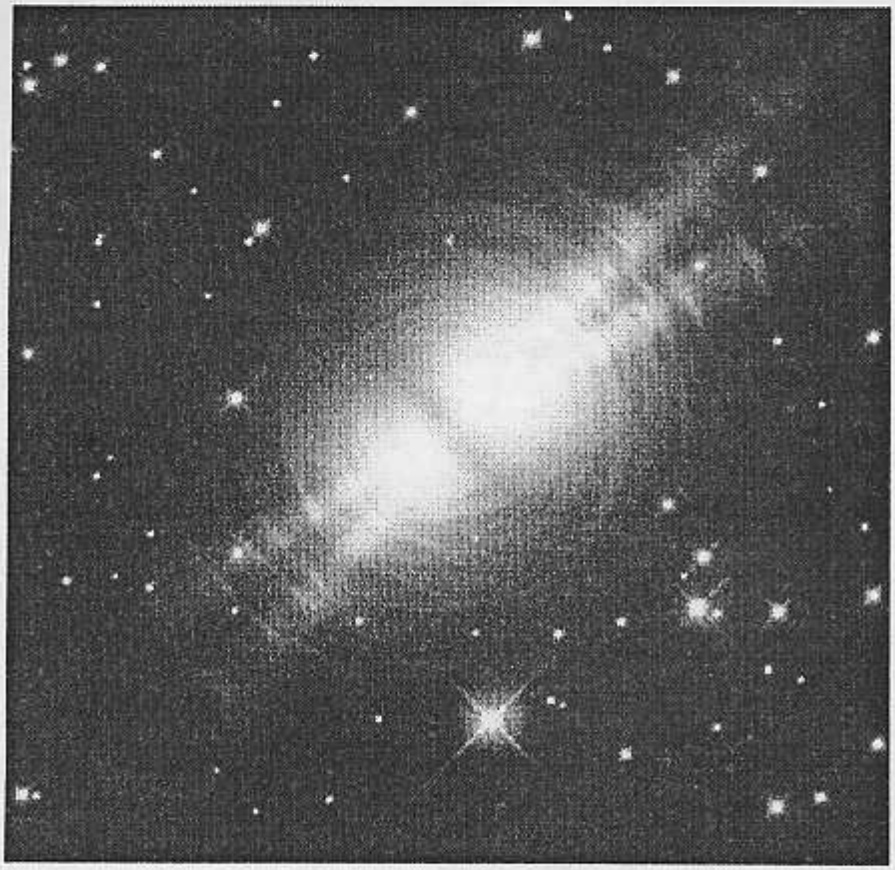
Reflections

of the University Lowbrow Astronomers

July 1996



Searchlight Beams from the Egg Nebula

Credit: R. Sahai and J. Trauger (JPL)

The dramatic and mysterious looking object revealed in this Hubble Space Telescope image is known as the Egg Nebula. It is an aging star about 3,000 lightyears distant, entering its Planetary Nebula phase of evolution. Surrounded by an expanding cloud of gas and dust, a dense cocoon of dust (seen as the dark band running diagonally across the center) encloses the star itself and blocks it from direct view. The searchlight appearance is created as light from the star shines more easily through the thinner parts of the cocoon. Dust particles in the expanding cloud scatter and reflect the starlight making the beams visible. The sharpness of the HST image reveals a wealth of detail which will help to understand this complex and spectacular part of the stellar lifecycle.

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-Pinckney Road; further directions on page 9) on Saturdays before and after the new Moon. The party may be cancelled if it's cloudy at sunset. For further information, call 480-4514.

Important Dates

This Month:

July 13 - Public Star Party at Peach Mountain Observatory
July 19 - Meeting at 807 Dennison - Speaker Peter Alway on "Retro-Rockets: Experimental Rockets 1926-1941"
July 20 - Public Star Party at Peach Mountain Observatory
July 27 - Observatory Painting Party - BE THERE! (pg. 5)

Next Month:

Aug 10 - Public Star Party at Peach Mountain Observatory
Aug 16 - Meeting at 807 Dennison - speaker and topic to be announced
Aug 17 - Public Star Party at Peach Mountain Observatory

Cosmic Water Traced by Europe's Space Telescope ISO

European Space Agency Press Release
submitted by Kurt Hillig

The water that we drink and which fills the world's oceans had its origin among the stars. Astronomers are enthralled by results from the European Space Agency's Infrared Space Observatory, ISO, which reveal the chemistry of our Galaxy in unprecedented detail. Surprisingly conspicuous in the neighbourhood of stars at the end of their lives is water vapour made by the combination of primordial hydrogen with oxygen atoms newly manufactured by the stars themselves. Water then reappears during the formation of new stars and planets from the interstellar medium. This happened at the origin of tbe Solar System, and incidentally supplied the water which accounts for more than half of a human being's body weight.

In retracing this history, ISO also observes water in the form of ice in cooler regions around the stars, and in the dust surrounding young stars, from which planets could evolve. Comets represent an intermediate stage in planet-building, and they contain much water ice. According to one hypothesis the newly formed Earth received some of its water directly from impacting comets.

Water vapour in the Earth's atmosphere has prevented telescopes on the ground from detecting the water vapour among the stars, except in very unusual circumstances. ISO orbiting in space escapes the impediment of the atmosphere. Excellent onboard instruments register the characteristic infrared signatures of water vapour, water ice and many other materials.

