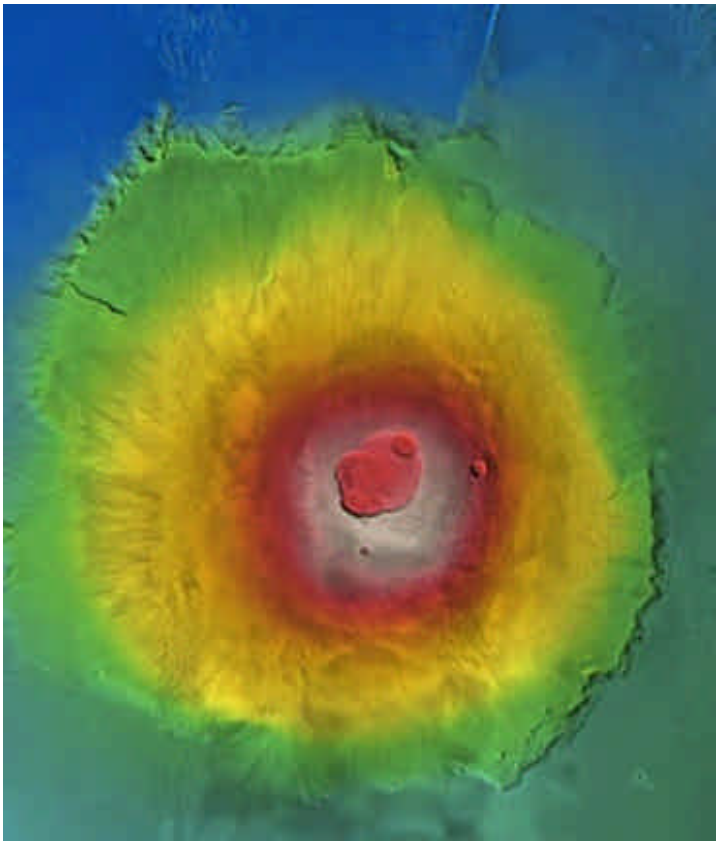
TRANSIT

The Newsletter of

Cleveland & Darlington Astronomical Society

10 February 2008



Olympus Mons on Mars as you have never seen it

Front page image -

Olympus Mons 3D

Thanks to the data from the Mars Express High Resolution Stereo Camera (HRSC), the Red Planet is about to come into 3D focus as never before.

Constructing a 3-D Digital Terrain Model requires a spacecraft to look at the same surface feature twice, each time from a different angle. Most attempts to do this in the past have required the spacecraft to target the same feature from two different orbital passes. The High Resolution Stereo Camera (HRSC) on Mars Express is the only experiment that can do it in one pass. To achieve its complementary views, HRSC has nine individual scan lines that point fore, aft and straight down. It therefore sees a feature coming, sees it directly underneath and watches it recede into the distance, providing all the different angles needed.

Editorial

Last meeting : 08 February 2008. Rod Hine on "Orbits, Spin and Chaos". A great trip back to Astronomy 101. All we should know about the physics basics of our hobby. Rod was very courageous. Presenters are advised never to share the stage with children, animals or weapons of mass destruction.

Previous meeting : 11 January 2008. Members' Night – Michael Roe on "Apollo 16", Julia Goudge on her Transit Garden at the Chelsea Flower Show and Barry Hetherington on Astronomical Bloopers – a brilliant evening for all.

Another Moonwalker visit :

Ken Willoughby & Carleton Community High School present an evening with Colonel Edwin "Buzz" Aldrin (Apollo 11 Lunar module Pilot and 2nd man on the Moon).

Sunday 30th March, 2008.
Carleton Community High School,
Green Lane,
Pontefract WF8 3NW

Admission £20.00

SAE to Ken Willoughby, 11 Hardistry Drive, Pontefract, West Yorkshire, WF8 4BU,
Tel no. 01977 795535
e-mail : kenwilloughby@btinternet.com

2008 Preview Night Sky Highlights

from Joe Rao

Here are some of the more noteworthy sky events that will take place this year.

February 1 — Venus/Jupiter conjunction, Part 1. This will be the first of two meetings this year between the two brightest planets in our sky. This one will occur in the morning sky, low in the east-southeast and is best seen about 45 minutes before sunup. On Feb. 4, a beautiful crescent moon will join the two planets making for an eye-catching array.

