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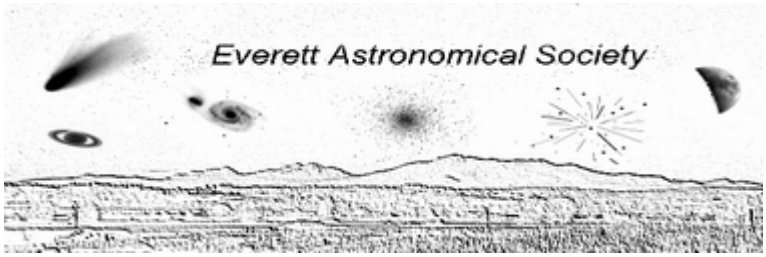
Volume MMVII. No. 3



The Stargazer

March 2007

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Newsletter co-editor: Bill O'Neil	(774) 253-0747	wonastrn at seanet.com	
Web assistance: Cody Gibson	(425) 348-1608	sircody01 at comcast.net	*See EAS website at:*
		(change 'at' to @ to send email)	http://members.tripod.com/everett_astronomy

EAS BUSINESS…

NEXT EAS MEETING – SATURDAY MARCH 24TH AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

★★★ THIS MONTH'S MEETING PROGRAM: ★★★
Comet Impact – The Deep Impact comet collision mission.

Map to library - http://www.epls.org/about/mlmap.htm

2702 Hoyt Avenue
Everett, WA 98201

Directions to library - http://www.epls.org/about/mldirect.htm

★ STAR PARTY INFO ★

Upcoming EAS star party schedule: (also see the regional star parties listed in the 'Astro Calendar for 2007')

Saturday March 24 - (evening after EAS meeting), weather permitting.

EAS member Ron Tam has offered a flexible opportunity to EAS members to come to his home north of Snohomish for observing on clear weekend evenings and for EAS starparties. Anyone wishing to do so needs to contact him in advance and confirm available dates, and let him know if plans change**. "***Our place is open for star parties any Saturday except weekends of the Full Moon. People can call to get weather conditions or to confirm that there is a star party. Our phone number is (360) 568-5152. They can e-mail me too (tam1951@nwlink.com) but I don't check my email daily. They can email me for directions if they never have been out here."*

Listed below are proposed dates for **planned EAS star parties** at my [Ron Tam's] place, depending upon the weather, of course.

Mar 24 - Saturday, (evening after EAS meeting)
Apr 14 - Saturday, (evening after EAS meeting)
May 19 - Saturday
Jun 16 - Saturday
Jul 07 - Saturday
Aug 11 - Saturday
Sep 08 - Saturday
Sep 19 - Saturday
Oct 13 - Saturday
Nov 10 - Saturday

Other dates may be available, but these coincide with times around the new moon, and any conflicts we may have.

Fire In The Sky 2007 rocket launch in Mansfield, WA during the Memorial Day weekend is in a couple of months. The Tacoma Astronomical Society will be there with their telescopes having their star party. The EAS group is welcome to come out and join the crowd. You can see a pic of the flyer for the launch at:
http://www.rocketsnw.com/uploads/FITS2007Flyer3JPEG800X600.jpg

PacSci Astronomy Weekend in North Cascades - July 13-15

This July, Pacific Science Center is excited to offer a weekend of astronomy and natural discovery for its members. Educators from Pacific Science Center and the North Cascades Institute are teaming up to offer a variety of hands-on, family-friendly educational programs. During the day, there will be astronomy classes, guided nature hikes and canoe trips on nearby Diablo Lake. And then at night, discover the night sky like you've never seen it before. We hope you'll join us for a great weekend. July 13-15, North Cascades Environmental Learning Center North Cascades National Park. More information including pricing, detailed program, and reservation forms available shortly, so please check back at Pacific Science Center's website. **http://www.pacsci.org/travel/astronomy_weekend.html**

People should also join and send mail to the mail list *everett_astronomy@topica.com* to coordinate spur-of-the-moment observing get-togethers, on nights when the sky clears. We try to hold informal close-in star parties each month during the spring, summer, and fall months on a weekend near the New moon at a member's property or a local park. (call Jim Bielaga at (425) 337-4384 for info or check the EAS website.) Members contact Jim Bielaga for scope borrowing.

$$ - FINANCIAL HEALTH - $$

The club maintains a $950+ balance. We try to keep approximately a $500 balance to allow for contingencies. .

CLUB SCOPES

SCOPE	LOAN STATUS
10-INCH WARD DOBSONIAN	ON LOAN
10-INCH SONOTUBE DOBSONIAN	AVAILABLE
8-INCH DOBSONIAN	AVAILABLE

EAS members: contact VP James Bielaga at (425) 337-4384 or jamesbielaga at aol.com to borrow a scope.

EAS MEMBER NEWS

Attention EAS Members – 10% Discount for all Everett Astronomical Society Members at Aurora Astro Products

"Show your club membership card at Jim Bielaga's new astronomy store 'Aurora Astro Products' and receive a 10% discount on all purchases. This is an exclusive discount to E.A.S. members only.

I am proud to be able to offer this discount to Everett club members, and thanks for the support you have shown me on opening my new store. Also I have made great friends and learned a lot being a club member since 1991.

- Clear Skies, Jim Bielaga"

Aurora Astro Products
11419 19th Avenue SE #A102
Everett, WA 98208
425-337-4384
www.auroraastro.com
Open Monday - Friday 9:00 am to 6:00 pm
Saturday 10:00 am to 5:00 pm
Over 37 product dealerships, and growing

Astronomy Day 2007 – April 20 and 21st

Friday Apr 20 – Dusk - Astronomy Day Observing Star party at Harborview Park http://www.everettwa.org/default.aspx?ID=539

Saturday Apr 21 – 10:00- 5:00 – Displays, Presentations, and Events at Everett Library Auditorium

Saturday Apr 21 - Dusk - Astronomy Day Observing Star party at Harborview Park http://www.everettwa.org/default.aspx?ID=539

http://www.astroleague.org/al/astroday/factsheet.html

EAS members – please mark your calendars for this event !

Does Anyone know about the history of the EAS ???

The Northwest Region of the Astronomical League (NWRAL) is putting together a new website and needs the following information from each club of the NWRAL. The EAS is looking for any information from members about the early history. Please contact Mark Folkerts if you have any info that could be of help. NRWAL would like a brief history of the club

- Club established date
- Who started the club
- When club joined the Astronomical League.

'Intergalactic Medium' Teleconference – Tuesday Mar 27 6:00pm

There is a great teleconference coming up this Tuesday, March 27th at 6:00 pm PDT. We will hear from Dr. Ken Sembach, Hubble Project Scientist and astronomer with the Space Telescope Science Institute about his interesting work with intergalactic matter. This mysterious region contains the building blocks of galaxies, as well as much that we are only beginning to understand. Learn about dark matter and its changing distribution, as well as "ordinary" matter and attempts to image it in clever ways. Dr Sembach will also update us on the new instruments that will be added to the Hubble Space Telescope and a possible repair mission. Join us for a remarkable evening of grand proportions and a look into mankind's attempt to explore the distant universe. Stick around for the always interesting Q&A afterwards! You can view the accompanying PowerPoint in two ways:

1.) Download the PowerPoint by at this address: http://nightsky.jpl.nasa.gov/docs/NSN_Sembach_Telecon.ppt or by going to the Tele-Conference link under ToolKit Downloads then Tele-Conferences and click on the PowerPoint titled "Intergalactic Medium with Dr. Ken Sembach". (PowerPoint is 7MB)
2.) Or you can view it online at http://www.astrosociety.org/nsntelecon/
To log into the Telecon on March 27th, between 5:45 - 6:00pm Pacific Time: Toll-free conference call line: 1-888-889-4951.
An operator will answer and:
- You will be asked for the passcode: NIGHT SKY NETWORK
- You might be asked for the call leader: MICHAEL GREENE
- You will be asked to give your NAME and the CLUB you belong to, and number of people listening with you.

We look forward to "seeing" you there. If you have any questions, please contact the Night Sky Network Administrators at: nightskyinfo@astrosociety.org

ASTRO CALENDAR FOR 2007

March 2007

Mar 15 - Asteroid 99942 Aphophis Closest Approach To Earth (.865 AU)
Mar 18 - Best weekend for Messier Marathons
Mar 21 - Vernal Equinox, 00:07 UT
Mar 24 - EAS March Meeting – 3:00 PM – Everett Public Library
Mar 24 - Saturday, EAS Star party at Tam's (evening after EAS meeting)

April 2007

Apr 08 - Easter Sunday
Apr 16-22 - Astronomy Week - Bringing Astronomy to the People
Apr 14 - EAS March Meeting 3:00 PM – Everett Public Library
Apr 14 - Saturday, EAS Star party at Ron Tam's - after EAS meeting
Apr 20 - Astronomy Day – Friday Star party at Harborview Park
Apr 21 - Astronomy Day – Saturday Star party at Harborview Park

Apr 21 - Astronomy Day Saturday events at Everett Library
http://www.astroleague.org/al/astroday/factsheet.html
Apr 19-22 - OAS Camp Delaney Spring Star Party -
http://www.olympicastronomicalsociety.com/Documents/CAMP%20DELANY%20V2.pdf
Apr 22 - Lyrids Meteor Shower Peak

May 2007

May 05 - Eta Aquarids Meteor Shower Peak
May 13-20 - Texas Star Party - http://www.texasstarparty.org/
May 17 - Comet 2P Encke Closest Approach to Earth (0.507 AU)
May 19 - Saturday, EAS Star party at Ron Tam's
May 25-28 - Riverside Telescope Makers Conf. - http://www.rtmc-inc.org/
May 26-28 - Fire In The Sky (WAC launch & star party)
http://www.washingtonaerospace.org/launches.php
May 28 – Memorial Day Holiday