When ISO scrutinizes selected objects, it detects emissions or absorptions of infrared rays at particular wavelengths, or "lines" in a spectrum, which reveal the presence of identifiable atoms, molecules and solids. The Short Wavelength Specrometer and the Long Wavelength Spectrometer provide detailed chemical diagnoses, and the photometer ISOPHOT and camera ISOCAM also have important spectroscopic capabilities.

Examples of water detection were among many topics reviewed at the first ISO Science Workshop held at ESA's Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands (29-31 May) when 300 astronomers from Europe, the USA and Japan gathered to assess results from ISO since its launch on 17 November 1995. The Long Wavelength Spectrometer has made remarkable observations of water-vapour lines in the vicinity of dying stars and in star-forming regions. So has the Short Wavelength Spectrometer, which also detects water ice. The photometer ISOPHOT has registered water ice in a large number of objects.

Although fascinated by the natural history of water in the cosmos, astronomers have more technical reasons for welcoming ISO's observations. They can use thc details in a spectrum to reduce the abundance of water and its physical circumstances. In the case of the newly forming star GL 2591 for example, frozen water has vaporized in the warmth of the star and risen to a temperature of about 30 degrces Celsius. The amount of water vapour, roughly 10 parts per million compared with hydrogen, is very high by cosmic standards.

"Its remarkable abundance tells us that water plays an important part in the birth of stars," says Ewine van Dishoeck of Leiden Observatory, whose team of astronomers from the Netherlands and Sweden has used ISO's Short Wavelength Spectrometer in this work. "Stars form by the collapse of a cloud of gas and dust, but a build-up of heat inside the cloud makes the work of gravity harder, when it tries to compress the cloud. By radiating strongly in the infrared, water enables the cloud to shed heat very efficiently. This cooling function of water facilitates star formation. So here ISO gives us a new clue in astrophysics."

An inventory of interstellar ice

The spaces between the stars are very cold, so vapours like water condense and freeze on the surface of available grains, in the manner of frost in winter. They form part of the interstellar dust that darkens the visible sky and which ISO is thoroughly analysing for the first time. The Short Wavelength Spectrometer sees water ice in many settings, for example in NGC 7538, a cloud surrounding a newly forming star. Before ISO, ground-based telescopes had found frozen carbon monoxide and methanol (methyl alcohol) in interstellar space, as well as water ice. ISO observes all these ices much more clearly. It has also seen carbon dioxide ice and methane ice, which are undetectable from the ground. French astronomers have even distinguished ice containing heavy carbon-13, in the ISO data.

The amounts of carbon dioxide and methane detected by ISO are surprising, and ices now account for a larger proportion of the carbon compounds drifting in space. Carbon dioxide ice ranks second to water ice in the vicinity of NGC 7538. Astronomers can start making a complete inventory of the frozen volatile materials in interstellar space and compare them with those found in the Solar System.

"ISO gives us spectra of the kind we dust people used to dream of," says Doug Whittet of the Rensselaer Polytechnic Institute in Troy, New York, who leads a US-Dutch team using the Short Wavelength Spectrometer in this study."Our detection of carbon dioxide and methane in interstellar ices has implications for understanding the behaviour of comets, as well as the origin and evolution of life on Earth."

Sand and soot among the stars

Other components of the dust identified by ISO are mineral grains and large molecules built mainly of carbon and hydrogen, often called hydrocarbons for simplicity's sake. Here too there is a direct connection with the history of the Solar System and the Earth, because similar minerals and hydrocarbons turn up in meteorites and in comets, as analysed for example by ESA's Giotto mission to Halley's Comet in 1986.

Cosmic Water, con't

Silicate minerals, familiar as sand on the seashore, are the principal constituents of the solid Earth. Ground-based infrared telescopes have glimpsed the characteristic signatures of silicate grains in various interslellar settings, but again ISO has a better view. It has observed silicates and other minerals both in the vicinity of dead stars like the planetary nebula NGC 6302, and in disks of dust around young stars where new planets may be forming.

In such protoplanetary disks, astronomers using ISO's Short Wavelength Spectrometer have confirmed the existence of a special form of silicon oxide. It was previously found in comets, and seen in interstellar space only with difficulty and uncertainty by ground-based telescopes. Other silicon oxides are widespread in the Galaxy in non-crystalline (amorphous) form. The special silicon oxide, which may be crystals, is possibly a symptom of planet-making in progress.

Thanks especially to carbon compounds, the Universe is capable of supporting life. A widespread infrared emission at around 12 microns, first noted in 1983 by the IRAS satellite in the Milky Way and in other galaxies, turns out to be due to hydrocarbons gathered in wispy clouds. In interstellar space, complex hydrocarbons make tarry grains similar to the soot from car exhausts or coal fires. ISO's instruments, identifying these hydrocarbons by their characteristic infrared wavelengths, find them almost everywhere they look, except close to stars which tend to decompose the hydrocarbons. Teams are using the ISOPHOT and ISOCAM instruments to survey the hydrocarbons in dozens of locations in the Galaxy. The hydrocarbons appear most conspicuous at the outer surfaces of dense clouds of gas and dust, and should give clues to physical conditions prevailing there.

