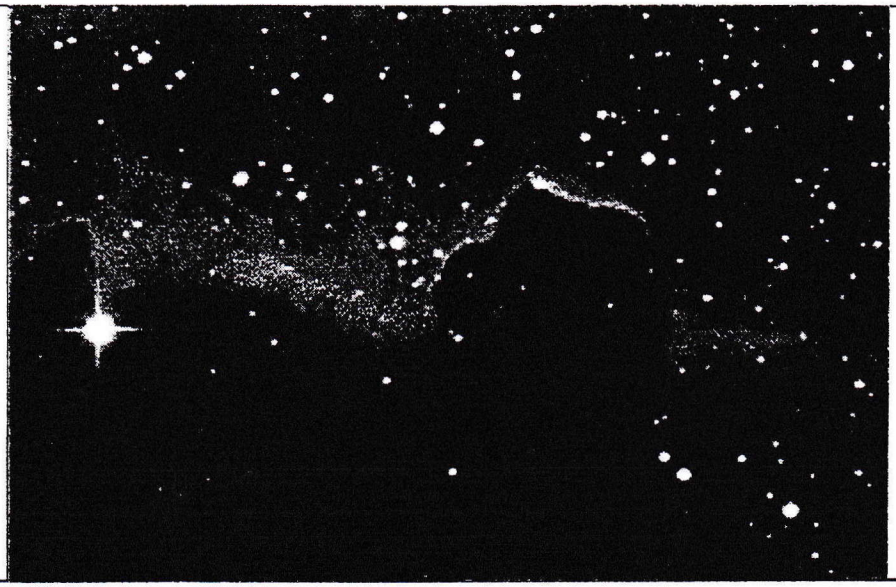
REFLECTIONS



REFLECTIONS

December 1994

Bernard Friberg and Douglas Warshow, Editors

Of the University Lobrow Astronomers

The University Lowbrow Astronomers is a club of 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 also held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; there is a map near the end of the newsletter) on Saturdays before and after the new moon; if it's cloudy or very cold just before sunset, call (313) 480-4514 to see if the event is cancelled. For futher information, contact Bill Razgunas at (313) 995-0934.

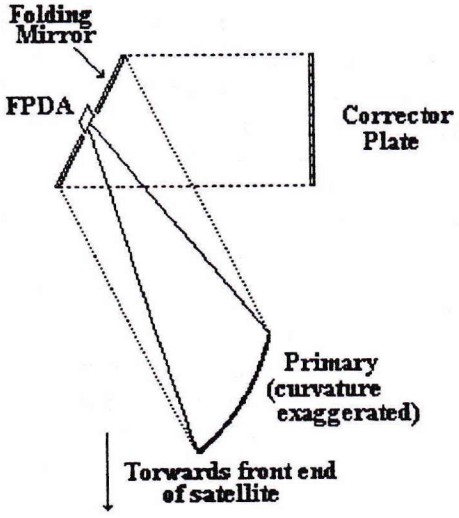
This Month		Next Month	
December 1	Computer subgroup meeting at Doug Warshow's place (1010 Catherine, #408) at 7:30 PM. Call (313) 998-1158 for directions.	January 1	National Hangover Day. See stars all day long (like it or not).
		January 3-4	Peak of Quadrantid meteors.
		January 4	Earth at perihelion.
December 3	Open house at Peach Mountain.	January 5	Computer subgroup meeting at Bill Razgunas' house. Call (313) 995-0934 to confirm or to receive details.
December 16	Meeting at 807 Dennison. Time again for Fred Schebor's Artsy Meaningless Slide Show.		
December 21	Winter solstice at 9:23 PM EST. The longest night for observing you will get for another year!	January 7	Open house at Peach Mountain.
		January 20	Meeting at 807 Dennison. Mario Mateo will discuss "New Light on Dark Matter."
December 31	Scheduled open house. Call (313) 480-4514 to confirm.	January 28	Open house at Peach Mountain.

