in the week, so no low-level cumulus clouds impeded visibility. The next system was still far off, so the high sky stood clear. Calm conditions meant that the thick, wet fog forming in the damp air slid downhill and stayed there, turning off the lights of cities and towns, leaving a spectacular view, clear to the horizon, in all directions.

For almost twenty years, my deep-sky observing program has been to observe all the galaxies, star clusters, and nebulae listed in Burnham's *Celestial Handbook*, at or north of 45 degrees south declination. That boundary encloses 85 percent of the sky. From observing sites at 36 or 37 degrees north latitude, it is a tough limit – it takes good sky, good equipment, and moderate skill to chase down a 13th magnitude galaxy more than eighty degrees off the zenith. Since clear weather is scarcest, and I am laziest, in the cold months of the year, the last handful of unobserved objects lie far to the south, at right ascensions best placed in the dead of winter. But on such a night as this, surely I can get a few more.

I set up my six-inch Maksutov, and swing it south and east. Maybe, but not now – that part of the sky is too low. Brrr, it will be some hours yet. I zip up my down vest, double my fists inside my mittens, and settle down to look at less exotic objects for a while.

Yet my eyes are drawn to the great cluster of suns on the far side of Sirius. I think of my eye patch in whimsy – for in truth, there is a pirate ship in the sky.

She is the Argo, the trim fighting galley of the Greek corsair, Jason. She sails upon the southern Milky Way. Modern astronomical cartographers have separated her vast bulk into four separate constellations, yet her form remains. Canis Major must be a salty sea dog, for he dances on the aft rail of her poop deck, the constellation Puppis. Pyxis is her small and stubby mast – galleys are driven primarily by oars. Vela comprises her sails. And there is one more.

In this region lie dazzling stars, blue-white diamonds that shock the eye with cold actinic fire – zeta Puppis, gamma Velorum, and a generous strew of others, a great thunder of suns. If this is pirates' booty, it is treasure rare indeed. And there is one more.

I climb the hill with my 10x50 Ultraview binocular, red flashlight, and an old Norton's *Star Atlas*. Fremont Peak stands above most of the surrounding terrain, and the view to the south goes to the true horizon. In the crystalline air, I star-hop through unfamiliar heavens, south of Sirius, through Puppis, south, and south again. I pause at a particularly bright star, a few degrees above the distant skyline, near an airplane landing light that winks off and on. Can that star be...? No, it's just tau Puppis.

The airplane light has risen slightly, and brightened enormously. I put down the binocular, for it is easily visible to the naked eye. It drowns tau Puppis. I try the binocular again. The light is not moving with respect to the stars. It brightens further, regularly flashing reds, and yellows, and all the other colors of the horizon, but now and then exhibiting the same diamond purity of the lesser luminaries higher up. It is Canopus, the brightest star in Carina, the keel and fourth constellation of Argo. Canopus is second only to Sirius for brightness among the nighttime stars. Even at a degree above the horizon, it is *bright*. I have never seen it before, nor anything else in Carina. For the first time in my observing career, all the parts of the Argo lie before me. I take it as an omen.

I descend to my telescope and dig out Burnham's. Quick, quick, get two clusters and a nebulous wisp in western Vela, before they drop below the shoulder of the hill. Phew! More leisurely now, swing the telescope up to Antila for nine or ten galaxies, none much below 32 degrees south. Then back to Vela, for three galaxies in the eastern part of the constellation, that lie near my 45-degree southerly limit.

There is just one object left. It lies another hour of right ascension to the east, not yet high enough to see, so I kill time chasing down the Messier galaxies in Leo and Virgo with the 10x50 – a cinch, the only problem is keeping track which is which. I started my Burnham's observing program in 1978, with a 7x50. The object that remains is bright enough to find with a binocular, but it will be more fun to end on a different note. A friend has a Meade 12-inch LX200, a computer-controlled telescope with capabilities unheard of in 1978. I ask him to dial up the object for me, not telling him why until I am certain of success.