Shortly before ISO's launch, amateur astronomers reported that the star called R Coronae Borealis was fading from view. This elderly star is normally quite easy to see with binoculars, but intermittently it puffs off clouds of dust that almost hide it from view. Professional astronomers do not have the time to monitor irregularly variable stars, and rely on amateurs to alert them to such events like that in R Coronae Borealis. A few months later when the star could be seen only with powerful telescopes, ISO obtained an infrared spectrum of the star in just one minute, using the high-speed spectroscopic facility of the photometer ISOPHOT.

"We caught this star smoking," says Helen Walker of the Rutherford Appleton Laboratory in England, who was in charge of the observation. "The amateurs saw the star fade from view in visible light in October, but it remained bright in the infrared. The telltale wavelengths revealed sooty carbon compounds newly formed in the star's vicinity. Without ISO we could not hope to analyse such a striking event."

Complexity and inspiration

ISO's camera ISOCAM has obtained impressive images of interstellar dust in many parts of the Galaxy. ISOCAM often uses its spectral capabilities to decompose tbe dusty emissions by wavelength, and so determine their origins. One of the places where ISOCAM has detected extensive regions of hydrocarbons is at the outer edge of the Rho Ophiuchi dark cloud. At 500 light-years, this is also the nearest scene of recent star formation. Spectacular images from ISOCAM show many young stars unseen by visible light, and remarkable filamentary structures in their envelope of dust.

ISO is providing astronomers with more details about the interstellar medium than they can fully understand so far. Not only do chemical mysteries lurk in spectra still being analysed, but some of the spatial features of the Galaxy imaged by ISO leave astronomers scratching their heads. Co-existing cold and hot regions make complicated patterns, which were preeviously thought of only as lukewarm averages.

"The Universe is a very complex place," warns Martin Harwit, a pioneer of infrared astronomy. "But ISO is defining its overall contents, assessing the energy budgets of our Galaxy and others, and teaching us a lot about the demography of old and young stars. For me, the results of ISO so far are inspirational."

The Old Astronomer to His Pupil

by Sarah Williams
submitted by Kurt Hillig

Reach me down my Tycho Brahe, I would know him
when we meet,
When I share my later science, sitting humbly at his feet;
He may know the law of all things, yet be ignorant of how
We are working to completion, working on from then to now.

Pray remember that I leave you all my theory complete,
Lacking only certain data for your adding, as is meet,
And remember men will scorn it, 'tis original and true,
And the obloquy of newness may fall bitterly on you.

But, my pupil, as my pupil you have learned the worth of scorn,
You have laughed with me at pity, we have joyed to be forlorn,
What for us are all distractions of men's fellowship and smiles;
What for us the Goddess Pleasure with her meretricious smiles!

You may tell that German College that their honor
comes too late,
But they must not waste repentance on the grizzly savant's fate.
Though my soul may set in darkness, it will rise in perfect light;
I have loved the stars too fondly to be fearful of the night.

The Milky Way

By Mark Deprest

Have you ever wondered how something got its name? I have, in fact that's kind of how I got started in astronomy. But that's a different story for a different time. In this article I would like to relate a few stories about the Milky Way that come from a number of different ancient cultures.

Although the skies were viewed from a variety of latitudes around the world, most of these ancient cultures had a common feeling about the Milky Way. They all seemed to view it as something like a road or a path, a river or a bridge, or a similar symbol of unity in connection with the passage of life to death.

In one story, we are told that the Milky Way is the trail of burning cinders, left when Phaethon, the mortal son of Helios, the Sun God, took an ill-fated joy ride in the Sun chariot.

Another story of the Milky Way and perhaps the reasons we call it such. Is one involving Jupiter and his son Hercules, who was born of a mortal woman. It seems that Jupiter wished to give this son of his immortality. So he secretly laid the infant beside his wife Juno in order that the baby could feed from her godly breasts. Hercules, possessing the strength of Jove began to suckle the godly bosom so powerfully that a great deal of the precious milk spilt and sprayed all over the heavens. This spray formed the Milky Way. Some of the droplets landed on the Earth and became the flowers we know as lilies.

Some of the American Indians saw this subtle path of silvery light as a road taken by the souls of the dead on their long journey to Heaven. They believed that the bright stars in it were campfires where the souls could warm themselves and rest.

The Nordic people claimed that the Milky Way was the road that the Walkiries took the dead warriors to Walhalla.