February 20-21 — Total eclipse of the moon. Less than six months after last August's total lunar eclipse, we have yet another that occurs during the late-night hours of February 20-21. This eclipse will favor much of North America, occurring during convenient evening hours, although Europeans will also be able to enjoy a view of the darkened moon before it sets. Totality will last for a bit less time than usual (50 minutes), as the moon slides to just within the southern portion of the Earth's umbra, perhaps leading to a potentially bright total phase highlighted by a brighter southern limb. Adding to this spectacle, a planet (Saturn) and a bright star (Regulus) will be close to the totally eclipsed moon forming a broad triangle.

May 10 — Occultation of the Beehive star cluster. A waxing crescent moon, 38 percent illuminated, will pass in front of the famous Beehive Cluster this evening, making for a pretty sight in binoculars and low-power telescopes. Members of the cluster will disappear behind the moon's dark edge and will reappear about an hour later behind the bright edge.

May 21-22 — Jupiter without satellites! Anyone who points a small telescope toward the planet Jupiter will nearly always see some or all of the four famous Galilean satellites. Usually at least two or three of these moons are immediately evident; sometimes all four. It is very rare when only one moon is in view and rarer still when no moons at all are visible. On this night, Jupiter will appear moonless for about 20 minutes.

June 30 — Occultation of the Pleiades star cluster. This occultation is visible a skinny sliver of a waning crescent moon rising in the pre-dawn sky. Earthshine should also be present, imparting a "3-D effect" in binoculars and small telescopes. The best views will come as the brighter stars of this cluster reappear along the dark lunar limb.

August 1 — Total eclipse of the sun. Siberia anyone? From Novosibirsk you'll see the late-afternoon sun completely blotted out for 2.3 minutes. Totality will also be visible from Canada's Northwest Passage, western Mongolia, and the western end of the Great Wall of China.

August 11-12 — Perseid meteor shower. At first glance this doesn't look like a favorable year to view this famous meteor display, since the moon will be in a bright waxing gibbous phase on the peak viewing night.

August 16 — Partial eclipse of the moon. Europe, Africa and Asia will be in the best position to watch about four-fifths of moon become immersed in the Earth's dark umbral shadow.

September 19 — Another Pleiades occultation. A waning gibbous moon will already be within the Pleiades as it rises. The reappearance of stars such as Alcyone and Taygeta should be well-seen along the moon's dark limb.

December 1 — Venus/Jupiter conjunction, Part 2. This will be the second pairing-off of the two brightest planets in 2008, this time in the evening sky soon after sundown. And as a bonus, the crescent moon will join them forming a striking triangle and likely making even those who normally don't look up at the sky take notice.

Review: Infinity 125 mW Green Laser

Have you ever tried to point out the constellations to a friend? You huddle up close, point your arm out, and both of you try to locate the star you're looking at. "See that star? Right there? Now down a little, no, not that one. It's on the left… never mind, there's the Moon over there." I had a chance to play with a green laser pointer from techlasers.com, and let me tell you, that problem goes away once and for all.

The laser I received is the Infinity 125 mW laser from techlasers and it retails for $289.00 USD. But they also have lower watt lasers right down to 15 mW (for $79.00).

All their Infinity series are the size of a large pen. You can easily clip this in your shirt pocket, and whip it out when you need to clear up a constellation conundrum.

As long as you're using the laser for good, it's awesome. You point up into the sky, press the trigger, and a finger of light stretches from your hand to infinity. Instead of standing beside someone, with your arm outstretched, trying to point out a specific, dim object in the sky, you can just reach out and point to it.

I'm not kidding. Zap, your laser reaches out to a specific star. There's Venus, that's Mars. Zap… that's Andromeda.

It only takes 2 AAA batteries, and I've been using it for the better part of a month now, amazing my friends and entertaining my children, and it hasn't run out of batteries yet.

I've tested it around the house, and the spot where the laser hits the wall is almost too bright to look at. You can easily see the spot on a building a few miles away, and I'm sure distant aliens are squinting their eyes from the light when you beam it at their star (okay, not really). I'm sure my neighbours are wondering what that green beam is stretching up from my house.
I've got to say, though, it feels a bit like owning a firearm. I keep the laser out of reach of the kids, and make sure that we only use it with my supervision. I can imagine it would seriously damage someone's eyes if you weren't careful.
But if you're a responsible person, and you keep it away from airplanes flying overhead, I would say that a green laser is a great way to share your love of astronomy with your friends.