And there it is! At 88X, we resolve open cluster NGC 3680, the final entry in my doggedly-pursued and at last finished deep-sky program, above the prow of the Argo, in far Centaurus.

Third Huron County Star Party

Here's a heads up on another upcoming star party – the third annual Huron County Star Party, to be held May 1-3, 1997 at Duggan's Family Campground, 8 miles west of Port Austin (at the tip of the Thumb) on M-25. This is a very dark site – the campground is 500 feet from Lake Huron. The campground is privately owned and will be made ready for dark observing.

Electricity will be available (but bring your own extension cords and power strips); rustic sites have no electricity but are more open to the sky. Rest rooms and showers are available. Nearby activities include canoeing, golf, museums and horseback riding.

For more info, contact Barry Craig at (810)547-1299; campground queries should be directed to Diana at (517)738-5160.

LOWBROWS TAKE NOTE: We now have an e-mail group address – "lowbrow.astronomers@umich.edu". Mail sent to this address will be redistributed to all registered club members. If Doug Scobel doesn't have your e-mail address, let him know ASAP! Contact Doug Scobel <scobel@ann-arbor.applicon.com>

Giant Star Party at Kensington in April

David D'Onofrio, President
Warren Astronomical Society.
(810)977-5421 Dave1act.aol.com

With the coming of comet Hale-Bopp, our club thought it would be a great idea to gather together all the local Astronomy clubs in South Eastern Michigan to co-sponsor comet Hale-Bopp to the public. At this time Bob McFarland has joined us to co-sponsor this event and we wish to extend this invitation to you and your organization.

The viewing place selected will be at Kensington Metro Park at the Martindale Beach location. We have permission from the metro park authority at Kensington to host this event on the nights of April 25 & 26 1997 from 5:00pm to 12:00am. This event will be in conjunction with the Kensington Spring Festival occurring that same weekend. The Kensington authority are very excited about our event and would like to have us as their evening event for their Spring Festival. We are talking to the Detroit Astronomy Club, the Lowbrows and EMU to join us in this event. The following is a list of items that we have agreed upon with the Metro Parks Authority.

- Site location: Kensington Metro Park; Martindale Beach, public viewing time is 5:00 pm to 12:00 am. Viewing time for Astronomy club members is 5:00pm to 2:00am.
- Viewing area: Martindale Beach provides clear horizons up to between 5 and 10 degrees from the horizon facing West, North, and South. In those directions you are looking across the lake. The East is very good except there are a few scattered trees. This site contains plenty of wide sidewalks and grassy areas to set up telescopes and binoculars.
- Power: This site has A.C. power and additional power will be brought in if necessary.
- Facilities: There are facilities for restrooms as well as a medium size outdoor shelter at the site. This site can handle up to a couple thousand people.
- Lighting: We have control over the lighting at this site. There will be portable lighting in the parking lots which can be both aimed and controlled. We also can control the lighting at the outdoor shelter and restrooms.
- Transportation: The Metro Parks people will provide a vehicle to transport your telescopes from your car in the parking lot to the site should you need help. (about 200 feet)
- Food & Drinks: Elias Brothers will be selling food and drinks for the public.
- Displays: You will be allowed to set up a table (under the shelter) to pass out any FREE literature on your club and about the comet or astronomy in general. We have an agreement to sell a sticker displaying the comet and the Metro-Parks logo. Should you be interested in selling the logos, please contact me.
- Vendors: There is limited room for some vendors to set up, however they are not allowed to sell anything. They can display there products for sale but cannot sell on the premises. This is a Kensington Park rule.
- Parking: There is sufficient parking to handle up to a couple thousand people. Astronomy Club members bringing equipment will be allowed to park near their observing site.
- Shelter: Although the shelter is not very big, It will provide cover if it rains and also provide a dark area to have slide shows.

The Metro Parks people will copy, for free, copies of an information news letter that will contain information about the comet and possibly our clubs. Please contact me soon about this.