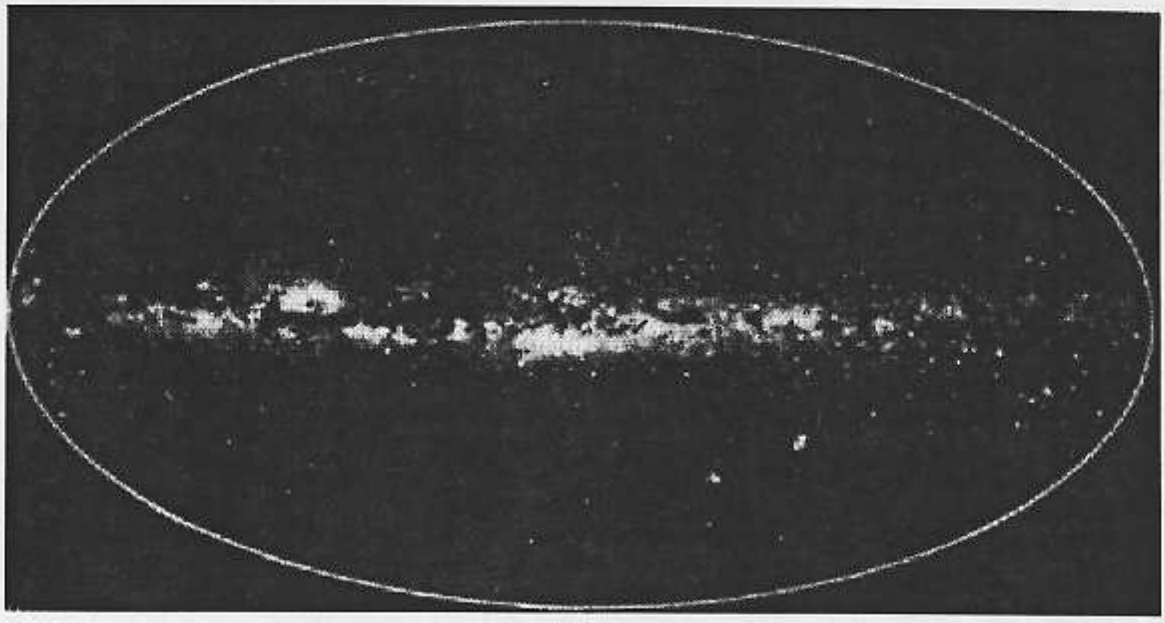
In China and Japan, the Milky Way was seen as a river along which the formless wraiths swim toward the Land of Peaches. The stars are like the elusive "silver fish," and when the Moon is shining these fish become invisible because they are frightened by the Moonwhich, in its crescent shape, looks very much like a fisherman's hook.

The Milky Way was often imagined to be a heavenly river that had an earthly counterpart. This view usually lead to a rather mysterious connection between the earthly river's origin and the heavens, giving the waters' of the river some divine power. In Italy the Po river was some how connected, in India it was the Ganges, in China it was the Chang Jiang. The Egyptians saw it as the Nile, whose life giving powers brought fertility to the desert. There is a new theory about this connection between the Nile and the Milky Way that involves the placement of the Pyramids and their relative position to the Nile. This new theory says that the Pyramids speak to us of a time in the distant past, when the relative alignment of the Nile and the Pyramids matched the alignment of the Milky Way and the Constellation of Osiris, known to us as Orion. This perfect match takes place in 10,500 b.c., which is some 7000 years before the Pyramids were built. There is much more to this theory which also accounts for the placement of the Sphinx, having something to do with the Age of Leo (when the Sun rises in Leo), which also happened back in 10,500 b.c..

In the Middle Ages the Milky Way was seen as a bridge between Heaven and Earth down which angels could descend to help or hinder those still alive on earth.

But which ever myth or story you prefer, I found that we are creatures of vast imaginations and the next time you look up and glimpse the subtle silvery light of the galaxy that is our home remember that this inspiring site is the stuff of legends.

If you would like to read more about the stories in the skies, I suggest you read "The New Patterns in the Sky", by Julius D.W. Staal.



Milky Way photomosaic by Lloyd Johnson

Astronomers Find Key to Locating Hotbeds of Starbirth

by Don Savage, NASA and Mary Beth Murrill, JPL

A team of U.S. astronomers working with data from the European Space Agency's Infrared Space Observatory (ISO) have discovered a clear-cut infrared signature that reveals hotbeds of star formation hidden within spiral galaxies.

Researchers presenting their results at a meeting of the American Astronomical Society in Madison, WI, say the discovery will streamline efforts to look at galaxies across the universe and easily find the areas where unusually intense episodes of starbirth are occurring.

"At the same time, the discovery may help explain why some areas within a galaxy burst forth with new stars but other similar regions remain comparatively quiescent," said Dr. George Helou, NASA's ISO project scientist and an astronomer at the NASA/JPL Infrared Processing and Analsyis Center (IPAC) at Caltech, Pasadena, CA. Helou leads a key ISO project to understand the properties and evolution of the interstellar medium of normal spiral galaxies such as our own Milky Way.

An infrared image of galaxy NGC 6946 produced with ISO data and processed at IPAC clearly shows bright areas seen at 7 and 15 microns where star formation is taking place. The galactic nucleus appears to be a hub of star birth, as are distinct areas along the galaxy's spiral arms.

Starbirth commonly takes place behind curtains of galactic dust and gas. ISO's infrared detectors, however, "see" the heat emitted from behind those curtains. The color composite image of NGC 6946 was made with data from ISO's mid-infrared camera. The instrument was built by a consortium led by Dr. Catherine Cesarsky of the CEA/Saclay Institute near Paris, France.

"We know from studying other galaxies that when they merge or collide, they create a burst of star formation. But in this case, there's no collision and no culprit to identify as the catalyst for star formation. In the absence of galactic collisions, why should there be any starburst at all. More data on this and other starburst regions from ISO and other infrared studies will help answer this question," Helou said.