June 2007

Jun 01 - Asteroid 4 Vesta Closest Approach To Earth (1.144 AU)
Jun 06 - Jupiter at opposition
Jun 9-16 Grand Canyon Star Party -
http://www.tucsonastronomy.org/gcsp.html
Jun 14-17 Rocky Mountain Star Stare - http://www.rmss.org/
Jun 16 - Saturday, EAS Star party at Ron Tam's
Jun 18 - Dwarf Planet 134340 Pluto Closest Approach To Earth (30.2AU)
Jun 20 - Summer Solstice, 20:24 UT
Jun 22-24 - Klickitat County Star Party - http://www.klickitatstarparty.net/
June 30 - Blue Moon (2nd Full Moon of month)

July 2007

Jul 04 - 4th of July Holiday
Jul 07 - Earth At Aphelion (1.017 AU from Sun)
Jul 07 - Saturday, EAS Star party at Ron Tam's
Jul 9-16 - Shingletown Star Party - http://www.shingletownstarparty.net/
Jul 11-14 Golden State Star Party at Mt Lassen NP
http://www.goldenstatestarparty.org/
Jul 13-15 - PacSci Astronomy Weekend in North Cascades
http://www.pacsci.org/travel/astronomy_weekend.html
Jul 12-14 - Table Mountain Star Party - http://www.tmspa.com/
Jul 13-15 - Klickitat County Star Party - http://www.klickitatstarparty.net/
Jul 14 - OAS Hurricane Ridge Star Party -
http://www.olympicastronomicalsociety.com/hurricane_ridge_star_parties.htm
Jul 29 - South Delta-Aquarids Meteor Shower Peak

August 2007

Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 3-4 - ALCON 2007 Portland Oregon - http://www.alconexpo.com/
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 8-12 - Mt Bachelor Star Party - http://www.mbsp.org/
Aug 11 - Saturday, EAS Star party at Ron Tam's
Aug 11 - Silver Falls (OR) Star Party -
http://www.oregonstateparks.org/park_211.php
August 11 - ICAS Artist Point Lookout Star Party -
http://groups.msn.com/WashingtonICAS/memberonlyevents.msnw
Aug 11-19 Mt. Kobau Star Party - http://www.mksp.ca/
Aug 12 - Perseids Meteor Shower Peak
Aug 11 - OAS Hurricane Ridge Star Party -
http://www.olympicastronomicalsociety.com/hurricane_ridge_star_parties.htm
Aug 16-19 - Oregon Star Party - http://www.oregonstarparty.org/
Aug 24-26 - RASCal's Star Party - http://victoria.rasc.ca/events/StarParty/
Aug 25 - Northern Iota Aquarids Meteor Shower Peak
Aug 28 - Total Lunar Eclipse - entire eclipse visible

September 2007

Sep 03 - Labor Day Holiday
Sep 6-9 - OAS Camp Delaney Fall Star Party -
http://www.olympicastronomicalsociety.com/Documents/CAMP%20DELANY%20V2.pdf
Sep 08 - Saturday, EAS Star party at Ron Tam's
Sep 6-9 Alberta Star Party - http://calgary.rasc.ca/asp2007.htm
Sep 15 - ASTRONOMY DAY (For Fall too this year!) Star Party
Sep 14-16 - Klickitat County Star Party - http://www.klickitatstarparty.net/
Idaho Star Party, September 9-11, 2005 Boise Astronomical Society
http://www.boiseastro.org/
Sep 19 - Saturday, EAS Star party at Ron Tam's
Sep 20-23 - Orion Nebula Star Party -
http://www.seattleastro.org/orionnebsp.html
Sep 23 - Autumnal Equinox (09:51 UT)
Merritt Star Quest - http://www.merrittastronomical.com/

October 2007

Oct 09 - Draconids Meteor Shower Peak
Oct 13 - Saturday, EAS Star party at Ron Tam's
Oct 14 - Dwarf Planet 136199 Eris Closest Approach To Earth (95.8AU)
Oct 12-14 - Klickitat County Star Party - http://www.klickitatstarparty.net/
Oct 21 - Orionids Meteor Shower Peak
Oct 31 - Halloween

November 2007

Nov 03 - Taurids Meteor Shower Peak
Nov 04 - End Daylight Saving time - Set Clock Back 1 Hour (US)
Nov 10 - Saturday, EAS Star party at Ron Tam's
Nov 12 - Dwarf Planet Ceres Closest Approach To Earth (1.832 AU)
Nov 17 - Leonids Meteor Shower Peak
Nov 22 - Thanksgiving Holiday

December 2007

Dec 07 - 35th Anniv (1972), Apollo 17 Launch (Last Mission to Moon)
Dec 13 - Geminids Meteor Shower Peak
Dec 22 - Winter Solstice, 22:06 UT
Dec 22 - Ursids Meteor Shower Peak
Dec 24 - Mars at opposition
Dec 25 - Christmas Holiday

UW Astronomy Speakers Colloquium Schedule

The Astronomy Department weekly colloquium meets Thursdays at 4:00 pm in PAB A102 - the classroom part of the Physics/Astronomy Building complex, (or at 11:30 in C520). www.astro.washington.edu/dept/colloquium.html
Mar 31 - Megan Pickett, '*Rings, Rocks, & Ripples, A New Recipe for Jupiter* '
Apr 05 - 11:30 C520 Gordon Richards, '*The Galaxy-Dark Matter Connection*'
Apr 07 - 11:30 C520 Frank van den Bosch, '*The Galaxy-Dark Matter Connection*'
Apr 11 - 11:30 C520 Samir Salim, '*GALEX Meets SDSS: Star Formation in the Local Universe*'
Apr 12 - 11:30 C520 Jeffrey Newman, '*New Results from the DEEP2 Redshift Survey*'
Apr 14 - Hugh Hudson, '*Solar Flares in the New Millenium*'
Apr 21 - Naomi McClure-Griffiths, '*HI Supershells and the Galactic Ecosystem*'
Apr 22 - 11:30 C520 Michael Blanton, New York U (title TBA)
Apr 26 - 2:30 A118? Carolyn Porco, Space Science Institute, '*Highlights from Cassini's Imaging Adventures at Saturn*'
Apr 28 - Evan Skillman, U. Minnesota, TBA
May 5 - Keith Holsapple, U.W. Aero & Astro, '*Asteroid Spin Data: No Evidence of Rubble-Pile Structures*'
May 12 - Kristen Larson, WWU, '*Dust Maps: Characterizing Extinction and Reddening of Gas at High Galactic Lattitude*'
May 19 - Josh Grindlay, '*Chandra-HST Studies of Compact Objects and Binaries in Globular Clusters*'
May 26 - Paul Boynton, U.W. Astronomy '*Discovery of the CMBR: Looking Back 40 Years*'
Jun 02 - Jim Bell, Cornell , '*Spriit and Opportunity on Mars*'
Jun 09 - Anjum Mukadam, U.W. Astronomy, tba

ON THE AIRWAVES - KSER 90.7 - 'IT'S OVER YOUR HEAD'

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our **astronomy radio show**, "**It's Over Your Head"** on radio station **KSER, FM 90.7.** The six-minute segment is

broadcast **every Wednesday morning at approximately 7:20 A.M.** and gives a weekly look at what's up in the sky over Snohomish County, with other information. If you are a listener to the program, show your support by giving the program director of KSER a call!" Web page with lots of archives and other info is available at http://www.itsoveryourhead.org/

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS MEMBERSHIP BENEFITS & INFORMATION

EAS Benefits -
Membership in the **Everett Astronomical Society** (EAS) includes invitations to all of the club meetings and star parties, plus the monthly newsletter, ***The Stargazer.*** Currently, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett

Magazine Discounts –
In addition you will be able subscribe to ***Sky and Telescope*** for $7 off the normal subscription rate, contact the treasurer (Carol Gore) for more information.
http://members.tripod.com/everett_astronomy/application.htm (**When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to Everett Astronomical Society to the EAS address.** The EAS treasurer Carol Gore will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.)

Membership in the Astronomical League -
EAS is a member of the **Astronomical League** and you will receive the Astronomical League's quarterly newsletter magazine, ***The Reflector***.

EAS Club Telescope Borrowing -
Being a member also allows you the use of the club's telescopes, including an award winning 10 inch Dobsonian mount reflector, a second 10" dob, or and 8" Dobsonian. Contact Jim Bielaga (425) 337-4384 to borrow a telescope.

10% Discount on Purchases at 'Aurora Astro Products' in Everett -
EAS members are currently offered a 10% discount for all purchases of any telescopes, accessories, or other items at Aurora Astro Products, when they show their EAS membership card.

EAS Library -
Membership will give you access to all the material in the lending library. The library, which is maintained by Mike Locke, consists of VCR tapes, DVDs, many books, magazines, and software titles. The EAS has a library of books, videotapes, and software for members to borrow. We always value any items you would like to donate to this library. You can contact a club officer or **Librarian Mike Locke**, phone (425) 259-5995, email mlocke at lioninc.com, to borrow or donate any materials. See list here: http://members.tripod.com/everett_astronomy/eas_library.htm

Joining or Renewing with the EAS -

EAS dues are $25 / year per family. Funds obtained from membership dues allows the EAS to publish the Stargazer newsletter, pay Astronomical League dues, pay insurance, host a web site, and maintain our library. If it has been a year since you paid your dues, please re-subscribe to keep the club financially solvent, and to continue to receive membership benefits.
http://members.tripod.com/everett_astronomy/application.htm

Send your annual dues renewals to the
Everett Astronomical Society
P.O. Box 12746, Everett, WA 98206.