Metro Park people are providing a Big screen and projector for slide shows. We need to provide slide shows during the two night event. We would like to have all the participating clubs take part in this event.

Metro Parks Authority will supply a Tractor/trailer that the public can walk through to explore various Astronomical Displays.

Metro Parks will advertise including the papers and cable TV. They are expecting between 2000 and 3000 people.

If your organization would like to participate in this event please contact me at (810) 977-5421 or email me at Dave1act@aol.com. Our deadline for submitting the newsletter and press release is March 20, 1997. I hope you can join us and look forward to hearing from you.

[Editor's note: The Lowbrows will be participating; Doug Scobel is coordinating this for us, please contact him if you haven't already done so. This event is expected to draw several thousand people, and lots of help will be needed for it; all Lowbrows are strongly encouraged to help out on at least one of the two nights!]

ATM News

The last meeting of the ATM group was sparsely attended, largely due to missed communication over when it was to take place. As a result, the most significant business we took care of was to better define the dates of future group get-togethers: specifically, we will meet on the Sunday afternoons immediately following the regular Lowbrow meetings each month. This should allow everyone to have at least a few days warning in the monthly newsletter.

We then moved on to look at several scopes and pieces that various members had brought, with an eye toward seeing what's good and bad about various designs. Much of the discussion focussed on the tradeoffs that are made in designing telescope bodies and mounts, between maximizing stiffness, minimizing weight, and simplifying construction and use.

Kurt Hillig brought his Meade 2045D – a very compact 4" SCT (Schmidt-Cassegrain Telescope). The small size of the 4" fork mount leaves little room for a large polar axis shaft (it's only 7/8" by 1"), and as a low-priced "entry-level" scope it uses nylon bushings as bearings; so there was a fair bit of wobble in the mount. Kurt has modified his by remachining the base of the fork to pivot on ball bearings. This has made a big difference – but for ATMs without access to a machine shop it's not a viable option.

Doug Nelle brought his collapsible Dobson-mounted 8" Newtonian scope. The rocker box of this scope also forms the bottom half of the optical tube, and the top half "telescopes" inside of this, with four thumbscrews to hold the two pieces in place. The scope packs into a mediam-size duffel bag, making it easily portable for camping trips – though it's heavy enough that you wouldn't want to take it backpacking!

We're running out of space here, so we'll see you at the next meeting – at Kurt Hillig's house, 7654 W. Ellsworth Rd (2 miles W.of Zeeb Rd.), March 23 at 2PM. Call 663-8699 for directions.

Meters and Megatons: The Physics of Large Impacts

Brian Davis <davis@miphys.physics.lsa.umich.edu>

As the TV networks have seen fit to hype the drama of meteor collisions in the past month, largely at the expense of scientific rigor, I thought this posting in the sci.astro usenet news group might be of interest. Those who don't watch TV can also read it! – Ed.

Does anyone know where I can find a formula that relates the kinetic energy of impact from an in-falling body to the body's size? I read a review in Physics Today and it has radius=5m yields ~1MT and radius = 1Km yields ~10^6 MT. I know the kinetic energy should scale as the radius to the third power but that assumes no air resistance and equal velocities upon explosion, so is not exactly accurate, and above two points bear this out.

I'm not sure they do. If you assume KE scales as the radius to the 3rd power, then those two figures are pretty close. Assuming the first is correct, the second "should" be 8.0 x 10^6 MT. Since they're only quoted to an order of magnitude (in your post, at least), they're only one off.

In general, I want to know more about what happens to objects that fall to the earth through the atmosphere.

That's quite a bit actually. The best way to learn about this is to read. I'd suggest the following as good, detailed (but not overly technical) sources: "Impact Cratering, a Geologic Process", H. J. Melosh, Oxford University Press, 1989, and "Hazards Due to Comets & Asteroids", T. Gehrels, Editor, University of Arizona Press, 1994.