Other key ISO experiments being conducted by U.S. astronomers are studies of quasars, investigations of dust debris around Sun-like stars and the birth and death of planetary systems. In addition to these experiments, more than one hundred U.S. astronomers are receiving observing time on ISO to conduct other investigations. The ISO was launched into Earth orbit November 16, 1995.

Observatory Painting Party

Saturday July 27 11:00 am til ?
Rain date: Sunday July 28

Calling all Lowbrows! It's time to pay the piper! The University graciously allows us to use its wonderful telescope, and in return asks that we provide basic upkeep for the observatory building.

We have the paint, and what we need is YOU. Your mother told you many hands make light work and she was right. More people means less work for each person, and more fun for everybody.

The tasks at hand are general painting and scraping. If you have them, we could use the following: ladders, scrapers and a paint sprayer. Since there is no running water up there, please bring along water jugs, as well as soap, rags and cleanup materials. The club will supply paint, thinners, and "expendables" such as paint brushes and rollers. Also bring along whatever refreshments you'd like.

The University doesn't ask much of us - so come on out and pitch in! Feel free to show up any time, and stay as long as you can. A fun time will be had by all!

Attention All ATM's

by Tom Ryan

Karl Mueller, a local Optician, is planning to hold a small calss on making a 6" apeture, 3-spherical mirro Vallejo telescopes, designed by R. Sigler. The class will feature generated optical elements, hand optical fining on grooved grinding plates, machine polishing, and advanced hand figuring using interferometric testing. Participants will complete the class with a finished set of optics for this f/16, diffraction-limited, 1/2 degree field design.

Requirements for the course include completeing the mechanical portion of the telescope before the course begins. A suggested design layout will be made available to prospective students. Previous optical experience in not necessary, but the ability to work with one's hands will be an advantage.

The class will consist of several sessions, totalling approximately 40 hours, after which the student will have a complete set of optics, requiring only coating and installation in their telescope.

The cost of the class is $460.00 per student. There is room in the first class for three students. The class is set to begin in August or September. Prospective students can contact Karl Mueller at (313) 663-9011.

Have Your Signature in Space

by Mark B. Vincent

You have heard about the chance to have your signature flown to Saturn on Cassini. Ahhh, that is just a digitized copy of your signature placed on a CD-ROM. Here is your chance to have your own handwriting flown 150 miles into space.

How can this happen?

As many of you may already know, we (John Clarke, Doug Warshow and I) are planing another rocket flight to observe Jupiter. The planned launch date was September 10, but this is not likely due to some unexpected hardware problems. We may not know the actual launch date for some time.

How will this work?

Our esteemed President D.C. Moons has volunteered to make a 18x18 inch decal sheet. You may sign it at this month's Lowbrow meeting. Since the speaker, Peter Alway, will be talking about rockets, what better timing? The sheet will then be taken to White Sands and fixed to the second stage on the night of the launch. In addition to this sheet, several U of M decals may be placed on the boosters. The positioning of the U of M decals will be based on some old photos Peter has provided of previous U of M launches. Peter has also said that there is a definite chance that some model rocket company may consider the possibility making a kit based on our artist conceptions of the rocket. Note, if this happens, the scale would likely be around 1/20, so write big and leave room for others.

As with Cassini, don't expect your signature back. It may not survive the 11g acceleration and Mach 6 speed during launch. Even if it did, no one will ever go out to see where the second stage slams back into the desert floor after falling 150 miles...without a parachute.

Why?

In appreciation of the help and support the Lowbrows have provided us.

Have you checked your calendar for July 27? Something special is happening . . . see page 5

Skywatcher's Diary

compiled by Robert C. Victor, Abrams Planetarium

Monday, July 15
In SSE two hours after sunset tonight, Comet Hale-Bopp is a hazy patch of about 6th magnitude, 13 degrees above Jupiter and 2.2 degrees lower right of a 4th-magnitude star, Alpha Scuti. The comet may be visible with unaided eye in very dark skies, and binoculars make it look larger and brighter. When you "star hop" to a target object, it's important to know the angular field diameter of your binoculars. To get a sense of magnitude and angular distance with unaided eye and through binoculars, look for the 2nd-mag star Sigma Sagittarii 3.5 degrees below Jupiter, and the 3rd-mag star Pi Sagittarii 5.2 degrees to Jupiter's left.

Tuesday, July 16
Comet Hale-Bopp shifts its position against the stars from one night to the next this week by just over 1/3 of a degree. About two hours after sunset, use binoculars to locate the comet as a 6th-magnitude hazy patch 13 degrees above bright Jupiter. Center your binoculars on the comet, and note the 3.8-mag star Alpha Scuti 2.2 degrees upper left of the comet, and 4.7-mag Zeta Scuti 3 degrees right of Alpha and 2.4 degrees upper right of comet. On July 22 the comet will pass only 0.8 degree lower right of Zeta. The comet will shift a total of 5 degrees during July 16-31, 8 degrees during August, and 3 degrees during September. This summer and autumn, our Sky Calendar will follow the comet as it brightens and slowly drifts across the evening sky.

Wednesday, July 17
Beginning 20 minutes after sunset, look for the thin crescent Moon very low, about 10 degrees north of due west. Don't be late, or you may miss it!

