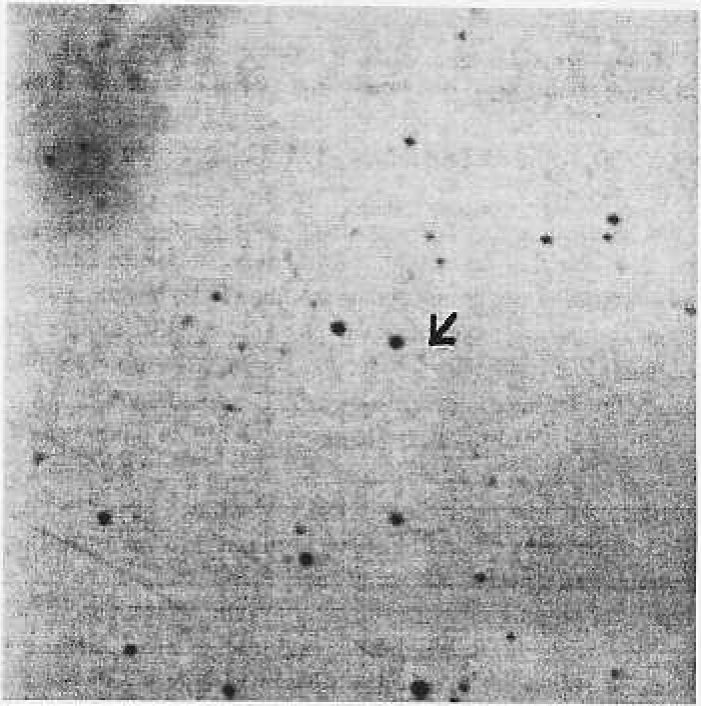
REFLECTIONS SNOITCELFER
of the University Lowbrow Astronomers

March 1998

Potentially Hazardous Asteroid 1997 XF11

The uncertainty in the orbit of this Near-Earth asteroid was reduced when Dr. E. Helin and K. Lawrence found "pre-discovery" observations (shown at the right) of 1997 XF11 in Palomar data obtained with the PCAS program in 1990. Its closest approach to the Earth, while still a "near miss," is no longer as close as previously believed.



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, weather permitting, at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; see inside for directions) on Saturday evenings before and after the new moon. The event may be cancelled if it is cloudy or very cold at sunset. For further information, call (313) 480-4514.

This Month

March 20	Meeting at 807 Dennison. 7:30 pm
March 21	Open house at Peach Mountain.
March 22	ATM meeting. Time and location TBD
March 28	Open house at Peach Mountain

Next Month and Beyond

April 17	Meeting at 807 Dennison
April 25	Open house at Peach Mountain.
May 1	Lowbrows at Leslie Science Center
May 2	Open house at Peach Mountain.
May 3	ATM meeting. Time and location TBD.

How Close ?

by Bernard Friberg

Last Thursday 3/12 it was reported that an asteroid 1997 XF11 was headed this way in 30 years and may pass within 30,000 miles of earth. These calculations are based upon only a few data points, so the error in the calculations may be more than 30,000 miles. This prompted many news reports such as: " Astronomers say a mile-wide asteroid described as "the most dangerous one we've found so far" may be on course for a near-miss -- or even a collision -- with Earth in the year 2028.

Some astronomers say the asteroid will come within 30,000 miles of the Earth, and they agree with Dr. Brian Marsden of the International Astronomical Union (IAU) who says, "Chances are it will miss" Earth. "The chance of an actual collision is small, but one is not entirely out of the question," says a notice filed by the IAU.

Asteroid 1997 XF11 was discovered December 6 by Jim Scotti of the University of Arizona Spacewatch program, and has been added to a list of 108 asteroids considered to be "potentially hazardous objects."

"Hills said an asteroid the size of 1997 XF11 colliding with the Earth at more than 17,000 miles an hour would explode with an energy of about 320,000 megatons of dynamite. That equals almost 2 million Hiroshima-sized atomic bombs. "

Such an asteroid hitting the ocean, Hills said, would create a tidal wave hundreds of feet high, causing extreme flooding along thousands of miles of coastline.If it struck land, he said, it would blast a crater 20 miles across and so clog the sky with dust and vapor that the sun would be darkened "for weeks, if not months."

The thought of a possible collision prompted an immediate effort to refine the calculations and the following day new reports surfaced:

"

New data shows asteroid will miss Earth, NASA says

Just a day after a group of astronomers reported that an asteroid """"was expected to pass within just 30,000 miles of the Earth's center and could possibly collide, astronomers at NASA's Jet Propulsion Laboratory said that their calculations -- based on newly uncovered data -- indicate the asteroid will pass no closer than 600,000 miles away.

"We are saying now that the probability of an impact is zero," said Donald K. Yeomans of JPL.

Yeomans said he and fellow astronomer Paul W. Chodas dug out some eight-year-old pictures of the heavens taken by the Palomar Observatory telescope and found that the photos contained images of asteroid 1997 XF11, which was then just an unidentified point of light.