THE HIPPARCOS OBSERVATORY

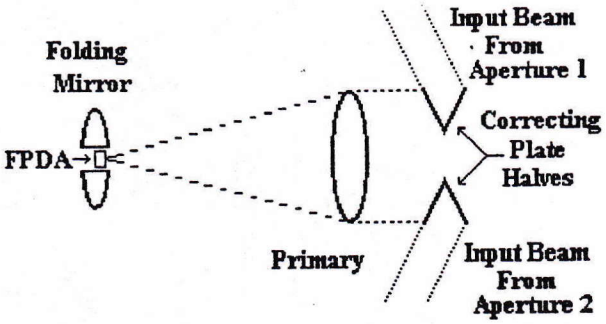
by Gerhard Niklasch
Technische Universitaet Muenchen

The HIgh Precision PARallax COllecting Satellite is designed to measure positions of more than 100,000 stars (down to about magnitude 11) with consistent and unprecedented accuracy; since observations span several years, parallax and proper motion data are also acquired.

The optical assembly is an all-reflecting folded Schmidt telescope. Incoming starlight first hits the (reflecting) corrector plate, then a flat folding mirror. From there, the light proceeds to the spherical primary, and then finally arrives at the focal plane detector assembly situated behind a hole in the folding mirror.



This is just half the story. Actually, the corrector plate was sawed in half after figuring, and the two halves were cemented together again tilted sideways, out of the plane of the above drawing, at angles of ~ 14.5 degrees to either side. So the bottom view of the telescope is roughly as follows:



The focal plane image thus combines two half-images of star fields, each displaced about 29 degrees from the telescope main axis, or ~58 degrees from each other. The telescope main axis is at right angles to the satellite's axis of rotation, and the whole assembly is kept rotating slowly (about 2 hours for one revolution). Thus the sensor's two fields of view sweep out a great circle on the sky, always viewing two areas simultaneously which are separated by a constant angle of ~58 degrees.

The sensor contains a grid of 2688 slits, and the angular measurements are actually carried out by measuring the averages of the time differences between occultations/ reappearances of star images at each of the grid lines. (The grid modulates starlight at about 1200 cycles per second. A star on the current scan circle can thus be tracked for about 2 seconds via the preceding aperture, and again, 20 minutes later, for ~2 seconds via the following aperture. The angle between two stars separated by 58+-.9 degrees along the scan circle can be measured with the full accuracy of the system since they will appear simultaneously in the detector's view for a short time; other angles are filled in as the spacecraft rotates. Obviously, everything depends upon keeping the rotation stable and jitter-free.)

The axis of rotation is kept at a constant angle to the sun, and made to slowly precess around the direction to the sun. Thus the scan circles sweep slowly across a large band of sky, which in turn (as the earth orbits the

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sun) proceeds to cover the entire celestial sphere.

There is another set of detectors in the FPDA for obtaining satellite attitude and orbit data, and its output is also used to tie another 400,000 stars or so into the coordinate system of the primary star catalogue.

HIPPARCOS was designed for a geostationary orbit. It benefits from the usual advantages of a space-borne instrument --- no atmosphere to look through, no attitude-dependent flexure under gravity. Far from the earth, external influence on the constant rotation of the spacecraft (magnetic torque, atmospheric drag) should have been minimal and predictable.

When the satellite was launched on an ARIANE on 8 August 1989, however, the orbit injection by its own apogee motor failed, leaving the spacecraft stranded in the highly elliptical transfer orbit. The data acquisition program and the reduction software had to be severely revised in order to accommodate this.

Nevertheless, the payload has been functioning satisfactorily, and with improved reduction methods available now it is hoped that the originally envisaged .002 arcsec precision can be attained.

It should be noted that amateur astronomers (as well as ground-based observatories) were involved in the preparation of the input star catalogue --- refining rough positions, identifying doubtful objects, sorting out components of double and multiple systems. •

CHEAP (COST) DISKETTES!