OBSERVER'S INFORMATION…

LUNAR FACTS

Mar 12	Last Quarter Moon
Mar 19	New Moon
Mar 25	First Quarter Moon
Apr 02	Full Moon
Apr 10	Last Quarter Moon
Apr 17	New Moon
Apr 24	First Quarter Moon
May 02	Full Moon
May 10	Last Quarter Moon
May 16	New Moon
May 23	First Quarter Moon
Jun 03	Full Moon

Digital Lunar Orbiter Photographic Atlas of the Moon

The Lunar and Planetary Institute has created a digital version of the Lunar Orbiter Photographic Atlas of the Moon, and Consolidated Lunar Atlas available online at:
http://www.lpi.usra.edu/research/cla/menu.html
http://www.lpi.usra.edu/research/lunar_orbiter

UP IN THE SKY -- THE PLANETS

Object	Rises	Transits	Sets	Con	Mag
Sun	**7:06 am**	**13:15**	**19:29**	**Psc**	**-27.5**
Mercury	**6:21 am**	Daylight	Daylight	**Aqr**	**+0.2**
Venus **	Daylight	Daylight	**22:33**	**Aqr**	**-4.0**
Mars	**5:45 am**	Daylight	Daylight	**Sag**	**+1.2**
Jupiter	**2:04 am**	**6:21 am**	Daylight	**Oph**	**-2.2**
Saturn **	Daylight	**22:30**	**5:52 am**	**Leo**	**+0.1**
Uranus	**6:39 am**	Daylight	Daylight	Aqr	+5.9
Neptune	**5:44 am**	Daylight	Daylight	**Cap**	**+7.9**
Pluto	**2:14 am**	**7:02 am**	Daylight	**Sag**	**+14.0**

(times local time for Everett PDT)

Observing Jupiter's Moons – Java tool
http://skytonight.com/observing/objects/javascript/jupiter

Transit times for Jupiter's Great Red Spot in 2007
http://skytonight.com/observing/objects/planets/3304091.html

NOAA SUN CALCULATOR
Need to know exactly what time the sun will set on Sept. 26, 2065? Or when it rose in 565 BC? How about the length of daylight a week from Tuesday in Albuquerque, N.M.? Just go to NOAA's solar calculator, now available on the Web. http://www.srrb.noaa.gov/highlights/sunrise/gen.html

INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

ISS Visibility –
http://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/SightingData/Seattle.html or also see link http://www.heavens-above.com/PassSummary.asp?lat=47.979&lng=-122.201&alt=0&loc=Everett&TZ=PST&satid=25544

CONSTELLATION OF THE MONTH: LEPUS

LEPUS: (The Hare). Lepus is south of the constellation of Orion, and the constellation can be seen and appreciated in an area with a good southern horizon. Lepus borders on the constellations of Caelum, Canis Major, Columba, Eridanus, Monoceros, and Orion. There are no established asterisms within its borders. Lepus ranks 23rd in overall brightness among the constellations, but 51st in size: it takes up approximately 290.29 square degrees (0.704%) of the sky. Lepus contains no known meteor showers, but one Messier object: M-79, a fine winter globular cluster. Lepus is completely visible from latitudes South of +63 degrees,

and completely invisible from latitudes North of +79 degrees. It has 28 stars brighter than magnitude 5.5, and its central point is at RA=5h31m, Dec.= -19 degrees. The solar conjunction date of Lepus is June 15th, and its midnight culmination date is December 14.

As mentioned, M-79 is a fine winter globular that shines at magnitude 8.4 and measures 7.5' across; it is visible as a fuzzy spot in binoculars or finderscopes. Smaller scopes show an unresolved golden-yellow ball of light, while amateur scopes in the 12-20 inch range resolve M-79's outer edges, showing its beautiful stellar composition. Lepus also contains a well known galaxy: NGC-1964.

NGC-1964 is a fairly bright, magnitude 11.8 Sb-type spiral measuring 5.0' x 1.6' across. The nearly edge-on angle of this galaxy allows an oblique view of both the galaxy's hub and core, but views of the spiral arms are lacking as a result of this angle; however, very large scopes may be able to elicit more spiral structure detail.

There are at least three famous stars in this constellation: Arneb (alpha Leporis) has a visual magnitude of 2.6; and Nihal (beta Leporis, and also known as Nibal) has a visual magnitude of 2.8. About 5 degrees east and 2 degrees north of mu Leporis is the star designated as R Leporis, also known as 'Hind's Crimson Star'. It was first noted to be intensely red by astronomer J.R. Hind in 1845, who compared it to a 'drop of blood against a black sky'. The visual magnitude of this star ranges from 6 to about 10. Next winter, see if you can plan some observing with a good southern horizon to discover some of the wonders of Lepus.

PLANETARY FOCUS - NEPTUNE

This month, our guest planet is Neptune, and these are the facts:

Rotation around the Sun: every 164.79 years

Orbit: from 29.76 (closest or 'perihelion') to 30.36 (furthest or 'aphelion') Astronomical Units (AU)*; this is an orbit that varies between approximately 2.77 billion and 2.82 billion miles from the sun. (*Note: One AU equals approximately 93 million miles).

Inclination of Orbit to Ecliptic: 1.8 degrees.

Mean Orbital Velocity: 5.43 km/sec.

Diameter at Equator: 50,538 kilometers (or 31,586 miles).

Mass: 17.2 (approximately 17.2 times more massive than earth); (5.9742 x (10 e24 (10 to the 24th power)) kilograms = 1 Earth Mass)**.**

Density: approximately 1.80 times that of water (global density).

Surface Gravity (Earth = 1): 1.19

Period of Rotation on its own axis: approximately 18 hours, 25 minutes.

Axis tilt: 29.56 degrees.

Satellites (moons): 8, as well as planetary rings.

Special Notes About Neptune: **Neptune** is the fourth largest planet in the solar system (one of the gas giants) in terms of equatorial diameter, but is more massive than Uranus, the third largest planet in diameter. Neptune is the most distant of the giant planets, and was discovered in 1846 by J.G. Galle at the Berlin Observatory, based on French (Urbain Leverrier) predictions resulting from disturbances in the orbit of Uranus (there were similar estimates made by Englishman John C. Adams).

Neptune returns to opposition two days later every year, and appears as an indistinct magnitude 7.7 bluish-green object in binoculars; in fact, no markings can be seen on its bluish-green disk from earth-bound telescopes. Neptune's color arises primarily from methane within its atmosphere, which is principally helium and hydrogen and a blend of methane, water, and ammonia. In 1989, Voyager 2 sent back remarkable images of Neptune during its fly-by. The Great Dark Spot was noted in its atmosphere. Like Jupiter's Great Red Spot, it occupies a equivalent proportion of the surface area of Neptune (as the GRS does of Jupiter's surface area), and is a high-pressure system around which near-supersonic winds flow in an anti-clockwise circuit. The Great Dark Spot measures approximately 12,000 by 8,000 kilometers. At about 50-70 kilometers above the main cloud plane, there are whitish cirrus-like clouds composed of methane ice crystals. Neptune also has belts and zones similar to Jupiter's, only much fainter.

The core of Neptune is believed to be rocky, composed primarily of silicon and iron. The atmosphere of Neptune revolves more slowly than its core, and this is opposite to the atmospheres of the other gas giants; the implication is that circulation of Neptune's atmosphere may take place in a retrograde (backward or opposite) manner. Neptune also gives off more energy than it receives from the Sun, suggesting that it has its own internal source of heat; the planet also has a magnetic field, which is somewhat weaker than that of the other gas giant planets. Four dark planetary rings were discovered during the Voyager 2 fly-by in 1989.

Neptune has 8 known moons; six of them were discovered during the 1989 Voyager 2 fly-by, and the remaining two (Triton and Nereid) were discovered from Earth. Triton is the largest moon of Neptune, and was discovered the same year (1846) as the planet itself; it is about ¾ the size of our own Earth's Moon. Interestingly, Triton has an orbit in the opposite direction to that of Neptune (retrograde), and is slowly coiling its way down towards Neptune. Triton is a very cold moon, and has a thin atmosphere of mostly nitrogen, with some methane and carbon monoxide. Its South Pole cap is pinkish in color (probably nitrogen snow and ice). Triton's face has been shown to have both craters and long cracks, but no mountains; its surface resembles that of a cantaloupe. It has also been noted to have geysers of nitrogen, some reaching 8 km in height! Nereid was discovered from Earth in 1949, and has a very eccentric orbit (going from 2 to 10 million kilometers from the planet at various times during its orbit).

YOUNG ASTRONOMER'S CORNER

TOPIC: Are all the stars the same? (This is a repeat, but modified, column first published in the Stargazer in 1998. There is often confusion regarding the fact that all stars indeed are not the same: there are many different properties of stars, such as temperature and size, that distinguish one from the other. As a result of this confusion, this column is occasionally worth repeating for all the new "Young Astronomers" readers.)

Most stars, to the naked eye, look fairly similar in appearance if not in brightness: we will address the fact that indeed they are not: If you've studied any Astronomy in school, perhaps you've seen the letters OBAFGKM, all in a row and listed exactly like that. What does this mean??? Perhaps you recall that in several previous Young Astronomer's Corners we've talked about the fact the even though most stars look like white dots from earth, there ARE some that are unusual looking, even from earth. Vega and Sirius are very bright and bluish-white, while Arcturus and Betelgeuse are yellowish-orange, even to the naked eye. These are OBVIOUSLY different, even without the aid of binoculars or telescopes. What's causing this distinct difference? By looking

closely at the light from these stars, such as through an instrument utilizing a slit and a prism (a spectroscope; you've probably seen the resulting "rainbow of light" when light passes through a crystal, or even through millions of raindrops, forming (you guessed it!)...a rainbow!!), we can see that the pattern formed is a continuous spectrum of colors (the different wavelengths of light, or 'colors'), on which are superimposed darker (absorption) and brighter (emission) lines. Believe it or not, this is a tremendous amount of information (i.e., star color) that relates closely to the surface temperature of the star, and, as a result, enables astronomers to figure out many basic properties of the star itself. The traditional way to remember the letters above are "Oh Be A Fine Girl (or Guy) Kiss Me"; these letters are still used today.