To take some of the questions one at a time:

I want to know the density of these objects,

Depends on what they're made of. Low end is around 900 kg/m^3 (ice; could be a little lower), high is about 7680 kg/m^3. 3500-4000 kg/m^3 is the typical range for "rock". This also assumes they're "solid" (see below).

their most likely arrival direction and velocity,

Direction is not quite isotropic, but close. I think you get a few more impacts on the leading edge of a planet (and slightly higher velocity ones) than on the trailing edge, but it's not a big factor. Final velocities can be as low as 11.2 km/sec – roughly 7 mps – but not lower (it's hard to get below escape velocity when you're falling in from a long way away), up to perhaps 40 km/sec for objects on cometary-type orbits. The mean is probably around 15-20 km/sec.

It should be added that most of the simple math worked out for this sort of thing assumes atmospheric entry is straight down, while in reality the most likely impact angle is 45 degrees, with just about any angle possible. And the angle changes the outcome considerably.

their most likely shape,

Unknown. In general irregular – almost any shape at all. Most research deals with an assumed spherical impactor, because a) it could be anything, and b) it makes the math easier. Many of these objects may be composite: two "kissing" balls of rock, or loose aggregations of gravel, or co-orbiting pairs are all possibilities.

what happens upon traversing the atmosphere?

Deceleration for the smaller ones. In principle, you would need to solve the equations for gravitational acceleration, drag, & ablation. You can write a simple spreadsheet to do this if you wish, but with all the other unknowns (like shape) a few rules of thumb will suffice. The main question is whether the object is "stopped" by the atmosphere, or if it still hits with a significant downward velocity ($v_{final} > 10\%\ v_{inital}$):

$R_{min} = 30\ P\ /\ (\ \rho\ g\ \sin\theta\ )$, where

R is the minimum radius to penetrate the atmosphere
P = Surface pressure (101253.6 N/m^2 for Earth)
ρ = Density of object (in kg/m^3)
g = acceleration of gravity (9.8 m/s^2)
θ = impact angle (90 degrees = straight down)

Note that for Earth, chunks of ice with r>75m, or chunks of iron with r>20m, make it through the atmosphere with very little deceleration. So in this case, your simple "KE goes as R^3" law is relatively accurate.

where they likely break up,

They can be broken up by the pressure differential between the front (slamming into the atmosphere) and the rear (exposed to a thin vacuum in the wake channel). For a hypothetical 100m iron impactor at 15 km/sec, at 10 km up the bow pressure is over 750 Atm, while the pressure on the rear face is near zero. This is what may crush the asteroid. Figuring out when is a little tougher, and depends on a lot of factors, most of which are unknown. I can tell you that above a certain size, if the object fragments it will not have time to spread out much, and will hit like a single object. The critical radius is:

$R_{crit} = 2\ H\ \sqrt{(\rho_{air}\ /\ \rho_{asteroid})}$, where

H = scale height of atmosphere (about 8 km for Earth)
ρ = densities of air and impactor respectively.

Objects larger than the critical radius impact as one body even after breakup. For Earth, icy objects with r>290m and iron objects with r>100m are likely to impact effectively as one body, regardless of aerodynamic breakup.

and what the kinetic energy gets converted into.

Heat! The atmospheric entry creates a bow shock and detached shock wave cone behind the object. In the bow shock temperatures reach over 20000 degrees K, and the shock wave carries away still more energy. If the object is large (i.e. deceleration and ablation are negligible), the energy dissipated in the air (in joules) is roughly:

$E = 2\ \pi\ C\ R^2\ v^2\ \rho\ H\ /\ \sin\theta$, where

C = drag coefficient (typically 0.25-0.5)
R = radius
v = velocity
ρ = density
H = scale height
θ = entry angle

Thought-Provoking Imagery Shows Sun's Place in the Galaxy

Douglas Isbell
Naval Research Laboratory

An action-packed movie assembled from images taken by an instrument aboard the NASA-European Space Agency Solar Heliospheric Observatory (SOHO) has provided a remarkable galactic perspective on the Sun and its place in the Milky Way.