Diskettes Unlimited sells 1.44M floppies for a base price of $0.25 each (labels are an additional $0.03 each). Since they are distributed only in lots of 100, I thought that people might want to order en masse (which would also save on shipping charges). Anyone interested please contact me.

— —Editor

FROM UNDERNEATH THE BIG TELESCOPE

by Deano Smith

Hi Everybody! I count myself as a "quasi-new" member. I was anonymously given a Lowbrow membership when I got here last year to start graduate study in astronomy. Unfortunately, most of the grad students knew little about the Lowbrows, and, given the environmental shock (I moved from San Diego) and my workload, I attended only one meeting last semester. Kurt Hillig is really responsible for getting my gears turning in the direction of involvement with the Lowbrows. He kindly volunteered to show off the 24" telescope to a group of high school students I was teaching last summer. After seeing the telescope and meeting Kurt, I decided "Hey -- this could be kinda fun!" So, in a moment of temporary insanity I volunteered to write a monthly column (page?!) for Doug Warshow's esteemed publication. My idea was to write about an astronomical topic or recent discovery at a "we have a good understanding of astronomy but don't want to see the partial differential equations" level. PLEASE give me some input on what you'd like to hear about from a wanna-be professional astronomer (don't go calling me a "high-brow" now...).

I'll start with some elaboration on the recently reported measurements of the Hubble constant. I expect you've heard a bit of this already:

The recent values of the Hubble constant were obtained by measuring the periods of Cepheid variable stars in galaxies in the Virgo cluster. Named after the prototype delta-Cephei, these stars vary in brightness over a period of hours to tens of days. Cepheids have an empirically observed linear correlation between their period and their intrinsic luminosity. By measuring the

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period, therefore, one can determine the absolute magnitude of the star. The distance is then found by comparing the observed apparent magnitude to the absolute magnitude.

The first results were reported by M. J. Pierce, et.al., who observed the galaxy NGC4571 with the Canada-France-Hawaii telescope atop Mauna Kea. The "CFHT" is one of the pioneering observatories in the technology of adaptive optics. A tip-tilt mirror and an ultra fast computer are used to correct for atmospheric refraction -- i.e. to "improve the seeing". Pierce got a value of 87+/-7 km/s/Mpc for the Hubble constant using three Cepheids in that galaxy. This value was disputed by astronomers favoring a smaller Hubble constant. They argued that fainter stars may be blended into the Cepheids, and that there was an insufficient sample size from which to measure the distance to the galaxy.

Enter Wendy Freedman et.al., with data from the Hubble Space Telescope. As part of the "key project on the extragalactic distance scale" her team observed 20 Cepheids in the beautiful spiral galaxy M100. Both this galaxy and NGC4571 are members of the Virgo cluster of galaxies. The Virgo cluster is sufficiently far away that its distance remained disputed (from 15 to 24 Mpc), but it is close enough to be able to resolve stars individually for photometric measurements.

The HST measurements yielded a distance of 17.1+/-1.8 Mpc to M100, giving a Hubble constant of 80+/-17 km/s/Mpc. This presents an interesting dilemma. The standard big bang model tells us the age of the universe is (2/3)*(1/H), where H is the Hubble constant, a measure of the expansion rate of the universe. So, plugging in the value of Freedman's group, one gets a universe 8 billion years old. Hmmm. We have measured stars in globular clusters to be about 16 billion years old, using well-developed theories of stellar evolution. Obviously there is a problem somewhere.

So, how accurate are these Cepheid measurements? They were made using a sequence of 15 one hour exposures (on a 2.4 meter telescope without atmospheric extinction!) of Cepheids at apparent visual magnitudes of 25.0 to 26.5. The random error over the observations was +/-.05 magnitudes. Measurement error with regard to the Cepheids contributes only about one third of the reported formal error. The primary source of error, it turns out, is determining where (from front to back) in the Virgo cluster M100 lies. Other contributions include uncertainties in the zero point for the Cepheid distance scale calibration, uncertainties in the velocity of the Virgo cluster, and differences in Cepheid variability based on metal content. There is the additional problem that there may exist local motions, such as infall of our local group of galaxies toward the Virgo cluster. Such local motions would give a value which does not precisely reflect the "Hubble flow" of the universe.