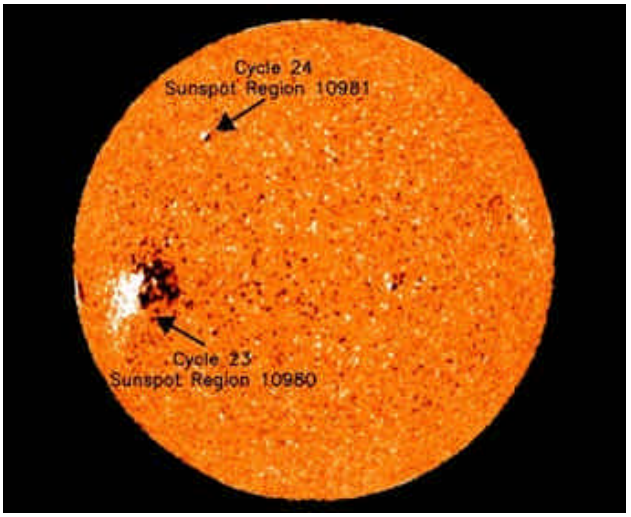
P.S. Not recommended for use by idiots (Ed)

A New Solar Cycle is Dawning

Posted by Kristina Grifantini ,

Solar Cycle 24 is officially here, say the professional sunwatchers at NOAA's Space Weather Prediction Centre.

A tiny sunspot, numbered 10981 by NOAA scientists, appeared in early January 2008 at a solar latitude of +27° and with a magnetic polarity opposite that of the larger sunspot group near the equator. Its appearance marks the onset of solar activity Cycle 24.



The start of a new 11-year-long activity cycle was confirmed by January 3rd appearance of a sunspot — not just *any* sunspot, but one at a high solar latitude and with magnetic polarity opposite that of its predecessors.

Scientists knew something like this was in the offing. A magnetic cluster seen in mid-December had the looked-for polarity and position in the Sun's northern hemisphere. It just hadn't coalesced into a distinct spot.

Sunspots, caused by magnetic knots, look dark because they are a few thousand degrees cooler than the surrounding surface. When more sunspots pop up, so do solar flares and the more powerful coronal mass ejections (CMEs), the most violent explosions in our solar system. Both flares and CMEs can hurtle "storms" of superheated particles, X-rays and ultraviolet radiation toward Earth. Our planet's magnetic field generally does a good job of deflecting these storms, but satellites and astronauts can be vulnerable to harmful — even lethal — doses of radiation. Flares and CMEs can sizzle out power grids, interfere with communication and GPS satellites, and create dazzling auroras.

In recent months the sunspot count has varied between zero and a few dozen, according to weekly reports sent to *Sky & Telescope* by a network of about 30 observers coordinated by Texas amateur Tom Fleming. But the numbers are certain to rise in the weeks and months ahead.

Space-weather scientists are split on the strength and timing for Cycle 24's upcoming maximum. Some models predict a strong cycle (140 sunspots peaking in October 2011), while others portend a weak one (90 sunspots in August 2012). The "strong" proponents look at factors from preceding cycles, while the "weak" teams focus more on the poles' magnetic fields during the tapering of the previous cycle.

Predicting sunspot cycles is an emerging field. This is only the third time scientists have attempted to forecast the Sun's activity, but they're gaining experience and confidence. The sooner more sunspots with traits like this one start springing up, the more likely the new cycle will be a strong one, with more frequent solar outbursts. If sunspots don't appear in droves by the middle of next year, it may be a weaker cycle.

A tiny sunspot, numbered 10981 by NOAA scientists, appeared in early January 2008 at a solar latitude of +27° and with a magnetic polarity opposite that of the larger sunspot group near the equator. Its appearance marks the onset of solar activity Cycle 24.

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Have you noticed that the astronomers and mathematicians are much the most cheerful people of the lot? I suppose that perpetually contemplating things on so vast a scale makes them feel either that it doesn't matter a hoot anyway, or that anything so large and elaborate must have some sense in it somewhere.

Dorothy L Sayers

The “Astronomical Unit” May Need an Upgrade as the Sun loses Mass

Written by Ian O'Neill

The Sun is constantly losing mass. Our closest star is shedding material through the solar wind, coronal mass ejections and by simply generating light. As the burning giant begins a new solar cycle, it continues to lose about 6 billion kilograms (that's approximately 16 Empire State Building's worth) of mass **per second**. This may seem like a lot, but when compared with the total mass of the Sun (of nearly 2×10^{30} kilograms), this rate of mass loss is miniscule. However small the mass loss, the mass of the Sun is not *constant*. So, when using the Astronomical Unit (AU), problems will begin to surface in astronomical calculations as this "universal constant" is Based on the mass of the Sun.

The AU is commonly used to describe distances within the Solar System. For instance, one AU is approximately the mean distance from the Sun to Earth orbit (defined as 149,597,870.691 kilometres). Mars has an average orbit of 1.5AU, Mercury has an average of about 0.4AU… But how is the distance of one AU defined? Most commonly thought to be derived as the mean distance of the Sun-Earth orbit, it is actually officially defined as: *the radius of an unperturbed circular orbit that a massless body would revolve about the Sun in 2p/k days* (that's one year). There lies the problem. The official calculation is based on "k", a *constant* based on the estimated *constant* mass of the Sun. But the mass of the Sun ain't constant.