Thursday, July 18
Within half an hour after sunset, the crescent Moon is very low, nearly due west. In the next half hour, using binoculars if necessary, look for Regulus, heart of Leo, about 6 degrees to Moon's upper right. For observers with a star atlas and a telescope or good binoculars, the 8th- mag planet Neptune during darkness hours tonight is 1.7 deg ESE of 5th-mag 56 Sagittarii, and 1.4 deg SSE of 6th-mag 57 Sgr.

Friday, July 19
With the Moon still a thin crescent setting around nightfall, dark sky sites still offer excellent views of the Milky Way. Begin at nightfall with bright Jupiter in SSE and Antares in SSW. Between them and much lower lies a prominent close pair of stars marking the end of the Scorpion's tail, 2nd-mag Lambda with 3rd-mag Upsilon just 0.6 deg to its right. Between these stars and Jupiter lie eight stars of 2nd and 3rd magnitude forming the Teapot of Sagittarius. Its handle is below Jupiter. In summer and early fall, the Milky Way looks like steam rising from the spout of the Teapot! Scan the "steam" with binoculars. Along the Milky Way 14 deg above or upper right of Jupiter and 6 deg upper left of the Omega Nebula M17, is Comet Hale-Bopp!

Diary, con't

Tonight and Saturday from 9 p.m. until 11 p.m., if skies are clear, MSU Observatory will be open for viewing of Moon, Jupiter, Comet Hale-Bopp, and summer deep-sky objects. We encourage you to bring your binoculars!

Saturday, July 20
Two hours after sunset, bright Jupiter is in SSE, and first-mag Antares is in SSW, 31 degrees to Jupiter's right. Look 24 deg left of Jupiter for a pair of stars, Alpha 2.4 deg above Beta, in Capricornus. Though of only 3rd and 4th magnitudes, Alpha and Beta Cap stand out compared to their faint surrounding stars. Binoculars or sharp naked eye reveals Alpha as a close double star of 0.1 degree separation. (Actually the two members of Alpha aren't related; one is much farther from us.) The 5.3- mag star Sigma Cap is 4.3 deg lower right of Beta Cap. As a check, there's a compact triangle of two 5th-mag stars and a 6th-mag, about 2 to 2-1/2 deg left of Sigma. Finally, 5.7-mag Uranus is 1.1 deg below Sigma. Bring binoculars for a session at MSU Observatory, 9-11 p.m. if skies are clear.

Sunday, July 21
Tonight and next few evenings are ideal for using binoculars or a small telescope to view lunar craters and other surface features near the terminator, or Moon's day-night boundary.

Monday, July 22
An hour after sunset, face SW to see Spica 2 to 3 degrees lower left of Moon. In predawn darkness hours Tuesday through next Sunday, watch for Delta Aquarid meteors after the Moon sets. The observing "window" gets narrower each morning as the Moon sets later.

Tuesday, July 23
Calculate the time of your local midday (halfway between the times of your local sunrise and sunset). Within an hour later, look low, 15 to 20 degrees south of east, for the rising First Quarter Moon. It is half full, but called First Quarter because it follows the Sun across the sky today by 90 degrees, or one-quarter of a circle.

Wednesday, July 24
One hour before sunup on Thursday and Friday mornings, look between E and ENE to find Mars nearly 11 degrees lower left of Venus. This is the farthest apart they'll be until Sept. 26. Between now and then, they'll come within 3 degrees of each other in early September, then spread apart again. Look also for Aldebaran 11 deg upper right of Venus, and Betelgeuse, shoulder of Orion, about 14 deg below Venus. Using binoculars, scan the horizon 10 deg right of Betelgeuse for Orion's belt, a vertical line of three stars. Look also for Rigel, Orion's foot, 9 deg right of the belt.

Thursday, July 25
Locate the Moon in SSW 1-1/2 hours after sunset. Can you see the head of Scorpius, three stars of 2nd or 3rd magnitude in a slightly curved vertical line 2 to 9 degrees below the Moon? Binoculars help pick them out of the glare of the gibbous Moon. Brighter first-magnitude Antares, about 10 degrees to Moon's lower left, is easier to see.

Friday, July 26
Face south an hour after sundown to spot Antares about 11 degrees lower right of Moon.

This is the final weekend for public shows at Abrams Planetarium until mid-September. For more information, call our show info line at (517) 355-4672.

Saturday, July 27
Moon is in SSE at dusk, with bright Jupiter about 9 degrees lower left. Comet Hale-Bopp is only 10 degrees upper left of the very bright Moon -- not a good night for viewing! Wait until August 2, and then Moon will rise late enough to allow a brief dark moonless interval for viewing the comet and the Milky Way. Each night thereafter the Moon will rise later, and the dark "window" will widen.

Sunday, July 28
Face SE sky at dusk, and you can't miss bright Jupiter about 8 degrees to Moon's right.

Monday, July 29
The Moon is Full overnight, at 6:35 a.m. EDT on Tuesday. Do tonight's rising Moon (in ESE just before sunset) and Tuesday morning's setting Moon (in WSW around sunrise) seem unusually large to you? If you think so, you'd be correct. At about 4 a.m. EDT on Tuesday, the Moon is 221,797 miles from Earth, its closest for the year! The Moon's disk tonight is 14 percent larger in angular diameter than it was two weeks ago. July's Full Moon is known as the Hay or Thunder Moon, according to Guy Ottewell.