Where do things go from here? Freedman's group will be measuring Cepheids in two more galaxies in the Virgo cluster, two galaxies in a cluster in Fornax, and 10 other galaxies. Others are working to refine distance measurements from type Ia supernovae, which give much lower values for the Hubble constant. Ground-based observations will certainly continue, and with further implementation of adaptive optics, may improve substantially.

Stay tuned -- it's going to be an exciting few years!! •

SKY PUBLISHING ORDERS

I have sent out the order for all of your Sky Publishing requests. Although the items will probably not arrive in time for the December meeting, I shall contact you to say what you owe. You may pay my stand-in at the meeting.

— —Doug Scobel

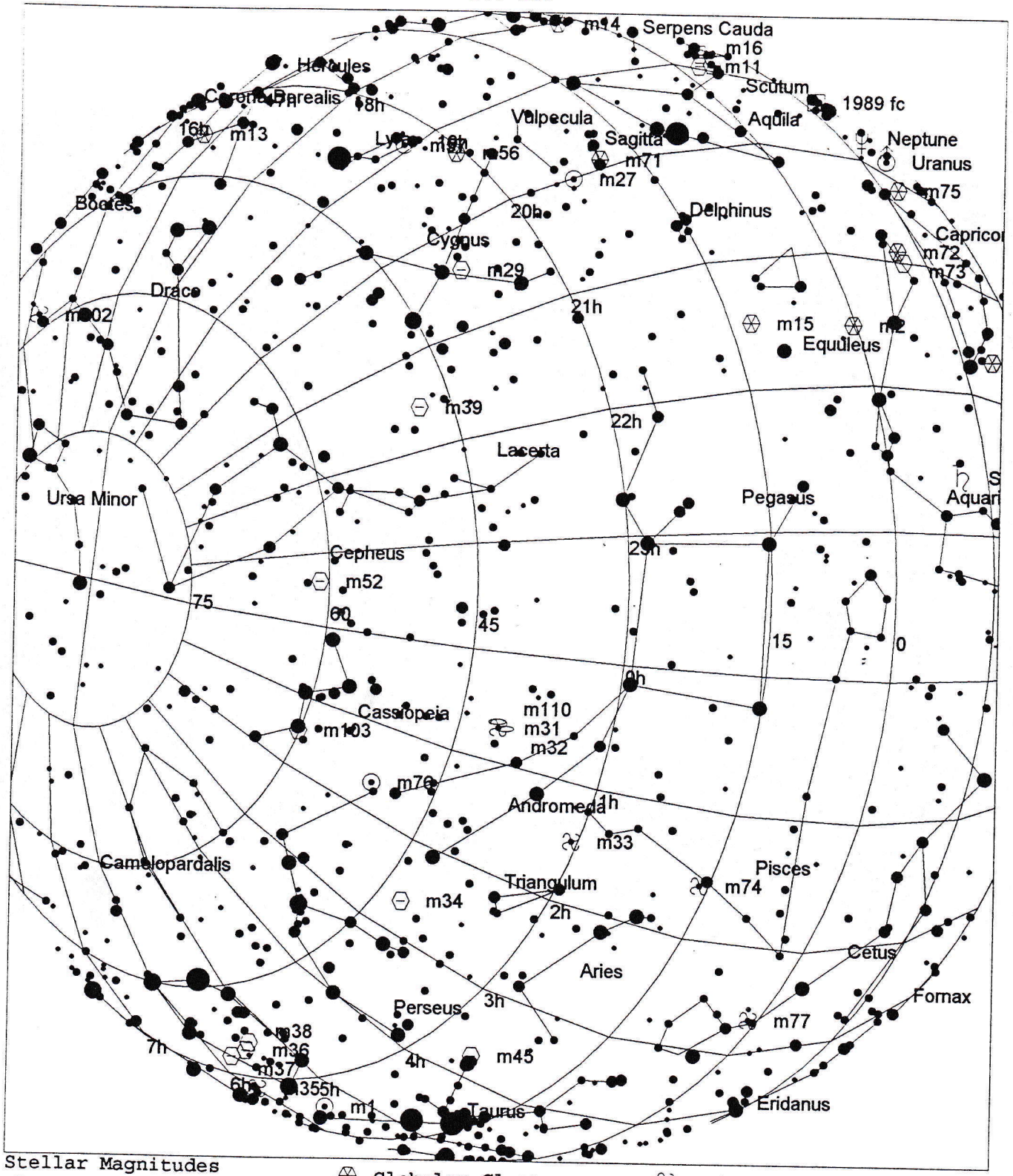
NGC6611

Distant Suns

Date/Time: Dec 16, 1994

View From: Earth (horizon mode), 42:20 N lat 83:03 W lon

Aimed At : 90:00 alt 90:00 az 180 fov



Stellar Magnitudes

-1 0 1 2 3 4 5 6

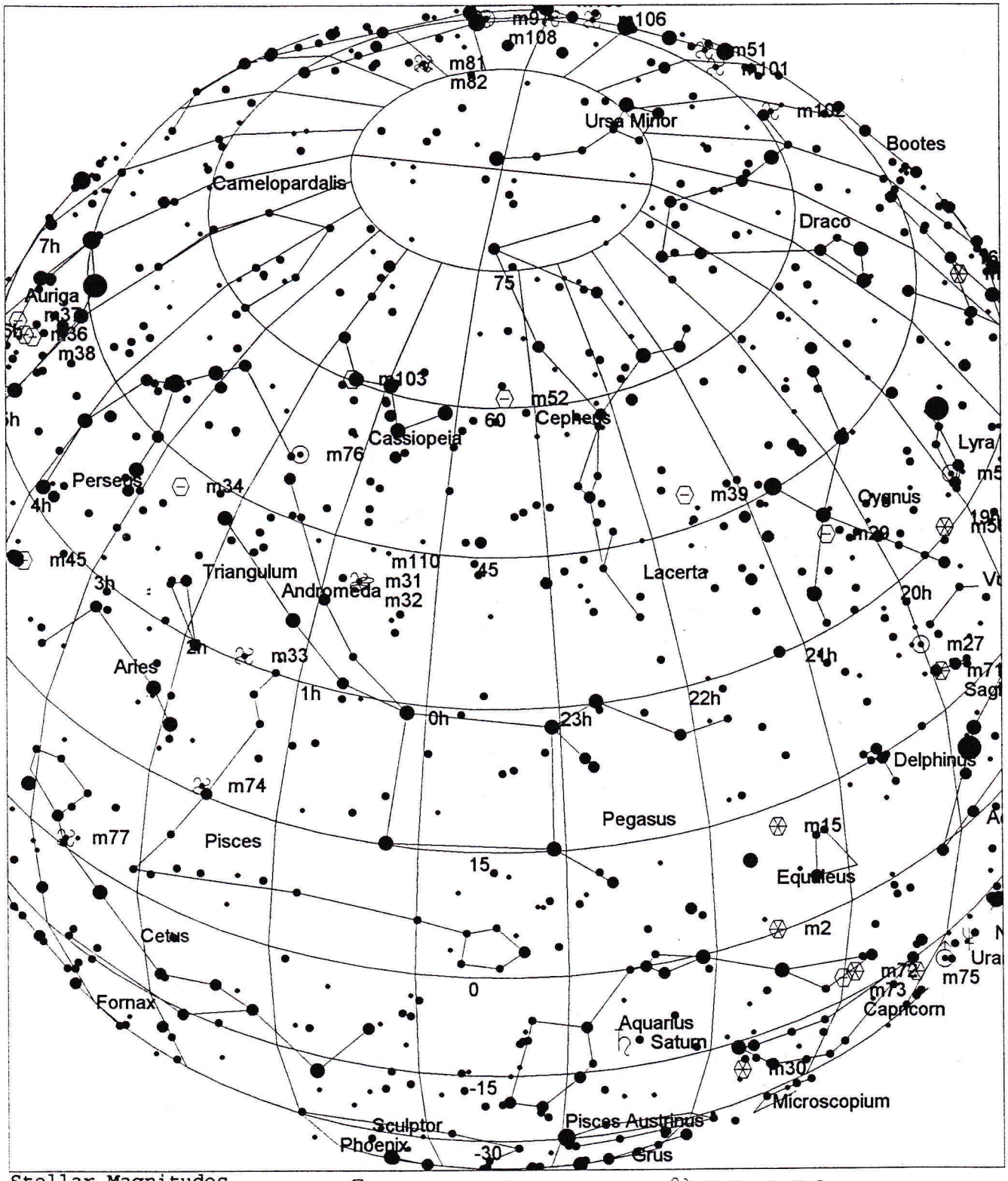
Globular Cluster
Open Cluster
Diffuse Nebulae
Planetary Nebulae
Spiral Galaxy
Elliptical Galaxy
Irregular Galaxy