The colors of the stars closely relate to the surface temperatures and chemical makeup of the stars, which frequently relate to the mass and life cycle stage of the star. Red Giants, Blue Supergiants, Red Dwarfs, White Dwarfs, and various and sundry Yellow Stars all have their place in a spectroscopic chart of the stars, and the color / temperature of the star can be charted against the absolute magnitude (brightness) of the star to learn much about its stage of evolution, or where it is in its life cycle. That is, its age and relative size and temperature, and what chemicals it is composed of (different chemicals in the stars "give off" different colors upon analysis of their starlight), can be compared to other stars in the sky. On such a chart, the "O" in our saying above generally corresponds to the hotter and younger stars, while the "M" generally corresponds to older, cooler stars. Our own sun, if viewed from very far away outside our own solar system, would be an unspectacular yellow dwarf "G" star. But all things are relative, because from earth, the sun is by far the most spectacular natural object around, and we cannot live without it! So then, with respect to temperature and color, size and mass, magnitude or brightness, chemical composition or makeup, and life-stage and age, one star can be VERY different from another….that is, ***they are NOT all the same!***

ASTRONOMY AND TELESCOPE "LINGO"

ASTRONOMY "LINGO": KREUTZ GROUP: A collection of sungrazing comets, first identified by Heinrich Kreutz in 1888, all with similar orbital elements; they were probably formed by the breakup of one single larger comet. Many members of this group were detected by spacecraft coronagraphs in the period from 1979-1989, and continue to be found with SOHO coronagraph.

TELESCOPE / EQUIPMENT "LINGO": ISOPLANATIC ANGLE: The largest field of view over which a distortion-free image may be formed while looking through the earth's

atmosphere; at optical wavelengths this field is a few arc seconds.

ASTRONOMY "FUN FACTS"

★★ A baseball hit on the surface of the asteroid Eros would reach escape velocity immediately. It would go into orbit around the sun, and would never come down!!

★★ The Big Bang singularity at Plank time was the ultimate black hole; infinite temperature and density existed; (Plank time is that time after the big bang where the uncertainty principle of quantum mechanics prevents speculation on times shorter than it). What we are and where we live today emerged from this initial black hole. Some scientists conjecture that our universe began as a black hole in another universe, which began as a black hole in another universe, etc…, etc…!!

★★ The seismometer set up by the Apollo 12 astronauts on the Moon's Ocean of Storms lasted far longer than expected, operating for almost eight years. During its time of operation, the seismometer registered almost 2,300 moonquakes and meteorite impacts: this is an average of almost one record per day.

★★ The Moon takes two thousandths of a second longer each year to circle the earth: this is about as long as it takes for a balloon to pop. In the far future, there will be increasingly less moonlight time as a result of this, and its light will be dimmer as well, as the earth's only natural satellite gradually pulls farther away.

★★ The surface of Mercury very closely resembles that of the earth's moon. But there would be a huge difference if it was Mercury circling the earth instead of earth's own Moon. Mercury is about 1.5 times the diameter of the Moon, and would shine with twice the light. Mercury would also cause ocean tides about four times higher than what the earth experiences now. Surfers would ply their trade where there used to be freeways and traffic jams!!!!

★★ The oldest moon rock found thus far was dated at 4.6 billion years old. It was found and returned during the Apollo missions. This age dates back to the time that the Earth and Moon were formed. This rock was one billion years old before the first single-celled organisms appeared on earth, and it is now the oldest rock on earth!!

★★ The interstellar dust in our Galaxy alone is equivalent to the mass of over 450 trillion planet Earths!! More interstellar dust grains can fit into about 12 cubic inches than there are stars in the entire Milky Way Galaxy (i.e., far more than 100 billion dust grains!)

"MIRROR IMAGES"

"MIRROR" IMAGES" : Because we live in the Northern Hemisphere, we often tend to focus (in both observing and reading) on celestial objects in this hemisphere. The point of this column is to inform club members about similar objects in the Southern Hemisphere (to the ones we are already familiar with in the Northern Hemisphere). The general class of object will first be defined, and then a representative object from each hemisphere will be described. ***Note: "MIRROR" IMAGES" is strictly the name of the column, and is not intended to imply that there is optical mirror symmetry between the two objects.***

CLASS OF OBJECT: ELLIPTICAL GALAXIES: Galaxies are large aggregates of stars, gas, and dust. Unlike other types of galaxies such as spirals, elliptical galaxies have no disc component, rather appearing in photographs only as fuzzy elliptical (which can however range from almost circular in shape to those which are more narrow) patches, or bulges, of light; these bulges decline smoothly in brightness from the center outward. Most ellipticals however are probably triaxial ellipsoids, with each of the three axes being of different length. The shape of any galaxy outline is the basis for the Hubble classification of galaxies: elliptical galaxies are denoted by the letter 'E' followed by a number from 0 to 7 (the larger the number, the more the degree of flattening or elliptical shaping). The E-0 galaxies are almost (but not perfectly) circular in shape, and the E-7 galaxies are the most elliptical, with a semimajor to semiminor axis ratio of approximately 3:1. Elliptical galaxies were originally thought to be without interstellar gas, but more recent X-ray and radio observations have demonstrated sizeable and intricate interstellar mediums, with very hot gas existing concurrently with clouds of neutral hydrogen; some ellipticals show low-level emission-line activity, and most elliptical galaxy stars are older in age, with

spectral types generally of type K or M. Generally, elliptical galaxies (along with S-0 galaxies) are the most red of all the galaxies; ellipticals are also, on average, dimmer than spiral or irregular galaxies. Elliptical galaxies demonstrate the greatest variation in total mass, extending down to extreme dwarfs which are no brighter than very bright globular clusters. Of all the very brightest of galaxies, only about 20% are ellipticals; however, when dwarf galaxies are included in the total population, the percentage of ellipsoid galaxies is approximately 60%.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: M-105 (NGC-3379): M-105 in Leo measures approximately 2.1' x 2.0' across, and shines at magnitude 10.6. M-105 has a relatively high surface brightness, but detail is lacking in telescopic observations. M-105 lies approximately 139 kiloparsecs from Earth. M-105 is an E-1 elliptical, and together with the fainter galaxies of NGC-3384 and NGC-3389, forms a triangle measuring about 8' on a side between each of the three objects.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: NGC-6776: A galaxy within the southern constellation of Pavo, NGC-6776 is an E-2 elliptical with a magnitude of 12.8, and measures 0.7' x 0.6'. It is relatively small, appearing in backyard scopes similarly to an unresolved globular cluster. NGC-6776 has a condensed center which is noticeably brighter than the remainder of the galaxy, but otherwise offers no detail in amateur telescopes.

ASTRONOMICAL NOTES -- ON & OFF THE WEB...

ICE ON MARS' SOUTH POLE IS DEEP AND WIDE

New measurements of Mars' south polar region indicate extensive frozen water. The polar region contains enough frozen water to cover the whole planet in a liquid layer approximately 36 feet deep. An instrument on the Mars Express spacecraft provided these data. This new estimate comes from mapping the thickness of the ice. The Mars Express orbiter's radar instrument has made more than 300 virtual slices through layered deposits covering the pole to map the ice. The radar sees through icy layers to the lower boundary, which is as deep as 2.3 miles below the surface.

"*The south polar layered deposits of Mars cover an area bigger than Texas. The amount of water they contain has been estimated before, but never with the level of confidence this radar makes possible*," said Jeffrey Plaut. Plaut is co-principal investigator for the radar and lead author of a report on these findings. The instrument, named the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS), also is mapping the thickness of similar layered deposits at the north pole of Mars. "*Our radar is doing its job extremely well*," said Giovanni Picardi, principal investigator for the instrument. "*MARSIS is showing itself to be a very powerful tool to probe underneath the Martian surface, probing the polar layered deposits.*," Picardi said. "*Not only is MARSIS providing us with the first-ever views of Mars subsurface at those depths, but the details we are seeing are truly amazing*." Polar layered deposits hold most of the known water on modern Mars, though other areas of the planet appear to have been very wet at times in the past. Understanding the history and fate of water on Mars is a key to studying whether Mars has ever supported life, since all known life depends on liquid water.

The polar layered deposits extend beyond and beneath a polar cap of bright-white frozen carbon dioxide and water at Mars' south pole. Dust darkens many of the layers. However, the strength of the echo that the radar receives from the rocky surface underneath the layered deposits suggests the composition of the layered deposits is at least 90 percent frozen water. One area with an especially bright reflection from the base of the deposits puzzles researchers. It resembles what a thin layer of liquid water might look like to the radar instrument, but the conditions are so cold that the presence of melted water is deemed highly unlikely. Detecting the shape of the ground surface beneath the ice deposits provides information about even deeper structures of Mars. "*We didn't* really know where the bottom of the deposit was," Plaut said. "*Now we can see that the crust has not been depressed by the weight of the ice as it would be on the Earth. The crust and upper mantle of Mars are stiffer than the Earth's, probably because the interior of Mars is so much colder*."