Tuesday, July 30
Tonight the Moon rises near the time of sunset across the northern part of the contiguous U.S., and several minutes after sunset seen from farther south in the U.S. In spite of its slightly greater distance from Earth tonight, the rising Moon may seem larger than on Monday evening, because the sky is darker during tonight's moonrise.

Wednesday, July 31
Using binoculars about 40 minutes after sunset, from a place with an unobstructed view of the horizon about 15 degrees N of due west, search for Mercury and Regulus less than a degree apart. Mercury is the brighter and farther north. This pairing is higher and easier to see from southern states.

Editor's Note: The Abrams Planetarium also publishes a Sky Calendar each month. A sample calendar for May 1996 is available at http://www.pa.msu.edu/abrams/may96skycal.html
Or send a long, self-addressed stamped envelope to:

July Sky Calendar
Abrams Planetarium
Michigan State University
East Lansing, MI 48824

Galileo Makes New Discoveries at Ganymede

NASA Press Release July 10, 1996

NASA's Galileo spacecraft has returned stunning close- ups of Jupiter's moon Ganymede revealing that the face of the huge satellite has been extensively bombed by comets and asteroids and dramatically wrinkled and torn by the same forces that make mountains and move continents on Earth.

"These images have exceeded our wildest expectations," said Dr. Michael Belton of the National Optical Astronomy Observatories, who leads Galileo's imaging team.

At the same time, scientists studying data from space physics instruments on the spacecraft have made the major discovery that planet-size Ganymede possesses its own magnetosphere -- a bubble-shaped region of charged particles that surrounds many of the planets but has never been found to exist around a moon. The finding indicates that Ganymede, which is three-quarters the size of Mars, very likely creates its own magnetic field. Possible sources of a magnetic field include a molten iron core or even a thin layer of conducting salty water underneath its icy crust.

"What we've found is a magnetosphere within a magnetosphere," said Galileo Project Scientist Dr. Torrence V. Johnson at NASA's Jet Propulsion Laboratory, Pasadena, CA. "While we expected some degree of interaction between Ganymede and Jupiter's magnetic environment, the size and the effect at Ganymede were completely unexpected," he said.

The crisp new images and magnetospheric findings were revealed in data returned by Galileo in the days since its first flyby of Ganymede on June 27, when the spacecraft came within just 519 miles of the big moon. Ganymede is the largest moon in the solar system. It is made of about equal proportions of rock and water ice. It is one of Jupiter's four large satellites that will be repeatedly visited by the Galileo spacecraft over the course of its two-year mission in orbit around the giant planet. Galileo entered orbit around Jupiter on December 7 last year. The spacecraft was launched from Earth on October 18, 1989.

The discoveries announced today are based on just a small portion of the data gathered and returned from the Ganymede flyby and mark the start of a steady stream of images and other information to be returned from Galileo over the next 18 months. The data were returned using new software radioed to the spacecraft earlier this year that allows Galileo to send back its scientific findings in shorthand form. This helps compensate for the loss of the use of Galileo's high-gain antenna and allows Galileo to return its findings via the smaller low-gain antenna also on the spacecraft.

These first images show two of the regions selected for close photographic study on Galileo's first pass of Ganymede yielded surprising new information about its geological past. The areas, called Galileo Regio and Uruk Sulcus, both show ancient cratered ice fields adjacent to or overlain by younger ice volcanic plains, ridged ice mountains, deep furrows and smooth broad basins that are products of tectonic forces. About half of Ganymede's older cratered surface appears to have been resurfaced by younger volcanic and tectonic activity.

"These images reveal fundamental details about how features seen by Voyager formed and show us age relationships and sequences that turn our previous thinking upside down," said imaging team member Dr. James Head of Brown University.

The discovery of Ganymede's magnetosphere was made by space physicists using data from Galileo's plasma wave spectrometer, which measures variations in electromagnetic waves in Jupiter's environment and from the magnetometer, which measures the strength and direction of magnetic fields. Both instruments were sending data to Earth during the Ganymede flyby while recording even more detailed information to be returned later this month.

The plasma wave spectrometer also showed that the densities of charged particles around Ganymede increased by a factor of more than 100 near Galileo's closest approach. "This indicates that Ganymede is surrounded by a thin ionosphere," said Dr. Donald A. Gurnett of the University of Iowa and principal investigator on the plasma wave spectrometer experiment. "The existence of an ionosphere suggests that Ganymede also probably has a tenuous atmosphere," he said.

As the spacecraft approached Ganymede, the magnetometer found the measured field was as expected at that position in Jupiter's powerful field -- fairly uniform and pointed in a southerly direction. But as the spacecraft crossed into the region where the plasma wave spectrometer sensed signals characteristic of a magnetosphere, the field increased in strength by a factor of nearly five and abruptly changed direction to "point" at Ganymede itself, said Dr. Margaret Kivelson of the University of California at Los Angeles, principal investigator of the magnetometer experiment.

Taken together, these two measurements strongly suggest that Ganymede is the first known moon with its own magnetosphere and the first example ever seen of a "magnetosphere within a magnetosphere."