As mass is lost via the solar wind and radiation (radiation energy will carry mass from the Sun due to the energy-mass relationship defined by Einstein's $E=mc^2$), the value of the Astronomical Unit will increase, and by its definition, the orbit of the planets should also increase. It has been calculated that Mercury will lag behind it's current orbital position in 200 years time by 5.5 km if we continue to use today's AU in future calculations. Although a tiny number - astrophysicists are unlikely to bse any sleep over the discrepancy - a universal constant should be just that, *constant*. There are now calls to correct for this gradual increase in the value of the AU by discarding it all together.

> "*[The current definition is] fine for first-year science courses. But for scientific and engineering usage, it is essential to get it right*." - Peter Noerdlinger, astronomer at St Mary's University, Canada.

Correcting classical "constants" in physics is essential when high accuracy is required to calculate quantities over massive distances or long periods of time, therefore the AU (as it is currently defined) may be demoted as a general description of distance rather than a standard scientific unit.

Skies Dim for British Astronomers

From Jonathon Amos

UK astronomers will lose access to two of the world's finest telescopes in February, as administrators look to plug an £80m hole in their finances.

Observation programmes on the 8.1m telescopes of the Gemini organisation will end abruptly because Britain is cancelling its subscription. It means UK astronomers can no longer view the Northern Hemisphere sky with the largest class of telescope. Researchers say they are aghast at the administrators' decision.

"To withdraw from the state-of-the-art Gemini facilities leaves the UK ground-based astronomy strategy in disarray - some would say deliberately sabotaged," said Professor Paul Crowther from Sheffield University. "This will badly affect the UK astronomical community's ability to address questions such as how galaxies form, or look for planets around other stars, or be able to adequately exploit space observatories such as the Hubble Space Telescope," explained the current chair of the UK telescope allocation committee for Gemini.

"The loss of Gemini North is particularly acute, since the majority of the UK past investment has been focused upon the Northern Hemisphere," he told BBC News.

Budget shortfall

Gemini is one of the international "science clubs" in which Britain has been a major partner and investor. It has a 23.8% share in the project (which also includes the US, Canada, Chile, Australia, Brazil and Argentina) and to date has invested some £70m in construction and running costs. Membership of the consortium gave British astronomers direct access to two of the biggest, most-modern optical-infrared reflecting telescopes in the world.

Gemini South, located in the Chilean Andes, and Gemini North, in Hawaii, are only now reaching their full potential after 15 years of development.

But the Science and Technology Facilities Council (STFC), which looks after UK astronomy funding, has signalled that formal notice to withdraw from Gemini would be issued shortly as it seeks to close a large shortfall in its budget. The STFC's problems have emerged out of the government's latest spending round which has left the council short of £80m in the three-year budget plan to 2011.

To manage its way out of this crisis, the STFC has announced its intention to close certain programmes and cut research grants. Science societies and union officials have warned the damage to UK physics and astronomy will be incalculable and will lead to hundreds of job losses.

Penalty fee

A request was made last year to the Gemini partners to allow the UK to come out of the organisation but still maintain some access to the Frederick C Gillett (Gemini North) facility through to the end of the current contract in 2012.

This request, however, has been rebuffed by the partners; and the STFC announced on Friday that it now had no option but to seek a formal cancellation of its subscription. Observations booked on the Gemini telescopes from 2 February will now be terminated.

"While we sincerely regret the need to withdraw from Gemini, the current circumstances leave us no choice," the STFC said in a statement. "This is particularly relevant in the context of preserving the highest priority programmes and providing headroom to pursue the next generation of scientific opportunities, for example the Extremely Large Telescope."

The ELT is a super-scope that will have a mirrored surface tens of metres across. It is still in the design phase and will not be built for a number of years.

Britain will incur a penalty of about £8m for cancelling its Gemini membership early; but this would still save more than £15m in "subs" that no longer needed to be paid between now and 2012, according to the STFC's statement. "We've effectively wasted £70m," countered Professor Crowther. "These facilities had reached their prime, but somebody else is now going to get to use them." He said the STFC, if it had wanted to save money, should have maintained its membership and rented out a proportion of its time to another nation's astronomers. That way it would have saved the penalty fee, he argued. "The STFC strategy just doesn't make sense."