KUIPER-BELT OBJECT BROKEN UP BY MASSIVE IMPACT 4.5 BILLION YEARS AGO

In the outer reaches of the solar system, there is an object known as 2003 EL61 that looks like and spins like a football being drop-kicked over the proverbial goalpost of life. Still awaiting a more poetic name, 2003 EL61 largely escaped the media hubbub during last year's demotion of Pluto, but new findings could make it one of the most important of the Kuiper-belt objects for understanding the workings of the solar system. In this week's Nature, the original discoverer of the body, Mike Brown, announces with his colleagues that an entire family of bodies seems to have originated from a catastrophic collision involving 2003 EL61 about the time Earth was forming. Brown and his team base their assumptions on similar surface properties and orbital dynamics of smaller chunks still in the general vicinity. They conclude that 2003 EL61 was spherical and nearly the size of Pluto until it was rammed by a slightly smaller body about 4.5 billion years ago, leaving behind the football-shaped body we see today and a couple of moons, as well as many more fragments that flew away entirely.

"*Some of these chunks are still in orbit around the sun and very near the orbit of 2003 EL61 itself*," says Brown, a professor of planetary astronomy. "*The impact made a tremendous fireball, and large icy chunks of the big object split off and went flying into space, leaving behind a huge ice-covered rock spinning end over end every four hours*. " "*It spins so fast that it has pulled itself into the shape of an American football, but one that's a bit deflated and stepped on*," Brown adds.

A significant part of the finding is that the collision occurred in a region of space where orbits are not very stable. "*In most places, things go around the sun minding their own business for 4.5 billion years and nothing happens*," says Brown. "*But in a few places, though, orbits go crazy and change and eventually objects can find themselves on a trajectory into the inner solar system, where they would be what we would then call comets*." As a consequence, many of the shards probably made their way to the inner solar system, and a few have undoubtedly hit Earth in the past. The study thus provides new ideas about how the solar system evolves, and how comets fit into the big picture. Brown adds that 2003 EL61 will put on quite a show in about a billion years, if anyone is still around to enjoy it. *"It's a long time to wait, but 2003 EL61 could become by far the largest comet in eons*," Brown says. "*It will be something like 6,000 times brighter than Hale-Bopp a few years ago*." www.gps.caltech.edu/~mbrown/2003EL61

CASSINI IMAGES SEAS ON TITAN

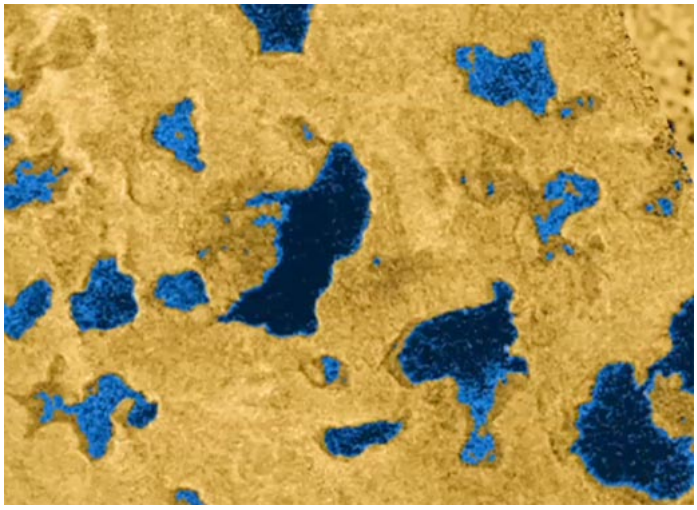
Instruments on the Cassini spacecraft have found evidence for seas, likely filled with liquid methane or ethane, in the high northern latitudes of Saturn's moon Titan. One such feature is larger than any of the Great Lakes of North America and is about

the same size as several seas on Earth. Cassini's radar instrument imaged several very dark features near Titan's north pole. Much larger than similar features seen before on Titan, the largest dark feature measures at least 39,000 square miles. Since the radar has caught only a portion of each of these features, only their minimum size is known. Titan is the second largest moon in the solar system and is about 50 percent larger than Earth's moon.

"*We've long hypothesized about oceans on Titan and now with multiple instruments we have a first indication of seas that dwarf the lakes seen previously*," said Dr. Jonathan Lunine, Cassini interdisciplinary scientist. While there is no definitive proof yet that these seas contain liquid, their shape, their dark appearance in radar that indicates smoothness and their other properties point to the presence of liquids. The liquids are probably a combination of methane and ethane, given the conditions on Titan and the abundance of methane and ethane gases and clouds in Titan's atmosphere.

Cassini's visual and infrared mapping spectrometer also captured a view of the region, and the team is working to determine the composition of the material contained within these features to test the hypothesis that they are liquid-filled. The imaging cameras, which provide a global view of Titan, have imaged a much larger, irregular dark feature. The northern end of their image corresponds to one of the radar-imaged seas. The dark area stretches for more than 620 miles in the image, down to 55 degrees north latitude. If the entire dark area is liquid-filled, it would be only slightly smaller than Earth's Caspian Sea. The radar data show details at the northern end of the dark feature similar to those seen in earlier radar observations of much smaller liquid-filled lakes. However, to determine if the entire dark feature is a liquid-filled basin will require investigation through additional radar flyovers later in the mission.

The presence of these seas reinforces the current thinking that Titan's surface must be resupplying methane to its atmosphere, the original motivation almost a quarter century ago for the theoretical speculation of a global ocean on Titan.



Cassini's instruments are peeling back the haze that shrouds Titan, showing high northern latitudes dotted with seas hundreds of miles across, and hundreds of smaller lakes that vary from several to tens of miles. Due to the new discoveries, team members are repointing Cassini's radar instrument during a May flyby so it can pass directly over the dark areas imaged by the cameras. http://www.nasa.gov/cassini

PANORAMA REVEALS MORE THAN A THOUSAND BLACK HOLES

By casting a wide net, astronomers have captured an image of more than a thousand supermassive black holes. These results give astronomers a snapshot of a crucial period when these monster black holes are growing, and provide insight into the environments in which they occur. The new black hole panorama was made with data from Chandra X-ray Observatory, the Spitzer Space Telescope and ground-based optical telescopes. The black holes in the image are hundreds of millions to several billion times more massive than the sun and lie in the centers of galaxies. Material falling into these black holes at high rates generates huge amounts of light that can be detected in different wavelengths. These systems are known as active galactic nuclei, or AGN.

"*We're trying to get a complete census across the Universe of black holes and their habits,*" said Ryan Hickox. "*We used special tactics to hunt down the very biggest black holes*."

Instead of staring at one relatively small part of the sky for a long time, as with the Chandra Deep Fields -- two of the longest exposures obtained with the observatory -- and other concentrated surveys, this team scanned a much bigger portion with shorter exposures. Since the biggest black holes power the brightest AGN, they can be spotted at vast distances, even with short exposures. "*With this approach, we found well over a thousand of these monsters, and have started using them to test our understanding of these powerful objects*," said co-investigator Christine Jones, also of the CfA.

The new survey raises doubts about a popular current model in which a supermassive black hole is surrounded by a doughnut-shaped region, or torus, of gas. An observer from Earth would have their view blocked by this torus by different amounts, depending on the orientation of the torus. According to this model, astronomers would expect a large sample of black holes to show a range of absorption of the radiation from the nuclei. This absorption should range from completely exposed to completely obscured, with most in-between. Nuclei that are completely obscured are not detectable, but heavily obscured ones are. "*Instead of finding a whole range, we found nearly all of the black holes are either naked or covered by a dense veil of gas*," said Hickox. "*Very few are in between, which makes us question how well we know the environment around these black holes*."

This study found more than 600 obscured and 700 unobscured AGN, located between about six to 11 billion light years from Earth. They were found using an early application of a new search method. By looking at the infrared colors of objects with Spitzer, AGN can be separated from stars and galaxies. The Chandra and optical observations then verify these objects are AGN. This multi-wavelength method is especially efficient at finding obscured AGN. "*These results are very exciting, using two Great Observatories to find and understand the largest sample of supermassive black holes ever found in the distant universe*", said co-investigator Daniel Stern. The Chandra image is the largest contiguous field ever obtained by the observatory. At 9.3 square degrees, it is over 40 times larger than the full moon seen on the night sky and over 80 times larger than either of the Chandra Deep Fields. This survey, taken in a region of the Bootes constellation, involved 126 separate pointings of 5,000-second Chandra exposures each. The researchers combined this with data obtained from Spitzer, and Kitt Peak's 4-meter Mayall and the MMT 6.5-meter optical telescopes, both located outside Tuscon, Ariz., from the same patch of sky. http://chandra.harvard.edu/photo/2007/bootes/

NEAR-EARTH OBJECT SURVEY REPORT TO CONGRESS

Goals of NEO programs -

(1) An analysis of possible alternatives that NASA may employ to carry out the survey of near-Earth Objects (NEO

(2) A recommended option to carry out the survey program pursuant to the recommended option; and

(3) An analysis of possible alternatives that NASA could employ to divert an object on a likely collision course with Earth.

The objectives of the NEO Survey program are to detect, track, catalogue, and characterize the physical characteristics of NEOs equal to or larger than 140 meters in diameter with a perihelion distance of less than 1.3 AU (Astronomical Units) from the Sun, achieving 90 percent completion of the survey within 15 years of. December 2005.

Key Findings for the Survey Program:

★ The goal of the Survey Program should be modified to detect, track, catalogue, and characterize, by the end of 2020, 90 percent of all Potentially Hazardous Objects (PHOs) greater than 140 meters whose orbits pass within 0.05 AU of the Earth's orbit (as opposed to surveying for all NEOs).