With the newfound data, the 1990 pictures, along with the recent observations of the streaking asteroid, Yeomans and Chodas recalculated the orbital path of the asteroid and found that it would miss the Earth by 600,000 miles at its closest approach in October of 2028. The newly calculated orbital path of the asteroid means it will pass outside the orbit of the moon."

In recent years there have been a handful of close calls .by larger asteroids, and some hits by smaller objects. On March 23, 1989, an asteroid about a half-mile wide crossed the Earth's orbit about 400,000 miles from Earth. If the Earth had been in that same spot a mere six hours earlier, a collision would have occurred. On January 17, 1991, an asteroid estimated to be about 30 feet wide passed within 106,000 miles of Earth. It was the closest "near miss" ever recorded. Smaller objects hit the Earth all the time. Most of them land in oceans or uninhabited areas, unnoticed. But some make headlines such as a small meteorite hitting a car in 1994. On October 9, 1992, a meteorite smashed through the rear end of a car in Peekskill, New York. Nothing was damaged , but the Chevy Malibu.

Asteroid 1988 EG Makes A Close Approach to Earth

1988 EG, a Near-Earth Asteroid discovered by J. Alu during the Palomar program (PCAS, E. Helin et. al.) will be observable in the next few days getting as bright as V = 13.7 magnitude. This approach is the closest known approach of any NEA to the Earth in 1998, about 3 million miles.(The discovery image is on the last page of the newsletter).

DISTANT GALAXY IDENTIFICATION TECHNIQUE IN HUBBLE FIELD

Series of four panels (next months newsletter) that illustrate the distant-galaxy identification technique. Four panels that show (top to bottom, or right to left when rotated correctly) F814W filter, F606W filter, F450W filter, and F300W filter images, or near-infrared through near-ultraviolet images. The identified galaxy is prominent in the near-infrared image but totally absent in any of the other images. It is this spectroscopic signature that identifies this galaxy as a very distant object.

Credit: Ken Lanzetta and Amos Yahil (State University of New York at Stony Brook), and NASA

Comets Currently Visible
Credit JPL and NASA

Long-Period Comets

C/1995 O1 (Hale-Bopp)
C/1996 D1 (Mueller)
C/1997 J2 (Meunier-Dupouy)
C/1997 N1 (Tilbrook)
C/1997 T1 (Utsunomiya)

Short-Period Comets

29P/Schwassmann-Wachmann 1 Comet is coming out of conjunction (6/5)
43P/Wolf-Harrington
55P/Temple-Tuttle
69P/Taylor
78P/Gehrels 2
103P/Hartley 2
104P/Kowal 2
128P/Shoemaker-Holt 1
132P/Helin-Roman-Alu 2

HALE-BOPP UPDATE

Observer: Ian Griffin

Location: Astronaut Memorial Planetarium & Observatory, Cocoa, Florida
Date: March 16, 1998 00:00 UT

349 Days Since Perihelion

Current Magnitude: 8.6 to 8.8
Earth Closest Approach: March 22, 1997 (1.315 AU)
Sun Closest Approach: April 1, 1997 03:14 UT (0.914 AU)
Current Distance From Earth: 4.754 AU (441.9 Million Miles)
Current Distance From Sun: 4.710 AU (437.8 Million Miles)
1 AU = 93 Million Miles = 150 Million Kilometers

Faster mirror sites are now available for this home page:

http://www.jpl.nasa.gov/comet/
http://galileo.ivv.nasa.gov/comet/

Cassini's Basic Operations Concept
Credit NASA

Cassini's principal objective is to send a suite of instruments to Saturn to collect scientific data about Saturn, its rings, its satellites (including Titan), its field and particle environments, and its interactions between them. The mission design has a long (almost 7 year) cruise to get the spacecraft to Saturn and a 4 year tour in orbit around Saturn. The cruise phase is planned to be a low activity flight period where only essential engineering and navigation activities will be performed. The science instruments are planned to be turned off, except for required maintenance activities (like keeping your bike's gears lubricated), a magnetometer calibration at Earth, and a single post-launch checkout. Two years prior to Saturn Orbit Insertion, the instruments will be turned on and calibrated and science data will be collected. During the Saturn tour, a full suite of integrated science observations will be performed to accomplish the science objectives.The spacecraft has been designed to have a high degree of autonomy. The spacecraft will provide general services for each of the twelve science investigations, including forwarding commands to the instrument, collecting and transmitting instrument telemetry, orienting the spacecraft to desired targets and providing attitude stability, power, and thermal control. The spacecraft will be flown with sufficient margins to allow the instruments to operate fairly independently from each other, but still allow for collaborative, synergistic collection of data.

The spacecraft will have an onboard data system which features instruments with computers capable of instrument control and data handling. Spacecraft sequences will use a combination of centralized commands (for control of the system level resources like power and thermal control) and instrument commands issued by the instrument computers. Instrument data will be formatted (including editing or compression) within the instrument computer. Data will be collected from each instrument on a schedule determined by the telemetry mode. This data is then assembled into "frames" and either stored on the Solid State Recorder or transmitted directly to Earth.