Taken during Dec. 22-27, 1996, the series of images show the Sun drifting in front of the stars of the constellation Sagittarius, as the constant solar wind blows outward in all directions. Soon, a comet passes into view from the south and disappears behind the Sun. Finally, in an unrelated event, a plainly visible giant puff of solar gas is emitted, representing a large mass ejection in a direction away from the Earth.

The remarkable images come from SOHO's visible-light coronagraph, LASCO, which is able to mask the intense rays from the Sun's surface in order to reveal the much fainter glow of the solar atmosphere, or corona. Operated with its widest field of view, LASCO's unprecedented sensitivity enabled it to see the thin ionized gas of the solar wind out to the edges of the picture, 13 million miles from the Sun's surface. Many stars are brighter than the gas, and they create the background scene.

The results may alter human perceptions of the Sun in the same way that the Apollo lunar mission photographs revealed the Earth to be a beautiful but isolated planet in space, according to leader of the LASCO team, Dr. Guenter Brueckner of the Naval Research Laboratory, Washington, DC.

"I spend my life examining the Sun, but this movie is a special thrill," Brueckner said. "For a moment, I forget the years of effort that went into creating LASCO and SOHO, and leave aside the many points of scientific importance in the images. I am happy to marvel at a new impression of our busy star that gives us life, and which affects our environment in many ways that we are only now beginning to understand."

For many centuries even astrologers knew that the Sun was in Sagittarius in December and drifting towards the next zodiacal constellation, Capricorn. This was a matter of calculation only, because the Sun's own brightness prevented a direct view of the starfield. The SOHO-LASCO movie makes this elementary point of astronomy a matter of direct observation for the first time.

"This is an especially dramatic sample of the data that scientists are now starting to gather routinely from SOHO," said George Withbroe, director of the Sun-Earth Connection science program at NASA Headquarters, Washington, DC. "It really helps drive home the idea that the Sun is a typical star, although we certainly have a special relationship with it."

In the movie, north is at the top of the scene, which corresponds with the orientation of the Sun as seen at midday in the northern hemisphere of Earth. SOHO's progress in orbit around the Sun remains in step with the Earth's motion. SOHO travels towards the right (west) in relation to the stars during the period of observation. As a result, the Sun's position appears to shift to the left (eastwards) in front of the stars. In this mode, LASCO observes an area of the sky 32 times wider than the visible Sun itself.

At the time of the observations, SOHO is looking towards the heart of the Milky Way Galaxy, which lies in the constellation of Sagittarius. The Milky Way, made by the light of billions of distant stars, forms a luminous band slanting down and to the right. Dark lanes seen in the Milky Way are real features familiar to astronomers. They are created by dust clouds in the disk of the galaxy that obscure the distant stars.

A doomed comet, previously unknown, enters on the left of the image on Dec. 22. Its path curves towards the Sun and on Dec. 23 it disappears behind the occulting mask of the coronagraph. It fails to reappear on the far side of the Sun. Whether or not its trajectory took it directly towards the visible surface, the comet must have evaporated in Sun's atmosphere. It was one of a family of comets known as sungrazers, believed to be remnants of a large comet that broke up perhaps 900 years ago. Other fragments were responsible for spectacular comet apparitions in 1843, 1882 and 1965.

Called Comet SOHO 6, it is one of seven sungrazers discovered so far by LASCO. Analyses of these cometary orbits, now in progress, are a prerequisite for their inclusion in the official record of comet discoveries. LASCO also provided unique pictures of Comet Hyakutake passing behind the Sun in early May 1996.

Debris strewn from the tails of many comets makes a disk of dust around the Sun, in the ecliptic plane where the planets orbit. It scatters sunlight and is sometimes visible attwilight on the Earth, known as the Zodiacal Light. In the raw images obtained by LASCO, the Zodiacal Light is brighter than the solar corona. Image processing subtracted these effects precisely, to bring the solar wind and the Milky Way into plain view.