★ The Agency could achieve the specified goal of surveying for 90 percent of the potentially hazardous NEOs by the end of 2020 by partnering with other government agencies on potential future optical ground-based observatories and building a dedicated NEO survey asset assuming the partners' potential ground assets come online by 2010 and 2014, and a dedicated asset by 2015.

★ Together, the two observatories potentially to be developed by other government agencies could complete 83 percent of the survey by 2020 if observing time at these observatories is shared with NASA's NEO Survey Program.

★ New space-based infrared systems, combined with shared ground-based assets, could reduce the overall time to reach the 90 percent goal by at least three years. Space systems have additional benefits as well as costs and risks compared to ground-based alternatives.

★ Radar systems cannot contribute to the search for potentially hazardous objects, but may be used to rapidly refine tracking and to determine object sizes for a few NEOs of potentially high interest. Existing radar systems are currently oversubscribed by other missions.

★ Determining a NEO's mass and orbit is required to determine whether it represents a potential threat and to provide required information for most alternatives to mitigate such a threat. Beyond these parameters, characterization requirements and capabilities are tied directly to the mitigation strategy selected.

Key Findings for Diverting a Potentially Hazardous Object (PHO):

The study team assessed a series of approaches that could be used to divert a NEO potentially on a collision course with Earth. Nuclear explosives, as well as non-nuclear options, were assessed.

★ Nuclear standoff explosions are assessed to be 10-100 times more effective than the non-nuclear alternatives analyzed in this study. Other techniques involving the surface or subsurface use of nuclear explosives may be more efficient, but they run an increased risk of fracturing the target NEO. They also carry higher development and operations risks.

★ Non-nuclear kinetic impactors are the most mature approach and could be used in some deflection/mitigation scenarios, especially for NEOs that consist of a single small, solid body.

★ "Slow push" mitigation techniques are the most expensive, have the lowest level of technical readiness, and their ability to both travel to and divert a threatening NEO would be limited unless mission durations of many years to decades are possible.

★ 30-80 percent of potentially hazardous NEOs are in orbits that are beyond the capability of current or planned launch systems. Therefore, planetary gravity assist swingby trajectories or on-orbit assembly of modular propulsion systems may be needed to augment launch vehicle performance, if these objects need to be deflected. http://neo.jpl.nasa.gov/neo/report2007.html http://www.nasa.gov/pdf/171331main_NEO_report_march07.pdf

A HOT START MIGHT EXPLAIN GEYSERS ON ENCELADUS

A hot start billions of years ago might have set into motion the forces that power geysers on Saturn's moon Enceladus. "Deep inside Enceladus, our model indicates we've got an organic brew, a heat source and liquid water, all key ingredients for life," said Dr. Dennis Matson, Cassini project scientist. "*And while no one is claiming that we have found life by any means, we probably have evidence for a place that might be hospitable to life*."

Since the Voyager spacecraft first returned images of the moon's snowy white surface, scientists have suspected Enceladus had to have something unusual happening within that shell. Cameras on the Cassini orbiter seemed to confirm that suspicion in 2005 when they spotted geysers on Enceladus ejecting water vapor and ice crystals from its south polar region. The challenge for researchers has been to figure out how this small ice ball could produce the levels of heat needed to fuel such eruptions.

A new model suggests the rapid decay of radioactive elements within Enceladus shortly after it formed may have jump-started the long-term heating of the moon's interior that continues today. The model provides support for another recent, related finding, which indicates that Enceladus' icy plumes contain molecules that require elevated temperatures to form. "*Enceladus is a very small body, and it's made almost entirely of ice and rock. The puzzle is how the moon developed a warm core*," said Dr. Julie Castillo, the lead scientist developing the new model at JPL. "*The only way to achieve such high temperatures at Enceladus is through the very rapid decay of some radioactive species*." The hot start model suggests Enceladus began as a mixed-up ball of ice and rock that contained rapidly decaying radioactive isotopes of aluminum and iron. The decomposition of those isotopes -- over a period of about 7 million years -- would produce enormous amounts of heat. This would result in the consolidation of rocky material at the core surrounded by a shell of ice. According to the theory, the remaining, more slowly decaying radioactivity in the core could continue to warm and melt the moon's interior for billions of years, along with tidal forces from Saturn's gravitational tug. Scientists have also found the model helpful in explaining how Enceladus might have produced the chemicals in the plume, as measured by Cassini's ion and neutral mass spectrometer. Matson is lead author of a new study of the plume's composition.

Although the plume is predominantly made up of water vapor, the spectrometer also detected within the plume minor amounts of gaseous nitrogen, methane, carbon dioxide, propane and acetylene. Scientists were particularly surprised by the nitrogen because they don't think it could have been part of Enceladus' original makeup. Instead, Matson's team suggests it is the product of the decomposition of ammonia deep within the moon, where the warm core and surrounding liquid water meet. The

thermal decomposition of ammonia would require temperatures as high as 577 degrees Celsius (1070 degrees Fahrenheit), depending on whether catalysts such as clay minerals are present. And while the long-term decay of radioactive species and current tidal forces alone cannot account for such high temperatures, with the help of the hot start model, they can. The scalding conditions are also favorable for the formation of simple hydrocarbon chains, basic building blocks of life, which Cassini's spectrometer detected in small amounts within Enceladus' plume. The team concludes that so far, all the findings and the hot start model indicate that a warm, organic-rich mixture was produced below the surface of Enceladus and might still be present today, making the moon a promising kitchen for the cooking of primordial soup. http://saturn.jpl.nasa.gov/news/press-release-details.cfm?newsID=729 To gather more information about the chemistry within Enceladus, the team plans to directly measure the gas emanating from the plume during a flyby scheduled for March 2008.

COMET MCNAUGHT - THE CELESTIAL WHIRLIGIG

Comet McNaught, the Great Comet of 2007, has been delighting those who have seen it with the unaided eye as a spectacular display in the evening sky. Pushing ESO's New Technology Telescope to its limits, a team of European astronomers have obtained the first, and possibly unique, detailed observations of this object. Their images show spectacular jets of gas from the comet spiralling several thousands of kilometers into space, while the spectra reveal the presence of sodium in its atmosphere, something seen very rarely.

Comet C/2006 P1 (McNaught) has rightly earned the title of a 'Great Comet' -- one so bright in the sky that such an occurrence could be expected just once in a generation. The problem for astronomers was that the comet stayed very close to the Sun and so was only visible very low on the horizon, making it impossible for most professional telescopes to study it in detail. One telescope, however, was up to the challenge: the New Technology Telescope (NTT), at La Silla. "*We had previously pointed the NTT very low to observe the planet Mercury, which is very close to the Sun and is therefore only visible low in the sky just after sunset. I realized that we could take advantage of the same low pointing limit to observe the comet while it was near the Sun*," said astronomer Colin Snodgrass.

From the 29th January onwards, the comet was thus observed with the NTT, revealing in detail the heart of the comet. This was no easy feat as even with the NTT it was only observable for half an hour after sunset. Luckily, the NTT has another major advantage: it is equipped with the versatile ESO Multi Mode Instrument (EMMI), which can provide both imaging and spectroscopic observations across the visible wavelength range. This meant that the maximum amount of scientific data could be taken during the limited time available for observations. The unique images reveal three clear jets of gas, which are seen to spiral away from the nucleus as it rotates, like a Catherine Wheel firework. "*These jets are produced when sunlight heats ices on the surface of the comet, causing them to evaporate into space and create 'geyser' like jets of gas and small dust particles, which stretch over 13,000 km into space -- greater than the diameter of the Earth -- despite the fact that the nucleus of the comet is probably less than 25 km in diameter*," explained Snodgrass. By comparing images like this taken at different times, astronomers should be able to calculate how fast the nucleus rotates from the changing pattern of jets. Other images also reveal that while the gas forms spiral jets, the large dust particles released from the comet follow a different pattern, as they are thrown off the comet's surface on the brightly lit side towards the Sun, producing a bright fan, which is then blown back by the pressure of sunlight itself.

As well as taking images, the astronomers were able to investigate which gases were present in the comet's atmosphere using spectroscopy. The usual gaseous species have been detected, such as cyanide, carbon, and ammonia, whose analysis will help the astronomers to determine the activity level of the comet and its chemical type. But already in the first high resolution spectrum obtained on 29 January, the astronomers noted something quite unusual. "*We detected two very bright lines -- the brightest of the whole spectrum taken on this day as a matter of fact -- close to 589 nm and quickly identified them as belonging to neutral sodium atoms*," said Emmanu Jehin. "*Further measurements showed this sodium emission to be extending over more than 100,000 km in the tail direction and fading rapidly with time*." Such lines have only been detected in the greatest comets of the past century like C/Ikeya-Seki in 1965, C/West in 1976 and C/Hale-Bopp in 1997, for which a very narrow sodium tail was even photographed. This straight neutral tail appears in addition to the dust and ionized gas tails when the comet is close to the Sun. "*Its origin lies most probably in the dissociation of the cometary dust grains*," said Jehin. "*In very active comets, which are also usually the ones which pass closer to the Sun, the dust grains are vaporized under the intense heat and start releasing sodium atoms which then react to the solar radiation and emit light -- at the very same yellow-orange wavelength of the lamps on our streets*." Sodium has also been observed around Mercury and the Moon forming a very tenuous atmosphere. But closer to us, at 90 km altitude in our atmosphere, there is the so-called 'sodium layer'. The origin of that layer is not well known but might be coming from the ablation of meteoroids that are burning (due to their high entry speed in the atmosphere) at the same altitude. As most shooting stars (or meteors) originate from comets (annual showers like the Eta Aquarids and Orionids originate from comet P/Halley, the Leonids come from comet P/Tempel-Tuttle, and the Perseids from comet P/Swift-Tuttle), the sodium in those dust particles might just be the same. As a kind of gift to the astronomers that layer is used by observatories like Paranal to produce with a laser an artificial star that allows for the correction of atmospheric turbulence!