Ground operations during cruise will be centralized here at JPL. During the Saturn tour, science operations will be conducted all over the world and incorporated into the sequence design at JPL. The idea here is to allow scientists to operate their instruments from their home institutions far away with as much ease and little interaction necessary to conduct their observations.

Due to the budgetary pressures in the development phase and the lengthy cruise period, the development of some capabilities (mainly software) have been deferred until after launch. The extent of deferrals is not firm, but it is clear that the spacecraft and ground system will be less developed in the early portions of the mission. Many of the open issues in the early mission scenarios are a result of the uncertainty on these deferrals. Other open issues are due to the very preliminary nature of the planning for these periods.

During cruise there will be periodic updates to the operations concept and the day-to-day strategies to keep them current with any changes in spacecraft or mission characteristics. During the cruise timeframe, following final trajectory selection, a plan for science activities during the tour will be developed. Modules (basic sequence components, like a mosaic that's performed many times over for different targets) will be developed both as experience with the spacecraft is gained during cruise and consistent with the science activity plan, so that by the time the spacecraft arrives at Saturn most sequences can be built with a minimum of hand-wringing and optimization by using these modules.

One of the most imporant parts of the operations concept is what we here at JPL like to call "Magellan-mode" operation, named after the Magellan mission to Venus. One of Magellan's mission goals was to map the surface of Venus (which it did, and very successfully) with radio waves from a large antenna. They discovered a way to use the same antenna for communication with Earth and spent part of each orbit pointed at Venus, mapping the planet, and the remainder (for the most part) pointed at Earth, returning data. Since most of the Cassini instruments are body-fixed (that is, they're bolted to the spacecraft), Cassini has to rotate the entire spacecraft to point to something of interest, so Magellan's approach works for us too. During operations at Saturn, the Cassini spacecraft will operate in a "Magellan-mode" fashion, observing the Saturnian system for about 12-15 hours per day. Once per day, the spacecraft will point its High Gain Antenna to Earth for 9 to 12 hours and transmit the science data collected, while continuing to gather fields, particles and waves data.

Operational Modes

The Cassini mission will achieve most of its goals by operating the spacecraft in a series of standard well-characterized configurations. These configurations are referred to as operational modes, and transitions between them will use preplanned sequences. Since there is insufficient power to operate all the instruments simultaneously, operational modes have been designed to balance the science return with the need to keep operational complexity and cost under control in planning sequences. Within an operational mode, any sciencSince there is insufficient power to operate all the instruments simultaneously, operational modes have been designed to balance the science return with the need to keep operational complexity and cost under control in planning sequences. Within an operational mode, any science and spacecraft activities will be allowed Many operational modes contain a suite of complementary instruments, along with appropriate levels of engineering support. An operational mode defines which instruments are on, how the spacecraft is controlled (by thrusters or reaction wheels), and a range of temperature and power and data usage to expect. Being in an operational mode means you only need to plan for a limited set of activities, problems or maneuvers to happen; mission planners don't have to worry about everything at once.

Day-to-Day Operations Concepts

Beyond the overall mission ops concept, there are a number of more specific ways we'll be doing business on a day-to-day basis. There are many types of spacecraft resources that must be tracked to make sure we don't run out of something we need, especially during an important activity (like launch or an important science opportunity). Some of the key resources are fuel (when we run out, it's all over), power (we don't want to have a blackout on the spacecraft), data rate (how much information the computer can hold, move around, and transmit to Earth), and power (many components need a certain power to operate).Some less tangible but equally important -- if not more so -- resources are complexity (how much time ground system staff catime ground system staff can afford to spend designing an observation), time (a lot of interesting science opportunities can happen pretty fast) and performance (the more the better!). Also, we can't forget cost -- the less expensive we build and operate the better.

Fuel

Cassini uses three different types of fuel to get us where we want to go, as well as pointing a heavy spacecraft in the right direction. The first and most efficient, by far, is the gravity assists! Even though flybys aren't really fuel like we'd usually think about it (there's no gas station on Earth for a fillup of gravity assists), we use them exactly like fuel to change our trajectory through space. While we're in orbit around Saturn, mission designers use many close flybys of Saturn's moon Titan to zip around Saturn in different ways. And since there aren't an infinite number of them for us to use, we have to plan each one carefully to make sure it's designed as well as possible.The second, a "tangible" fuel, is the bipropellant used by Cassini's main engine for large propulsive maneuvers. Even with the enormous help from gravity assists, Cassini still needs to perform a lot of propulsive maneuvers to keep on going in the right direction at the right speed.

There are four large propulsive maneuvers that we can't use gravity assistance for: the Deep Space Maneuver between the two Venus encounters during Cruise, to target correctly for the quick Venus2 - Earth "double gravity assist" (without which we couldn't get to Venus at the right time, and therefore couldn't get to Saturn as planned); the Saturn Orbit Insertion maneuver which slows us down enough to go into orbit around Saturn (without which the spacecraft would just fly right by and keep going out into deep space); the Periapsis Raise Maneuver several months after Saturn arrival which raises the closest approach distance to Saturn (called the periapsis) outside of Saturn's inner rings; and the Orbiter Deflection Maneuver, performed after the probe is released to set up the correct geometry for the probe mission.