Random flickers of light in the images are due to cosmic rays striking the detector. Cosmic rays are energetic particles coming from exploded stars in the Milky Way, and variations in the solar wind influence their intensity in the vicinity of SOHO and the Earth. Operating beyond the Earth's protective magnetic field, which repels many particles, SOHO is more exposed to the cosmic rays.

In the largest outburst from the Sun seen in the December movie, a mass ejection causes billions of tons of gas to race out into space on the right-hand (western) side of the Sun. The origin of this event much lower in the Sun's atmosphere was evident in an expanding bubble seen in processed images from the SOHO extreme ultraviolet imager.

Coronal mass ejections are the hurricanes of space weather. SOHO is ideally placed to report and even anticipate their origins in the Sun's atmosphere. Although the Sun is supposedly very quiet at present, being close to the minimum count of sunspots, LASCO has observed so many outbursts large and small — roughly one a day — that scientists are having to think again about how to define a coronal mass ejection. Later LASCO images, from Jan. 6, 1997, revealed a large mass ejection directed towards the Earth.

The movie and still photographs related to it are available on the Internet at the Naval Research Laboratory's SOHO/LASCO home page:

http://lasco-www.nrl.navy.mil/lasco.html

A mission of international scientific cooperation between NASA and the European Space Agency (ESA), SOHO was launched on Dec. 2, 1995. It is situated near the L-1 Lagrangian point, where the Earth's and Sun's gravitational forces balance, some one million miles sunward from the Earth. This vantage point enables solar astronomers to use SOHO's 12 science instruments to observe the Sun continuously, with no intervening "night." Major areas of research include studies of the solar interior via helioseismology, the solar atmosphere in ultraviolet and visible light, and the solar wind and energetic particles.

Pluto 2?

Brian Skiff <bas@lowell.edu>
Lowell Observatory

Here's one that will get tongues wagging: a large object at twice the distance of Pluto. Appended below is an excerpt from an MPEC (Minor Planet Electronic Circular) by Brian Marsden, which describes the discovery and follow-up of this body. The object described has an approximate semimajor axis of about 86 AU, a period of about 800 years (!), and an orbital eccentricity of 0.6 (very elongated). In the table of orbital elements is a number H, given as 5.0. This is the absolute magnitude of the object, and this value corresponds to a body in the 300-400 km diameter range. The object has been discovered because it is close to perihelion, and is at present about 35 AU (i.e. at about Pluto's distance).

Note also the amateur contribution: the most recent arc-extending positions have been supplied by Warren Offutt, a retired engineer who uses a 60cm (24-inch) "backyard" telescope in southern New Mexico.

Finally, because the orbital period is so long, the elements are not known very well. N.B. the comment about this at the bottom of the message.

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M.P.E.C. 1997-B18                     Issued 1997 Jan. 30, 23:25 UT

The Minor Planet Electronic Circulars contain information on unusual minor planets and
routine data on comets.  They are published on behalf of Commission 20 of the Interna-
tional Astronomical Union by the Minor Planet Center, Smithsonian Astrophysical Observa-
tory, Cambridge, MA 02138, U.S.A.  BMARSDEN@CFA.HARVARD.EDU or GWILLIAMS@CFA.HARVARD.EDU
URL: http://cfa-www.harvard.edu/cfa/ps/mpc.html

Selected Observations of 1996 TL66:
      J96T66L* C  1996 10 09.56206  02 00 21.58 +14 44 19.9 20.9 R       568
      J96T66L  C  1996 10 13.39172  02 00 02.31 +14 42 04.5 20.9 R       568
      J96T66L  C  1996 11 17.16251  01 57 05.45 +14 20 34.2 20.7 R       696
      J96T66L  C  1996 11 18.09057  01 57 01.15 +14 20 00.8 20.5 R       696
      J96T66L  C  1997 01 10.14272  01 54 49.66 +13 57 09.4 20.7 V       709
      J96T66L FC  1997 01 11.22515  01 54 49.95 +13 56 57.3 19.4 V       709