When a comet is approaching the Sun, the ices trapped in the small nucleus sublimate, sometimes in the form of very strong gaseous jets, dragging in the process a lot of dust particles into space and forming a dusty atmosphere -- called the coma -- of several thousands of kilometers around the nucleus. All those molecules and dust particles are then pushed in the direction opposite to the Sun (by the solar radiation pressure), creating the gaseous and dust tails of the comet.

SUN-LIKE BRIGHTNESS CHANGES OF SOLAR TWIN 18 SCORPII

Recent research is providing evidence that the Sun's recent brightness variations are typical of Sun-like stars. For the first time, astronomers have collected and analyzed a long-term set of activity and brightness measurements of a "solar twin." A team from Lowell Observatory announced that the close solar analog, 18 Scorpii, exhibits brightness changes over the course of its activity cycle that are nearly identical to the Sun's. This star's activity cycle (the phenomenon that causes the periodic rise and fall in the number of sunspots on the Sun) is about seven years long, compared to about 10 years for recent solar cycles. However, 18 Scorpii exhibits a suite of other characteristics that are essentially the same as the Sun's. These include mass, temperature, chemical composition, and luminosity. "*We found that where the Sun's overall brightness varies by typically 0.1*

percent over its activity cycle, 18 Sco likewise varies by about 0.09 percent, which is effectively the same," said Jeffrey Hall. "*And just like the Sun, 18 Scorpii gets brighter as it gets more active*."

Using complementary observations from Lowell Observatory's Solar-Stellar Spectrograph (SSS) and Tennessee State's Automatic Photometric Telescope (APT) program, the astronomers have measured output from one star that seems indistinguishable from the Sun in all respects: 18 Scorpii, or HD 146233. Identified as a close solar twin in 1997, 18 Scorpii exhibits behavior very similar to the Sun's, as well as an activity cycle similar to the Sun's. "*Since about 1970, solar variations probably account for only a small fraction of observed global warming*," said Wes Lockwood. "*However, earlier in the 20th century and in the pre-industrial era, natural forces, including solar variations, undoubtedly induced changes in terrestrial climate, and will continue to do so in addition to the impact of human activities. What we really want to know is what is the Sun capable of*."

Scientists have only been observing solar variations directly from space since 1978. To estimate what the Sun may have been doing earlier in human history, particularly during periods of unusual lulls in its activity such as the Maunder Minimum of 1645-1715, researchers have used "proxy" indicators, indirect records of solar variations preserved in the terrestrial record. (The Maunder Minimum was a time period noted by an absence of sunspots that coincided with the coldest part of the Little Ice Age). One method by proxy involves measuring concentrations of certain isotopes such as Beryllium 10 or Carbon 14. Changes in the strength of the solar wind modulate the flux of cosmic rays entering Earth's atmosphere, which in turn, affects the production rate of these isotopes. By measuring the changing isotope concentrations in terrestrial core samples, scientists reconstruct estimates of likely solar activity. Another way to constrain what the Sun might have done during its activity maxima and minima is to observe what the most nearly Sun-like stars do as their activity varies. The current research is the most recent finding as part of this unique long-term program and is in press in The Astronomical Journal: "The Sun-Like Activity of the Solar Twin 18 Scorpii."

The spectroscopic observations for this study were obtained with the Solar-Stellar Spectrograph (SSS), operated at the 1.1-meter John Hall Telescope at Lowell Observatory's dark sky site near Flagstaff, Arizona. In regular operation for 12 years, the spectrograph allows observations of Sun-like stars as well as the Sun itself. Meanwhile, co-investigator Gregory Henry acquired brightness measurements of 18 Scorpii using an 0.8-meter automatic photometric telescope (APT) at Fairborn Observatory in southern Arizona's Patagonia Mountains.

Observations from this study serve as a useful guide in reconstructing the evolution of solar luminosity, particularly with regard to the Sun's behavior during its occasional quiescent periods. "*We know that the solar twin 18 Scorpii has luminosity variations remarkably similar to those of the Sun*," said Hall. "*We'll now continue to study additional stars, including some that appear to be in Maunder minimum-like periods, and study their brightness changes. If we can reach a point where we are reasonably confident that the brightness variations exhibited by Sun-like stars really are representative of what the Sun does or doesn't do, we can place some useful limits on how much the Sun did or didn't vary in recent centuries or millennia. In turn, that helps constrain how much solar forcing we can justifiably put into climate models*."

The result of this study demonstrates that 18 Scorpii, the one star that seems to best meet all the criteria of a solar twin, is practically a solar clone in its brightness variations over the past 10 years. Though over 270 trillion miles away, 18 Scorpii is providing key insights into the long-term variability of our own star -- and the magnitude of its influence on terrestrial climate change. http://schwab.tsuniv.edu/ The Sun Blog -- On the trail of a solar clone http://www.lowell.edu/users/jch/sunblog/

MILKY WAY BLACK HOLE - COLOSSAL 'PARTICLE ACCELERATOR'

Scientists were startled when they discovered in 2004 that the center of our galaxy is emitting gamma rays with energies in the tens of trillions of electronvolts. Now astrophysicists have discovered a mechanism that might produce these high-energy gamma rays. The black hole at the center of our Milky Way could be working like a cosmic particle accelerator, revving up protons that smash at incredible speeds into lower energy protons and creating high-energy gamma rays, they report. "*It's similar to the same kind of particle physics experiments that the Large Hadron Collider being built at CERN will perform*," astrophysicist David Ballantyne said. When complete, the Large Hadron Collider in Switzerland will be able to accelerate protons to seven trillion electronvolts. Our galaxy's black hole whips protons to energies as much as 100 trillion electronvolts, according to the team's new study. That's all the more impressive because "*Our black hole is pretty inactive compared to massive black holes sitting in other galaxies*," Ballantyne noted.

Ballantyne collaborated with astrophysics Professor Fulvio Melia in the new study. For the last several years, Melia has been developing a theory of what may be going on very close to the Milky Way's black hole. Melia and his group find that powerful, chaotic magnetic fields accelerate protons and other particles near the black hole to extremely high energies. "*Our galaxy's central supermassive object has been a constant source of surprise ever since it's discovery some 30 years ago*," Melia said. "*Slowly but surely it has become the best studied and most compelling black hole in the universe. Now we're even finding that its apparent quietness over much of the spectrum belies the real power it generates a mere breath above its event horizon -- the point of no return*."

The Milky Way black hole "*is one of the most energetic particle accelerators in the galaxy, but it does this by proxy, by cajoling the magnetized plasma haplessly trapped within its clutches into slinging protons to unearthly speeds*," Melia said. Ballantyne used detailed, realistic maps of interstellar gas extending 10 light years beyond the black hole in modeling whether accelerated protons launched from the galactic center would produce gamma rays. "*We calculated very exactly how the protons would travel in this medium, taking into account specifically the magnetic force that changes the protons' trajectories*," he said. The team calculated 222,000 proton trajectories for a statistically solid study. Even though the protons move close to the speed of light, their motion is so random that it takes several thousand years for the particles to travel beyond 10 light years of the black hole. After the high-energy protons escape the black hole environment, they fly off into the interstellar medium, where they collide with low-energy protons (hydrogen gas) in a smash-up so energetic that particles called 'pions' form. These particles of matter quickly decay into high-energy gamma rays that, like other radiation, travel in all directions. Ballantyne, Melia and and their colleagues found that this process can explain the energy spectrum and brightness of gamma-ray emission that astronomers observe. Researchers detect the high-energy gamma-ray emission with ground-based telescopes at Namibia, Africa, at Whipple Observatory in southeastern Arizona, and elsewhere.

"*Ironically, even though our galaxy's central black hole does not itself abundantly eject hyper-relativistic plasma into the surrounding medium, this discovery may indirectly explain how the most powerful black holes in the universe, including quasars, produce their enormous jets extending over intergalactic proportions. The same particle slinging almost certainly occurs in all black-hole systems, though with much greater power earlier in the universe*," Melia said. Only 31 percent of the 222,000 proton trajectories in their sample produced gamma rays within 10 light years of the black hole, Ballantyne said. The other 69 percent escape to greater distances, where presumably they, too, will interact in gamma ray-generating collisions. "*Astronomers do, indeed, observe a glow of very-high energy gamma-rays from the inner regions of the galaxy*," Ballantyne said. "*It's possible that this emission is also caused by protons accelerated close to the central black hole*." http://www.physics.arizona.edu/~melia/ http://imagine.gsfc.nasa.gov/docs/science/how_l2/cerenkov.html

Galaxy Image Benefits From Vigilance on Dark Skies

A beautiful new image of spiral galaxy IC 342 that takes advantage of the dark night sky at Kitt Peak National Observatory was released at “The Night: Why Dark Hours Are So Important," symposium hosted at the Carnegie Institution. IC 342 is located in the constellation Camelopardalis, "the giraffe." From our perspective on Earth, this galaxy is viewed through much of the stars and interstellar dust and gas within our own galaxy, the Milky Way. This means that much of the star light from IC 342 is diminished before it reaches us. "*Without all of the interstellar gas and dust between us and IC 342, it would be one of the brightest galaxies in our night skies and a favorite target for backyard astronomers*," said astronomer Travis Rector. "*Being able to produce an image like this, through all that obscuring gas and dust, demands dark night skies like those still found in Arizona at Kitt Peak, which are crucial for making observations of this depth and sensitivity*." The image, obtained in late 2006, was taken using the 64-megapixel Mosaic-1 digital imager on the Mayall 4-meter telescope by Rector and Heidi Schweiker.