Bipropellant is composed of two ingredients, mono-methyl-hydrazine and nitrogen tetraoxide. Let's just say they work very well together, ignite easily when brought together (don't worry, this only happens in the engine nozzle itself), are easy to store, and don't freeze at the temperatures we're expecting aboard Cassini.

The third type of fuel is hydrazine, which is used by the Reaction Control Thrusters for very small propulsive maneuvers and for turning the spacecraft to point at different things (rotational maneuvers). Currently Cassini is predicted to use less than half of its hydrazine to accomplish the primary mission, so we're pretty confident there'll by plenty of margin for an extended mission.

Communications

Did you know...? Cassini will regularly use the Deep Space Network's largest antenna, which is 70 meters (230 feet) in diameter - nearly an entire football field wide. (Image only available electronically)

The Cassini spacecraft communicates with Earth using a 4 meter fixed High Gain Antenna (HGA) and two wide beam Low Gain Antennas (LGAs), both of which communicate with the Earth in the X frequency band. The HGA transmits data to Earth (downlink) at a frequency of about 8.4 gigahertz (8,400,000,000 cycles per second). For comparison, the FM band on your radio is centered around 100 megahertz (or 100,000,000 cycles per second). The Earth sends commands to the spacecraft at a frequency of about 7.2 gigahertz (the uplink). The two frequencies are different so that the uplink doesn't interfere with the downlink (like two radio programs trying to broadcast on the same station).

Did you know...? Cassini will collect and transmit about 2 trillion bits of science data, the equivalent of about 800 sets of the Encyclopedia Britannica!

Data rates for transmitting data to Earth vary from about 40 bits per second -- roughly equivalent to the rate of information conveyed in a normato the rate of information conveyed in a normal spoken conversation -- to about 170,000 bits per second -- equivalent to one-eighth the rate of information played from a music CD. The low rates are used primarily during cruise, where there's not much science being conducted and we can't point the HGA directly to Earth for temperature reasons. Once the spacecraft reaches Saturn the lowest downlin

Did you know...? On a busy day at Saturn the spacecraft could transmit up to 4 gigabits (4,000,000,000 bits, or about a CD-ROM worth) of information to Earth. Add that up over several years at Saturn, and you can see just how much information we're getting per dollar!

The HGA is so called because signal strength is gained by focusing the radio energy into a highly concentrated narrow beam. In fact, most of the power is concentrated within one half of one degree (about one seven hundredth of a circle).The LGAs, on the other hand, have a much wider beam pattern, which allows the orbiter to communicate with Earth when circumstances prevent us from pointing the HGA to Earth directly. There are two LGAs, one pointing along the same direction as the HGA and one on the same side of the spacecraft as the Huygens probe, at right angles to the first LGA.There are three Deep Space Network (DSN) complexes which support uplink and downlink to the orbiter, at Goldstone, California, Madrid, Spain, and Canberra, Australia. These sites were chosen at widely separated longitudes to provide essentially continuous tracking capability to any interplanetary spacecraft as the Earth rotates. The equipment at each site is quite similar.

Did you know...? The 20 watt spacecraft transmitters produce a received power of about 0.0000000000000001 watts at the Deep Space Network antennas on Earth. The signal typically takes at least an hour to reach the Earth from Saturn.

Cassini will use the DSN's 34 meter (112 feet) and the 70 meter (230 feet) diameter antennas at each site, with emphasis on the Madrid and Goldstone sites after the orbiter arrives at Saturn. For increased performance, more than one antenna can be used simultaneously in an "array" to increase the strength of the received signal.One would think that we've got all the antennas we'd need - even a single 70 meter antenna, which is almost as large as a football field, seems like it could find any signal no matter how faint. Not so. Cassini's signals are so feeble by the time they reach Earth from Saturn that we often have to array to get the amount of data we want back to the Earth. Even now, plans are in the works to build additional stations at the DSN, some of which may be used to augment the already awesome fleet of communication antennas Cassini uses. (Image only available electronically)

One factor that complicates matters somewhat is "light time." Since electromagnetic radiation travels at a finite speed -- about 300,000 kilometers (186,000 miles) per second -- and Saturn is so far away, it takes a while for the spacecraft data to get to the ground and vice versa. After arrival at Saturn, the "light time" from Earth to Saturn is about 70 to 90 minutes. This means the spacecraft doesn't receive commands until 70-90 minutes after they're sent, with the same delay on the ground when receiving telemetry from the spacecraft. Imagine trying to talk to someone on the phone when you have to wait an hour and a half for them to say hello!

Recording Data

Cassini uses a state-of-the-art Solid State Recorder (SSR) as the primary memory storage and retrieval device. The spacecraft is equipped with two SSRs, each with a usable capacity of up to 2,000,000,000 bits (zeros or ones). All data recorded to and played back from the SSR is controlled by the Command and Data Subsystem (CDS), which often acts as a policeman to make sure all the data is preserved until there's a chance to send it to Earth. Among many other tasks, the CDS has the job of taking the data recorded from each instrument (such as an image of the rings or a measurement of Saturn's magnetic field) and placing it in a secure place on the SSR so that the instruments can examine something else.While at Saturn, a principal purpose of the SSRs is to store science and spacecraft status data during the oduring the observation periods (when the HGA can't be pointed at Earth because the instruments need to be pointed to an interesting science target) for playback during the downlink peri"high activity" days, when there are a lot of interesting science opportunities, both SSRs will be used to downlink up to 4,000,000,000 bits of data. When science opportunities are more sparse (during so-called "low activity days"), up to 1,000,000,000 bits of data will be collected. This data is saved until the HGA can be pointed to Earth for a DSN pass, which are typically scheduled at a rate of one per day.