Distant Suns

Date/Time: Dec 16, 1994

View From: Earth (horizon mode), 42:20 N lat 83:03 W lon

Aimed At : 90:00 alt 180:00 az 180 fov



Stellar Magnitudes

-1 0 1 2 3 4 5 6

Globular Cluster

Open Cluster

Diffuse Nebulae

Planetary Nebulae

Spiral Galaxy

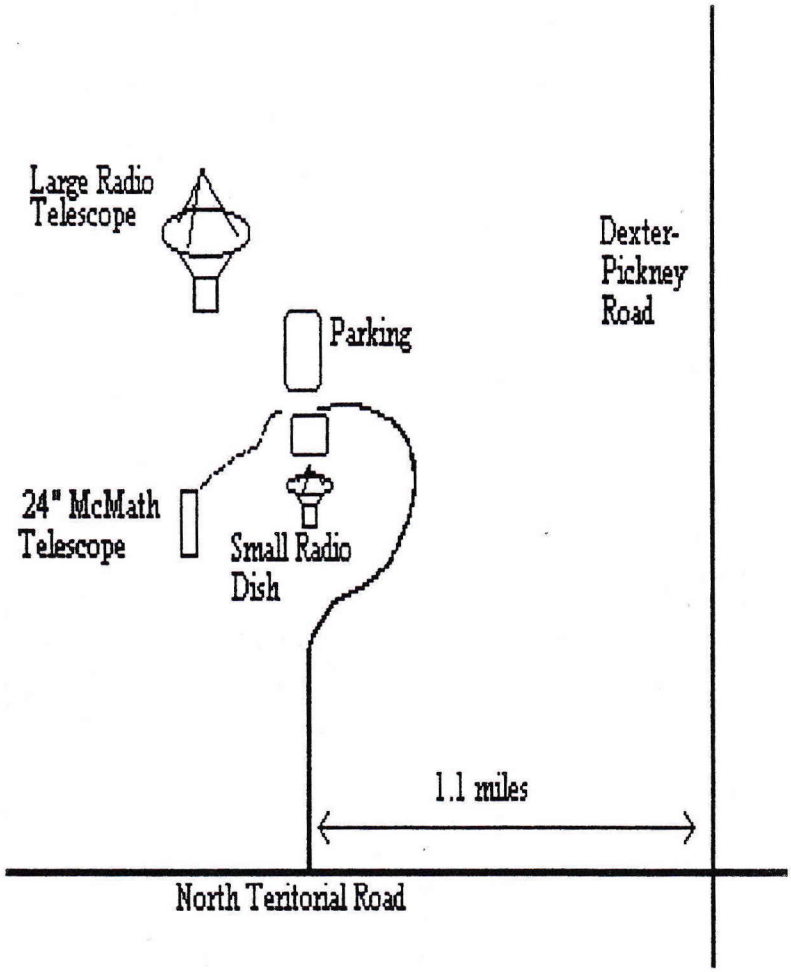
Elliptical Galaxy

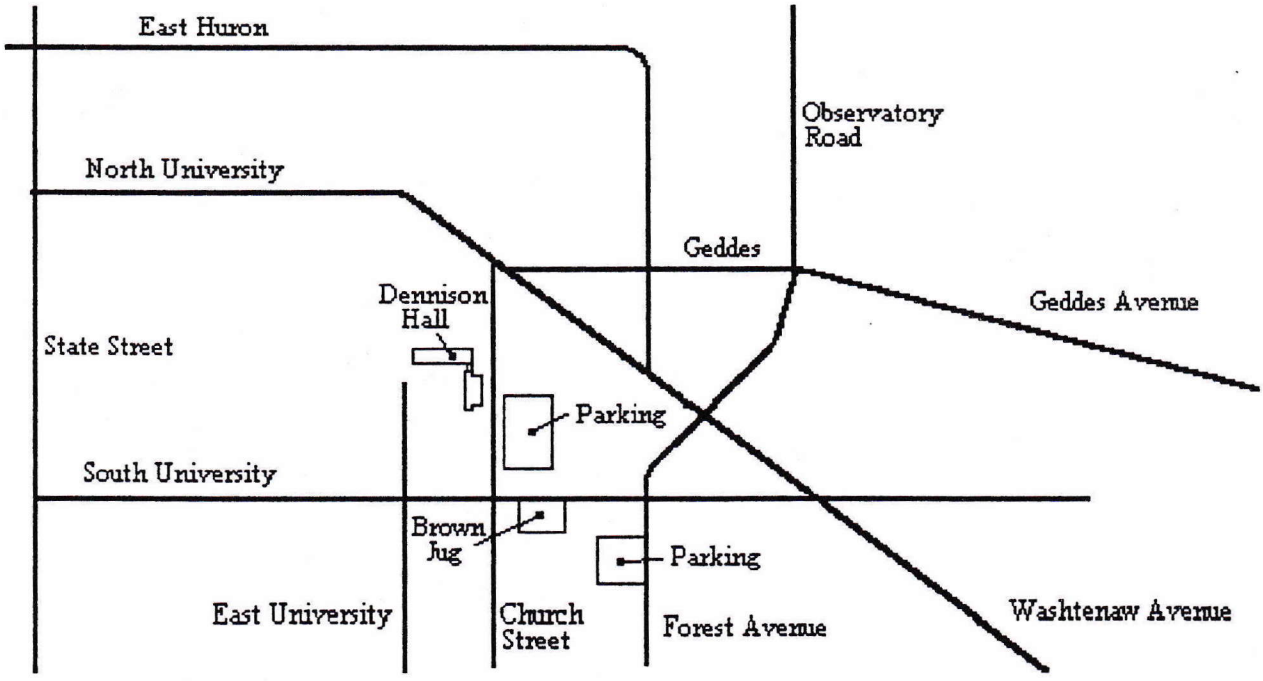
Irregular Galaxy

Places:

Dennison Hall is also known as University of Michigan's Physics and Astronomy building. It is found in Ann Arbor on Church Street about one block north of South University Avenue. This is also one block north of the Brown Jug, our after-meeting eating place. We meet in room 807.

The 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 and used 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.





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. Computer subgroup meetings are held on the first of each month, rotating among members' houses. See the calendar on p. 1 for the 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 are cancelled if the sky is cloudy or the temperature is below 10°F at sunset - call 480-4514 to check on their status. Many members bring their telescopes; visitors are welcome to do likewise. Peach Mountain gets cold at night so dress warmly - and bring mosquito repellent!