IC 342 is located roughly 11 million light-years from Earth, in the next group of galaxies beyond our Local Group. Its face-on appearance in the sky -- as opposed to our tilted and edge-on views of many other nearby galaxies, such as the large spiral galaxy Andromeda (M31) -- makes IC 342 a prime target for studies of star formation and astrochemistry, Rector adds.

A recently completed study of the dark skies in southern Arizona and how they may change over the next 25 years ("An Assessment of the Impact of Growth on the Dark Skies of Pima County," D.R. Davis, et al., 2006) found that continuing effective enforcement of the Outdoor Lighting Code adopted by Pima County, ongoing public education, and minimization of light-intensive land use near Kitt Peak should stabilize light pollution at current levels. However, other observatories in Arizona face significant threats without similar actions, the study found. Speakers at "The Night" meeting in Washington include experts and practitioners in fields ranging from astronomy, biology, medical and behavioral research to anti-terrorist force protection, recreation and parks management, illumination engineering and other engineering disciplines. The conference is co-sponsored by the American Astronomical Society, the American Council for an Energy-Efficient Economy, the Association of Universities for Research in Astronomy, the Ecological Society of America, the International Dark-Sky Association, Monrad Engineering, the National Optical Astronomy Observatory and the National Science Foundation (NSF) and is supported by a grant from NSFs Division of Astronomical Sciences and Office of Multidisciplinary Activities. The new image of IC 342 is available in a variety of sizes at http://www.noao.edu/image_gallery/html/im1032.html

Fundamental Property of Galaxies Discovered

A new study using data collected by the Keck Observatory has revealed that certain fundamental properties of galaxies have actually changed very little over the last 8 billion years, nearly half of the age of the universe. According to the research, the relationship between a galaxy's mass and a new speed indicator that measures movement of its stars and gas remains the same for all forms of galaxies, from spirals like our own Milky Way, to elliptical galaxies, and even the so-called "train wrecks" left over by galactic mergers. "*Surprisingly, if you use this new speed indicator to measure the motions of stars and gas in a galaxy, you can predict the mass in stars the galaxy has with pretty high accuracy*," said Susan Kassin, a post-doctoral researcher and lead author of the study.

Galaxies like our Milky Way are made up of billions of stars formed into a spiral disk along with some gas. Like a spinning pinwheel, our galaxy also spins, but at a speed of a few hundred kilometers per second.

It's known that half of the age of the universe ago, many galaxies look more disheveled, as they are assembled through galaxy collisions and accretion of new gas and stars. According to the research, disheveled galaxies and the remnants of galaxy collisions have mixed-up velocities in addition to some orderly rotation. Furthermore, the research found that when all these velocities are totaled up, the total amount of motion was found to be similar to that of more well behaved galaxies. "This suggests that the mixed-up velocities may settle down to orderly rotation over time as the universe ages," said Ben Weiner, a co-author of the study.

There are three main types of galaxies in the universe: spiral or disk-like galaxies like our own Milky Way, elliptical or cloud-like galaxies, and the remnants of galaxy collisions. It was previously known that when it comes to spiral galaxies, the more massive the galaxy, the faster its stars and gas rotate. The relation between the mass in stars of spiral galaxies and the rotation

speed of their stars and gas is known as the Tully-Fisher relation. When it comes to elliptical galaxies, the more massive a galaxy is, the faster the random motions of its stars. This relation is known as the Faber-Jackson relation. The latest research went a step further; discovering a new relation between how massive a galaxy is and a new speed indicator that takes into account both rotation velocity and random or disordered motion. This new relation applies to spiral, elliptical, and other types of galaxies, like disheveled galaxies or the remnants of galaxy collisions, and has remained essentially the same over the past 8 billion years -- roughly half the age of the universe.

Kassin, Weiner, and the other researchers were able to bring together both the Tully-Fisher and Faber-Jackson relations -- and include "disturbed" or train-wreck galaxies which previously didn't figure in either -- by using a new speed indicator, a number which when applied to galaxies, allows astronomers to better mathematically define the movement of stars. "*This relation holds for all the galaxies, no matter what they look like*," Kassin said. "*It ties together the Faber-Jackson relation with the Tully-Fisher relation and works for all kinds of odd-ball galaxies that are more common in the early universe*."

According to Sandra Faber, co-author of the study and one of the namesakes of the Faber-Jackson relation which she helped develop in 1976, the research is believed to reflect a fundamental property of the universe. "*Both of these relations were imprinted by the nature of fluctuations that made galaxies in the first place*," she said. The recent study involved 544 distant galaxies of various types, which according to Kassin makes this the largest study to date of the speed and movement of distant galaxies' stars and other matter. The galaxies studied ranged in redshift from 0.1 to 1.2, which means their light was emitted between 2 billion and 8 billion years ago. Redshift is a way of gauging the distance of an object by measuring how much of the wavelength of its light has shifted toward the redder regions of the spectrum due to galaxies moving away from us because of the expansion of the universe. It is similar to the Doppler Effect which involves changes in sound from an object moving away from oneself.

Kassin said the DEIMOS spectrograph at Keck II, one of two 10-meter telescopes the observatory operates on the summit of Mauna Kea, was key to obtaining the amount of data necessary for the study. "*Without it, we wouldn't have been able to have anything close to this large of a sample*," she said. Additional data came from the Hubble Space Telescope and the Canada-France-Hawaii Telescope, which is also located atop Mauna Kea. The results of the research have been presented in a study to be published in a special issue of "Astrophysical Journal Letters" devoted to the initial results of a far-reaching study of galaxies know as AEGIS, for All-wavelength Extended Groth Strip International Survey. AEGIS involves nearly 100 scientists from 16 institutions in Europe, North America, and Asia studying a certain area of the sky using a variety of wavelengths ranging from X-rays to radio and including ultraviolet and visible light. For more information see the Web site at http://aegis.ucolick.org

ASTEROIDS SPIN AT YORP SPEED, THANKS TO SUNLIGHT

Sunlight alone can change the way an asteroid and other small bodies spin in space, suggests a new study. The observations provide the most conclusive evidence to date that an effect of sunlight called YORP plays a direct role in the evolution of asteroids. Graduate student Patrick Taylor and assistant professor of astronomy Jean-Luc Margot mapped the shape and located the spin pole of a 100-meter-diameter (about 300 feet) near-Earth asteroid called (54509) 2000 PH5 (abbreviated to PH5) between 2001 and 2005, using radar at the Arecibo Observatory in Puerto Rico and Goldstone telescope in California.

Meanwhile, a team led by astronomers Stephen Lowry and Alan Fitzsimmons in Belfast used telescopes around the world to measure PH5's light curve, the varying brightness of the asteroid as it rotates. They found that PH5's spin, already unusually fast at about 12 minutes per rotation, is accelerating by about one millisecond per year. The researchers say that by ruling out other potential forces on PH5, such as tidal torques, they were able to demonstrate that the most likely culprit for the acceleration is the YORP effect from sunlight. The acronym, from the tongue-twisting Yarkovsky-O'Keefe-Radzievskii-Paddack, is an effect that occurs when photons from the sun are absorbed by a body and reradiated as heat. In the process, two forces influence the object: one from the impact of the photons, providing a tiny push, and the other as a recoil effect when the object emits the absorbed energy. For small, irregularly shaped objects like PH5, YORP can cause measurable changes in motion.

On average, asteroids rotate every four to 12 hours. But the smallest asteroids (with a diameter of less than 10 kilometers, or about 6 miles) tend to spin either unusually slowly or unusually quickly -- and astronomers have long wondered why. "*It is one of the significant and longstanding questions in asteroid science*," said Margot. "*YORP is more effective on small objects, so it can nicely explain this*." YORP could also explain why some asteroids come in pairs. Most asteroids are actually loosely bound clumps of rubble with very little internal cohesion, so an object with an increasing spin rate could eventually spin faster than its own strength and gravity can endure -- ultimately flying apart to form two objects. Several dozen asteroids are known to be binaries, with potentially many more undiscovered. PH5 was discovered in 2000 by the MIT near-Earth asteroid search program. When it was observed, it was about five times more distant than the moon. Before the researchers could attribute the asteroid's accelerating spin to YORP, they had to discount the other possible torques that could be influencing its rotation. Using a shape model produced from high-resolution images gathered by the Arecibo telescope, the team led by Lowry and Fitzsimmons found that tidal torques as the asteroid passed near Earth were not strong enough to account for the acceleration. In fact, tidal forces are just as likely to decelerate the spin.

Beyond the finding's significance to asteroid science, it is also a testament, said Margot, to the unique capabilities of the Arecibo telescope. "*Arecibo is absolutely critical for this experiment*," said Margot. And while one millisecond may sound trivial, he added, even a change that small adds up. "*The length of the day on PH5 can be halved in half a million years*," he said. "*Anything, even a minute change in our lifetime, can have a dramatic effect in geological timescales*."
http://www.news.cornell.edu/stories/March07/margot.yorp.html

FROM THE EDITOR'S TERMINAL

The Stargazer is your newsletter and therefore it should be a cooperative project. Ads, announcements, suggestions, and literary works should be received by the editor at least two weeks prior to the next upcoming scheduled EAS meeting. If you wish to contribute an article or suggestions to ***The Stargazer*** please contact Mark Folkerts by email or by telephone (425) 486-9733 or co-editor Bill O'Neil, at (774) 253-0747.

The Star Gazer
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In March's StarGazer:

The next EAS Meeting is 3:00 P.M. Saturday March 24th at the Everett Public Library Auditorium.