Many instruments collect data at unpredictable rates due to data compression that they use. Data compression is a way to save only those parts of data that you're really interested in. With images, the amount of bits a compressed picture takes up can depend a lot on what's in it. For example, an image that is mostly black space (say, of a very distant small moon) may have higher compression than an image that is a closeup of Saturn or a satellite (like the figure at right), since the black regions (that have little detail) compress more. (Image only available electronically)

Unpredictable storage rates means that CDS has an important job as a "data policeman." CDS must make sure one instrument doesn't use SSR space that's been allocated to another instrument, such as when compression is less than expected.

Attitude Control and Pointing

The two most common types of spacecraft are spin-stabilized and three-axis stabilized. The former, such as the Pioneer and Galileo spacecraft, obtain stabilization by spinning so that the entire spacecraft acts as a steady gyroscope. It's much like a spinning top that stays upright only as long as it spins. Three-axis stabilized spacecraft like Voyager and Cassini maintain a fixed orientation except when maneuvering.

Did you know...? The spacecraft is so stable that its minimum rate of motion of 107 microradians over 100 seconds (0.22 degrees / hour) is less than 1/100th the rate of movement of the hour hand on a clock.

Cassini's orientation and spin rates are maintained by the Attitude and Control System (AACS) which uses one of two modes to control its motion. Reaction wheels are heavy wheels on the spacecraft which, when spun, spin the spacecraft in the opposite direction. Wheels are very stable, but can't spin the spacecraft very fast. Thrusters are the small jets placed here and there on the spacecraft and use hydrazine fuel to control motion, just like the space shuttle does. These jets aren't as accurate as the wheels are and use up fuel, but they can spin the spacecraft a lot faster.In cruise, the spacecraft uses the thrusters to control its motion (usually to keep it pointed at the Sun), primarily because the thruster mode is the simplest mode and gets the job done very well. Also, when the spacecraft does need to turn off-Sun, it's best to do it quickly before the spacecraft gets too hot. Some maneuvers during cruise are small enough that we can use the thrusters, and not the large main engine, which makes things that much simpler. After arrival at Saturn, most of the time is spent in reaction wheel mode, since it has better stability for the remote sensing cameras. Also, wheels don't use up fuel, but power instead, which is a renewable resource provided by the power generators on board. Occasionally, up to once or twice per week, the reaction wheels need to be unloaded. A reaction wheel unload is when the thrusters and the wheels are on simultaneously and the thrusters allow the wheels to spin down (slowing their rotation rates). Over time, the reaction wheels will have to spin faster and faster to compensate for environmental influences on the spacecraft like wind from Titan's atmosphere during a flyby. When the wheels need to slow down, a "reaction wheel unload" is performed with the help of the thrusters.

Propulsive Maneuvers

During the Cassini mission, there are many propulsive maneuvers (as opposed to rotating the spacecraft) which the spacecraft must perform to correct the orbit to the conditions required to complete the mission. Some of these maneuvers are very predictable; they are planned into the trajectory because there's no other way (such as a planetary flyby) to get from one place to another. These maneuvers are called deterministic maneuvers and are usually quite large. One of the most important is the Saturn Orbit Insertion maneuver (SOI), which keeps us from escaping Saturn's gravity when we first arrive.Many of the maneuvers, however, are required because unpredictable errors creep into the spacecraft path and must be corrected. Even the smallest push or error in maneuver performance will, over the long coast times during a cruise period, move the spacecraft enough that it must be eliminated during a later maneuver. These maneuvers are called statistical maneuvers, and would be zero in an ideal world.

The mission has a limited budget of propellant which it can use to perform maneuvers. This budget is usually referred to as a "Delta Vee" budget. Delta Vee stands for "change in velocity" and represents how much the spacecraft can change its speed and direction over the course of the mission. A "delta vee" of one meter per second is on the small end of the scale, whereas delta vees in the hundreds of meters per second (like the SOI burn) are large maneuvers. One meter per second may not sound like much; it's what's required to go from standing still to your average pace in an art museum. Remember, however, that we're not talking about a person, but rather a spacecraft that weighs as much as a small school bus, and we haverepresents how much the spac

Margin

In any activity (such as our bike or car trip example), it is a good idea to leave some margin for error and unexpected activities. Margin, when set at a reasonable level, is not overly wasteful of resources and significantly improves the chances of success. At the very least, margin reduces stress, be it psychological stress on the mission planners or stress on spacecraft resources. In our example, leaving an hour's worth of margin getting to school is probably excessive; you'd be sleepy all the time and have to wait a long time for the day to start. A few minutes, on the other hand (depending on what kind of delays you might have to deal with), wouldn't radically affect your sleep schedule and would allow for a leisurely, low-stress trip to school.Mission planners use margin all the time when planning activities at Saturn. There are a number of kinds of margin, all of which set aside resources such as time, propellant, component lifetime, or safety, which mission planners use in concert to help guarantee success without overly penalizing science activities.