Observer details:
      568 Mauna Kea.  Observers C.Trujillo, D.Jewitt, J.Luu, J.Chen
        2.2m University of Hawaii reflector + CCD.
      696 Whipple Observatory, Mt. Hopkins.  Observers C.W.Hergenrother, W.R.Brown
        1.2m reflector + CCD.
      709 Cloudcroft.  Observer W.Offutt
        0.6m Ritchey-Chretien + CCD.

Orbital elements for 1996 TL66:
      Epoch 1996 Nov. 13.0 TT = JDT 2450400.5     Marsden
      M 357.30082            (2000.0)          P               Q
      n  0.00124115     Peri. 187.67898    +0.70850464    -0.66061767
      a 85.7535943      Node  217.77480    +0.66710115    +0.74168859
      e  0.5934785      Incl.  23.90319    +0.23021127    -0.11611345
      P 794     H 5.0    G 0.15     U 6
>From 32 observations 1996 Oct. 9 - 1997 Jan. 11, mean residual 0".29.

Ephemeris:
      1996 TL66     a,e,i = 85.75, 0.59, 24       q = 34.861
      Date      TT   R. A. (2000) Decl.   Delta      r    Elong.  Phase     V
      1997 01 22   01 55.00  +13 55.5  35.172  35.179   89.6    1.6    20.7
      1997 02 01   01 55.36  +13 55.3  35.342  35.176   79.5    1.6    20.7
      1997 02 11   01 55.89  +13 56.1  35.506  35.173   69.5    1.5    20.7
      1997 02 21   01 56.60  +13 57.8  35.660  35.170   59.6    1.4    20.7

The above orbit is a general solution, the estimated uncertainty range in semimajor axis
being 80 < a < 108 AU.  Further discussion is included in a paper by Luu et al. (1997,
submitted to Nature).
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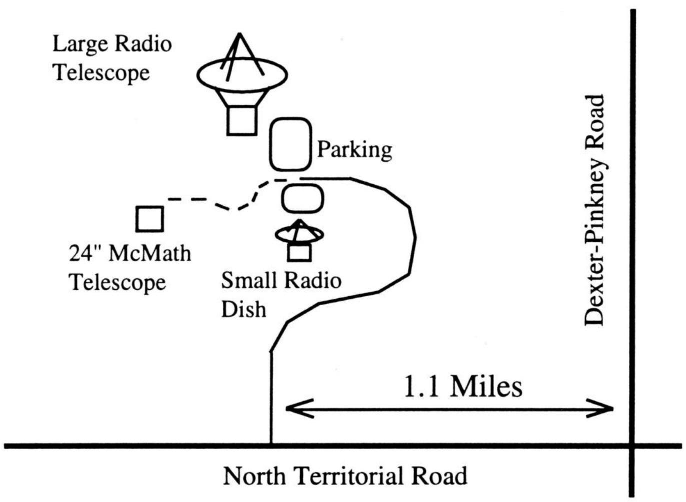
Places:

Dennison Hall, also known as the University of Michigan's Physics and Astronomy building, is located on Church Street in Ann Arbor, one block north of South University Ave. The University parking structure on Church Street is very close by, and is open to the public after 6 PM.

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-Pinckney 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. Peach Mountain is home to millions of mosquitos in the summer, so bring insect repellant!



Times:

The monthly meetings of the Lowbrows are held on the third Friday of each month at 7:30 PM in 807 Dennison Hall. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.

An amateur telescope making group meets monthly, with the location rotating among members' houses. See the calendar on the front cover for more information on the time and location of the next meeting.