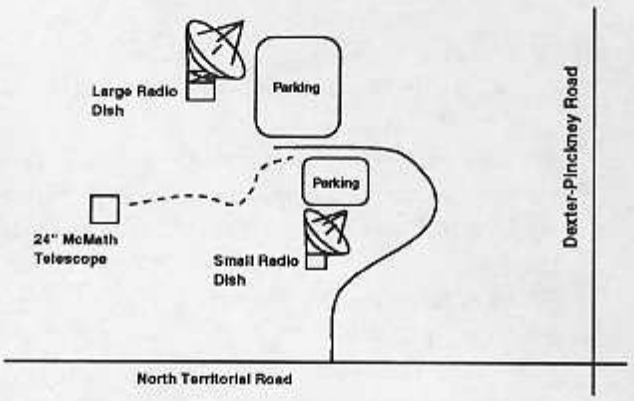
"We knew Ganymede was an interesting place," said Johnson. "What we have just found makes it even more exciting."

The new discoveries will be quickly followed up by other data to be returned by the spacecraft this summer. All the experiments on Galileo that measure magnetic fields and particles recorded detailed data during the close approach, and these data will be played back from the tape recorder in the next two months. "With all the data in hand, we will gain better insight into what is causing the strange environment around this moon," said Johnson. The Galileo science and engineering teams are planning three more close flybys of Ganymede over the next 18 months, which will take the spacecraft to different regions of the big moon's magnetosphere and allow close study of other regions of its surface.

Places

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.

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 tthe McMath telescope building.



Times

Monthly meetings of the Lowbrows are held on the 3rd 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 member's houses. See the calendar on the cover page for the location of next meeting.

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties may be 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 tocheck on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitos - bring insect repellent, and it does get cold at night so dress warmly!

Dues

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students. 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 either at the monthly meeting or by mail at:

Doug Scobel
1426 Wedgewood Drive
Saline, MI 48176

Magazines

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

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

Newsletter Contributions

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call the Newsletter Editor Laura Meluch or e-mail to meluch@alumni.engin.umich.edu to discuss length and format. Announcements and articles are due by the first Friday of each month. Articles should be mailed to:

Laura Meluch
522 Second Street
Ann Arbor, MI 48103

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From the Editor . . .

Hello again! I hope you all enjoyed the Fourth of July holiday weekend, took advantage of our lovely weather and got in a lot of good viewing. The Ganymede article arrived much past my deadline, but I managed to squeak it in. I'll try to put more pictures in next month's issue. I expect to see ALL of you at the painting party on July 27, so be there or be square.

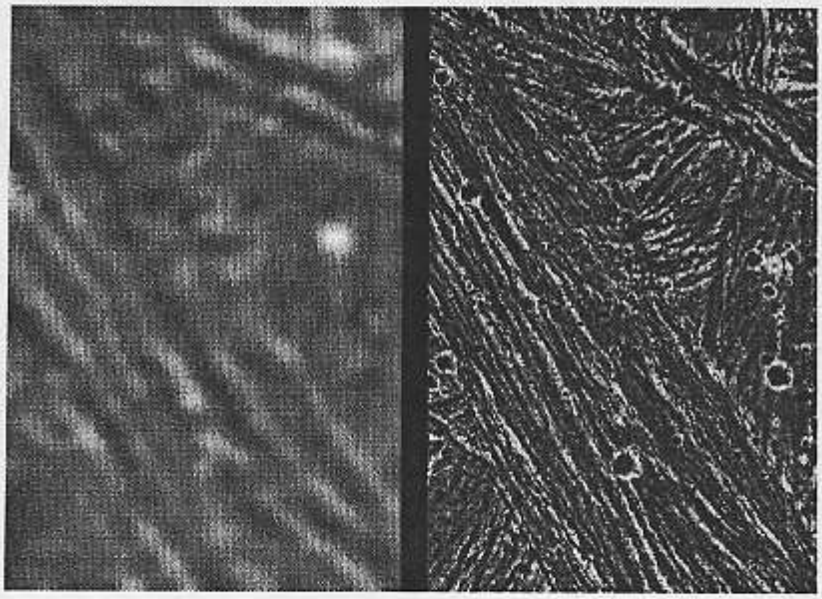
And as always, keep those cards and letters coming!

At the Next Meeting

Peter Alway, author of "Rockets of the World" and "The Art of Scale Model Rocketry," shares his research on 1930's rocketry. He will discuss the rockets of Goddard, the German rocket society, and the Soviet rocket groups, all of whom foretold the space age.

In 1925, the rocket was a powder-fired toy. In 1942, the first V-2 missile reached outer space. In between, lone inventors, groups of dreamers, and governments turned interplanetary travel from a fantasy to a mere engineering problem.

Voyager and Galileo Images of Ganymede



Date: June 27, 1996
Distance from Ganymede: 7,448 km (4,628 miles)

These images demonstrate the dramatic improvement in the resolution of pictures that NASA's Galileo spacecraft is returning compared to previous images of the Jupiter system. The frame at left was taken by the Voyager 2 spacecraft when it flew by in 1979, with a resolution of about 1.3 kilometers (0.8 mile) per pixel. The frame at right showing the same area was captured by Galileo during its first flyby of Ganymede. It has a resolution of about 74 meters (243 feet) per pixel, more than 17 times better than that of the Voyager image.

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Check your membership expiration date on the mailing label!