Two good examples of margin that the mission planners have implemented are time margin and Titan flyby altitude margin. Time margin is generic time set aside during the sequence development to allow for activities added later and uncertainties in the duration of activities. For the final sequence, about two minutes per hour are set aside. During Titan flybys, margin in the form of additional altitude is set aside to guarantee that the "wind" from Titan's atmosphere isn't more than the spacecraft can handle. Since we don't know Titan's atmosphere very well right now (there's only a handful of pictures and other data available), we've had to do some educated guessing, but it's unlikely the atmosphere will be dense enough to make us raise the flyby distance.

Announcements:

(1) This month 3/22 at 2:00pm the ATM group will meet at Paul Walkowsky's home 338 Manor Dr., Ann Arbor, MI.

A Note from Paul

The nearest Major intersection is Pontiac turnTrail and Barton Dr.--Just go 3 blocks North (out of town) from the light and left on Manor. Third house on the left from the end of the street. 2 car driveway with a basketball pole near the drive.

If you get lost on the way, call 662-0145 and those who made it will talk you in in such an obtuse and recondite manner that you'll wish you brought a map instead.

I have no major projects in anything but the paper work stages (yea I'm working on my income taxes) so bring your own projects along. I'd be especially interested in seeing a laser collimator demonstrated, now thatthe guts are under $35.00 in Astromart.

(2) Do you have E-mail capability and you do not treceive the Lowbrow E-mail messages? Please notify Kurt Hillig (khillig@umich.edu), Doug Scobel (djscobel@ann-arbor.applicon.com) or Bernard Friberg (Bfriberg@aol.com)

Dues:

Membership dues are $20 per year for individuals or families, and $12 for students.
Checks made out to: University Lowbrow Astronomers and mailed to Doug Scobel, 1426 Wedgewood Drive, Saline MI 48176 .

Magazine Subscriptions :

As a member of the Lowbrows, you are entitled to substantial discounts on *Sky and Telescope* and *Astronomy* magazines. To qualify for the discount, however, you must submit all subscription requests through the club treasurer. Make the check payable to "University Lowbrow Astronomers."

The current magazine subscription rates are:

	Normal Rate	Club Rate	Savings
*Astronomy**	$34.95	$20.00	$14.75
*Sky and Telescope***	$36.00	$27.00	$9.00

*Club rate allowed on 1 or 2 year subscriptions.
**Club rate allowed only on 1-year subscription. *NOTE*: For non-magazine purchases, simply mention your club affilliation and send your order in directly to the publisher(s).

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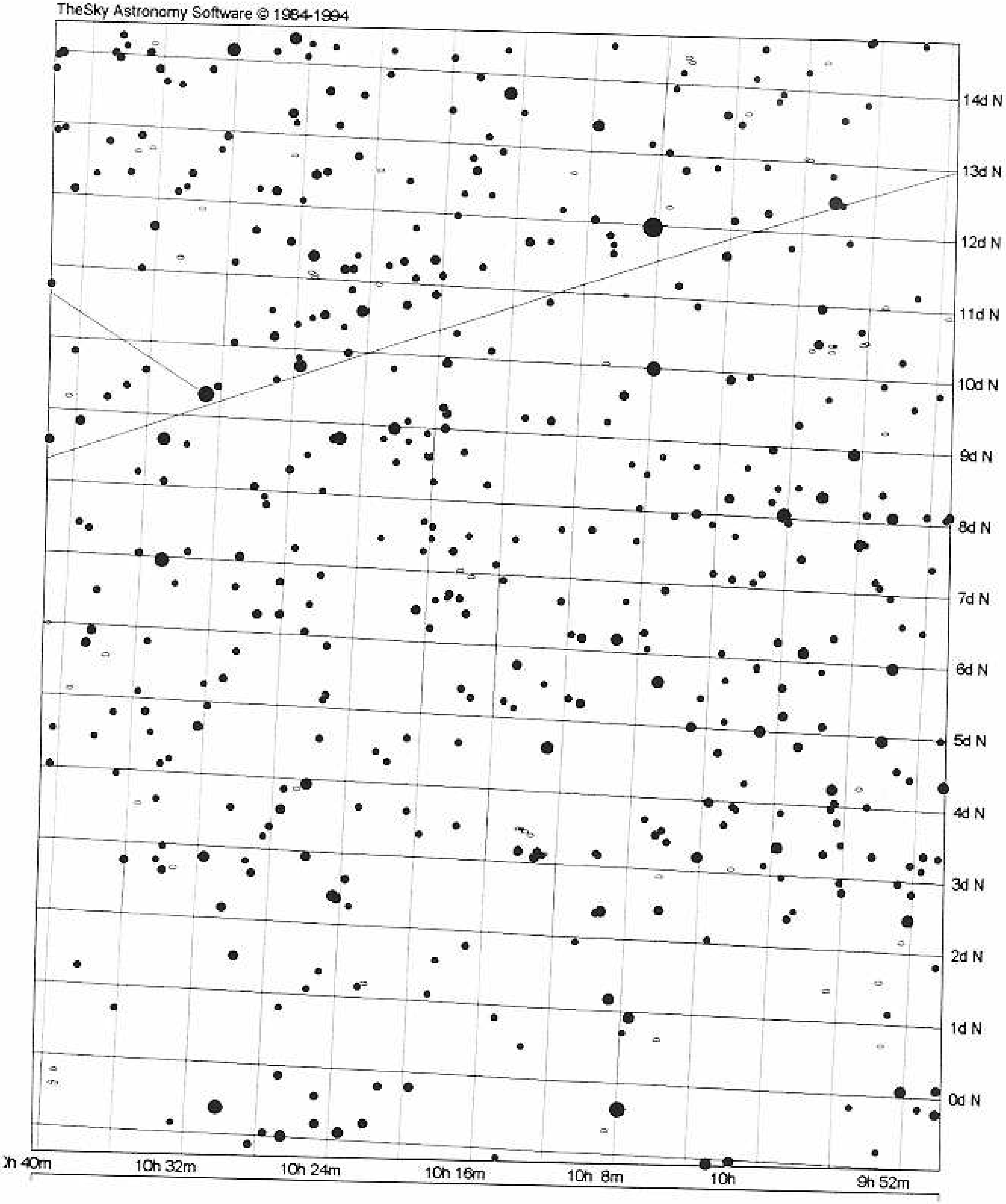
This months newsletter assembled by Bernard Friberg