Public Open House/Star Parties are held on the Saturdays before and after each new Moon, at the Peach Mountain Observatory. Star Parties may be cancelled if the sky is cloudy at sunset or the temperature is below 10°F – call 480-4514 to check on the status. Many members bring their telescopes; visitors are welcome to do likewise. Peach Mountain can get cold at night, so dress appropriately!

Membership:

Membership dues in the Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students. This entitles you to monthly issues of *Reflections* and the use the 24" McMath telescope (after training). Dues can be paid to the club treasurer, Doug Scobel, at any meeting or by mail at this address:

1426 Wedgewood Dr.
Saline, MI 48176

Magazines:

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

Sky and Telescope: $27 / year
CCD Astronomy: $20 / year
Astronomy: $20 / year
Odyssey: $16.95 / year

For more information, contact the treasurer.

Newsletter Contributions:

Members (and non-members) are encouraged to write about any astronomy-related topic in which they are interested. Images, whether photographs, sketches, or in electronic form (GIF, TIFF or JPEG) are also welcome. Call the editor (Kurt Hillig) at 313/663-8699(h) or 313/647-2867(o), or send e-mail to khillig@umich.edu, to discuss length, format, etc. Announcements and articles are due 14 days before each monthly meeting. Contributions can be mailed to:

Kurt Hillig
7654 W. Ellsworth Rd.
Ann Arbor, MI 48103

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Newsletter:	Kurt Hillig	313/663-8699
Publisher:	Lorna Simmons	313/525-5731

Peach Mountain Keyholder:
Fred Schebor 313/426-2363

Visit our Home Page:

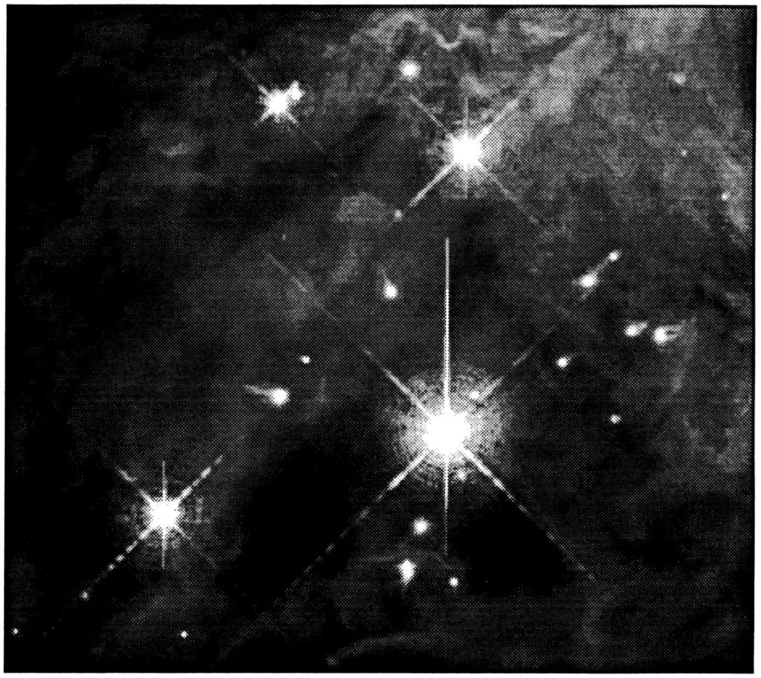
http://www.astro.lsa.umich.edu/lowbrows.html

Monthly Meeting:

The Lowbrow Astronomer(s) on: All About Comets Part II

Mar. 21, 1997 at 7:30 PM

Room 807 of the Dennison Building on the UM Campus



The center of the Trapezium cluster in the Orion Nebula (M42), showing the four massive energetic stars and a number of evaporating proto-planetary disks. This mosaic, made by combining multiple Hubble Space Telescope images, was presented to the American Astronomical Society meeting in Toronto on January 14th, 1997. Photo credit: John Bally, Dave Devine, and Ralph Sutherland. [You should see it in color! - Ed.]

University Lowbrow Astronomers
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Check your membership expiration date on the mailing label!