Telephone Numbers:

President:	Bill Razgunas	995-0934
Vice Presidents:	Kurt Hillig	663-8699
	Stewart Cohen	665-0131
	Tom Ryan	662-4188
	Steve Musko	426-4547
Treasurer:	Doug Scobel	429-4954
Observatory Director:	Bernard Friberg	761-1875
Newsletter:	Douglas Warshow	998-1158
	Bernard Friberg	761-1875
Membership:	Doug Scobel	429-4954
Peach Mountain Keyholder:	Fred Schebor	426-2363

Dues:

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

Doug Scobel
1426 Wedgewood Drive
Saline, MI 48176

Magazines:

Members of the Lowbrow Astronomers can get a discount on subscriptions to any of these magazines:

Sky and Telescope:	$20 / year
Astronomy:	$18 / year
Odyssey:	$16.95 /year

For more information, please contact the club treasurer (Doug Scobel: 429-4954).

Sky Map:

The sky map in this issue of Reflections was produced by Douglas Warshow using Distant Suns 2.0 for Windows drawn for the end of twilight on the monthly meeting date.

Photographs:

All photographs converted for publishing by Bernard Friberg.

Newsletter Contributions:

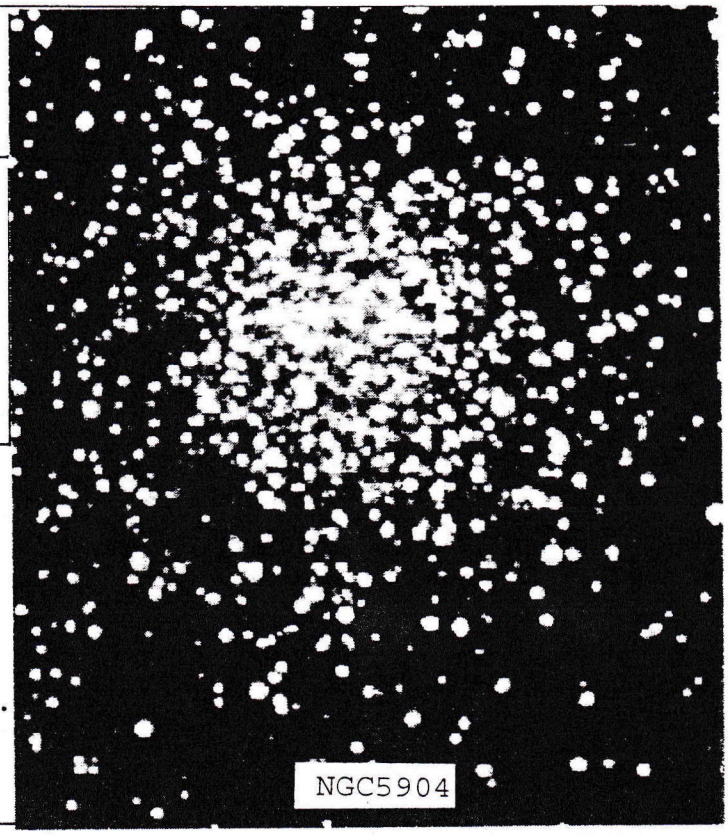
Members (and non-members) are encouraged to write about any astronomy-related area in which they are interested. Call the editor (Douglas Warshow) at 998-1158, or send e-mail to 75054,310 via CompuServe to discuss length format, etc. Submission of photographs is also welcome. Announcements and articles are due 14 days before each meeting (i. e., the first Friday of the month). Contributions should be mailed to:

Douglas Warshow
1010 Catherine, Apt. 408
Ann Arbor, MI 48104-1647

Monthly Meeting

Sit back and relax with Fred Schebor's Artsy Meaningless Slide Show

at 7:30 PM
at
Room 807 Dennison Hall
Physics and Astronomy Bldg.



University Lobrow Astronomers
1740 David Ct.
Ann Arbor, MI 48105

Check your membership expiration date on the mailing label!