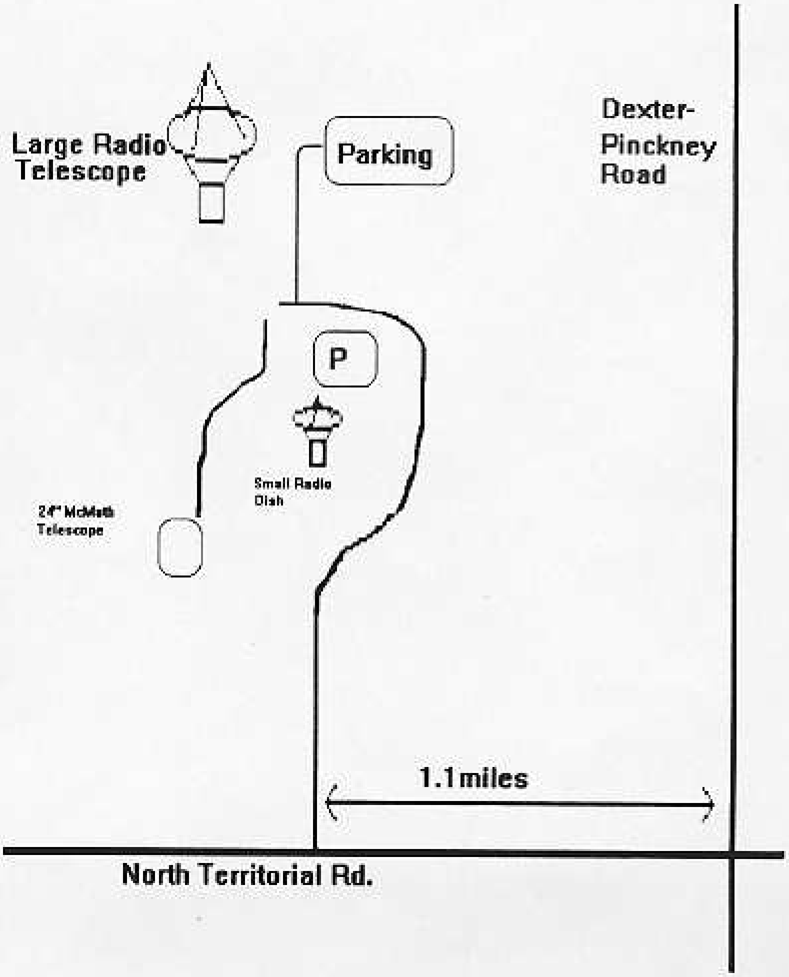
Location of asteroid 1988EG on 3/20/1998 : RA = 10h 5.66m Dec = 8 deg 31.5m

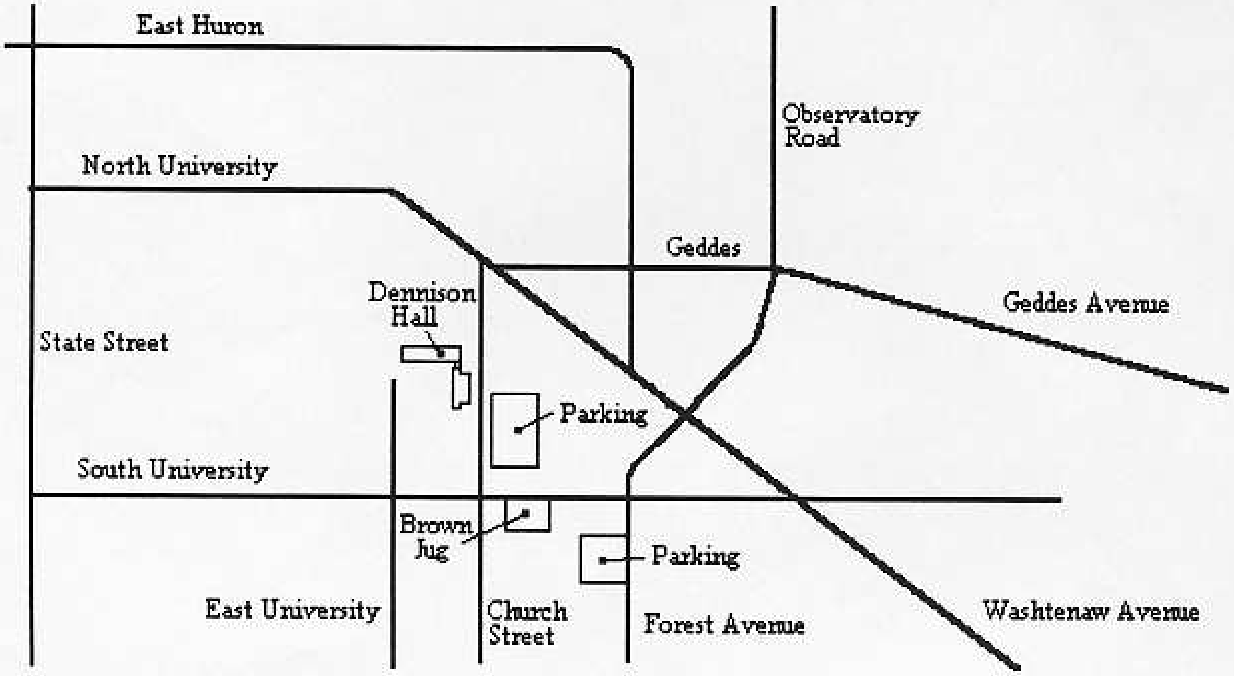
Places and Times:

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. The meeting is held in room 807.

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.

Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM in 807 Dennison





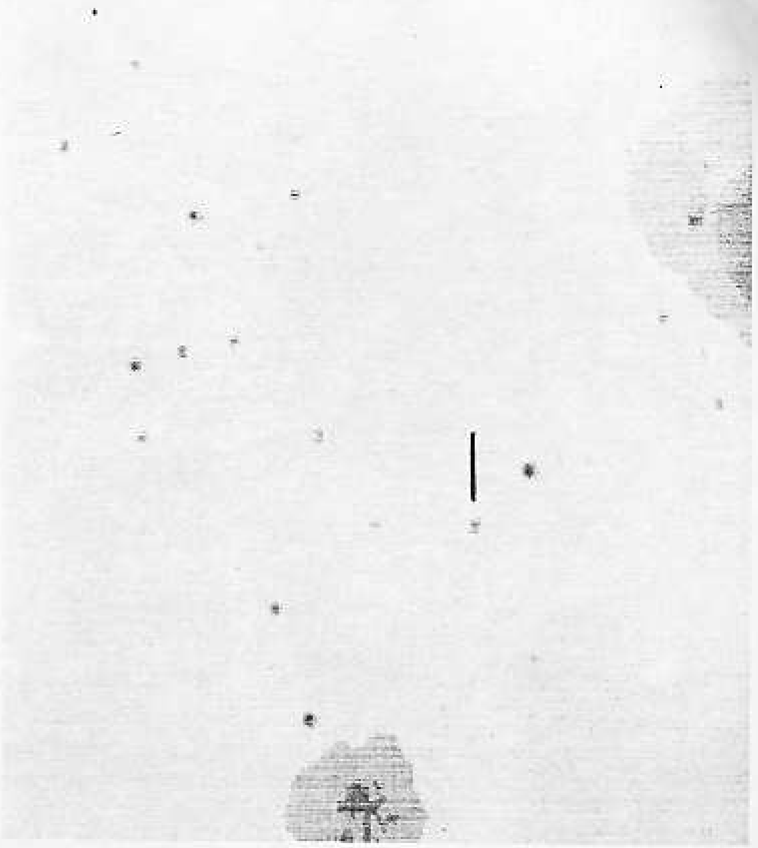
Monthly Meeting:
March 20, 1998
@ 7:30 pm

Room 807 Dennison Hall at the University of Michigan

"A visit to Russia - Art and Science in the former Soviet Union."

Dick Van Effen of the Sunset Astronomical Society

toured Russia several years ago to visit many famous sites. His talk will cover : the Hermitage Art museum in St. Petersburg, Star City ,a Mission Control Center near Moscow, and a Soyuz/Progress launch at Baikonur Cosmodrome in Kazakhstan. The current state of dilapidation of the Soviet moon rocket and Buran shuttle are also discussed.



Asteroid 1988 EG
Makes A Close Approach to Earth

University Lobrow Astronomers
3684 Middleton Dr.
Ann Arbor, MI 48105

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