Club commitments

The decision of the UK to withdraw from Gemini has undoubtedly angered its partners. The Gemini consortium has a programme of instrument upgrades proposed for its two telescopes, and the way this is funded into the future will now need to be reassessed. British astronomers will continue to have access to eight-metre-class telescopes in the Southern Hemisphere, in particular through the UK's membership of the European Southern Observatory organisation (Eso). The Eso has four 8.2m telescopes at its Paranal site in Chile.

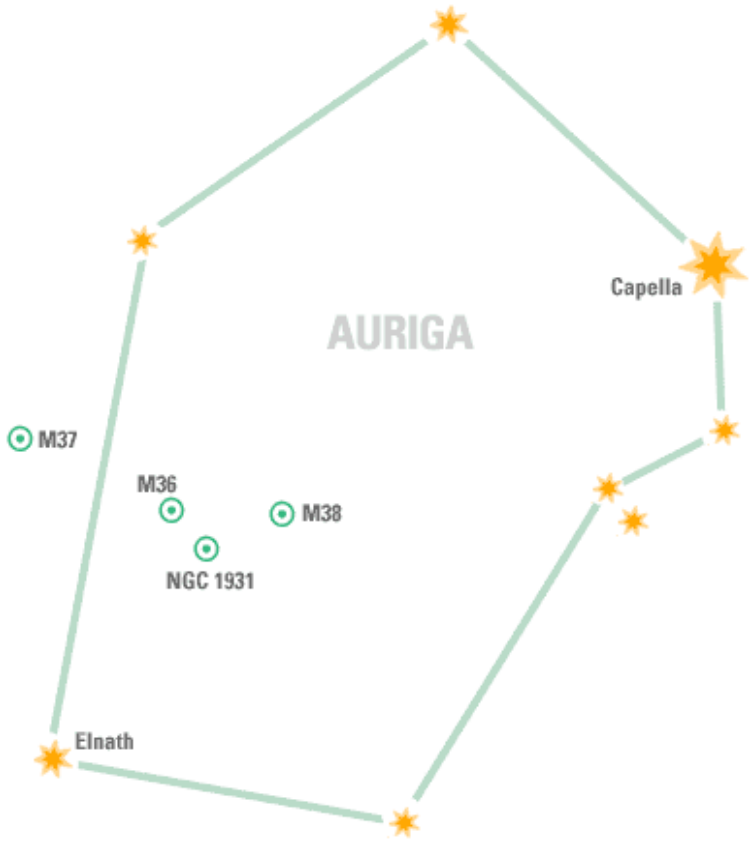
In future, the only way British astronomers can look at the Northern Hemisphere sky with the largest class of telescope is if they are working on projects with co-researchers whose national funding agencies are sponsors of one of these

facilities. Effectively, however, British scientists are now locked out from looking at what is directly above the UK with the world's best telescopes.

From Ed, the Planetarium Director.

Can you circulate this to CaDAS & DAS members stressing the importance of these subject areas in getting young children involved in science & engineering. Lobbying your MP is a good way to go:
http://www.ras.org.uk/index.php?option=com_content&task=view&id=1376&Itemid=1
http://www.saveastronomy.org.uk/write.shtml
And/or signing the e-petition:
http://petitions.pm.gov.uk/Physics-Funding/

It's crazy that the UK is a world leader in these areas of science and we're cutting it ... never to be reclaimed! Ed Restall, WWP P& O



Constellation Auriga

Auriga the Charioteer is most notable for its three bright open clusters and for sporting the sixth brightest star in the night sky, **Capella** (mag 0.08), a spectroscopic binary orbiting each other every 104 days.

In ascending order of interest are Auriga's three Messier-designated open clusters: M36, M38 and M37. All are clearly visible to the naked eye from a dark site and, in binoculars, appear as bright fuzzy patches; naturally, a telescope brings out the most detail.

M36 will show around 50 stars in an 8" scope while

M38 shows twice as many stars, some in apparent chain-like arrangements. But the most notable of the trio is

M37. In a 12" scope, roughly 150 stars are visible in this neatly arranged cluster, some tinged red.

NGC 1931 is a bright emission nebula surrounding a very small open cluster. With high magnification in an 8" telescope, the nebula is quite

Chunks of Junk - China ASAT Test, Plus One Year

It has been one year since China took aim on its own nearly one-ton meteorological satellite by way of an anti-satellite (ASAT).

That January 11, 2007 target practice spewed out a huge cloud of clutter - debris that remains a troublesome problem for operating satellites, as well as the International Space Station. Odds are that somebody's satellite is due for a whacking - if it hasn't already taken place.

The destruction of the eight-year-old Fengyun-1C spacecraft by a direct-ascent rocket shot from China peppered low Earth orbit with the largest amount of human-made debris in space history.

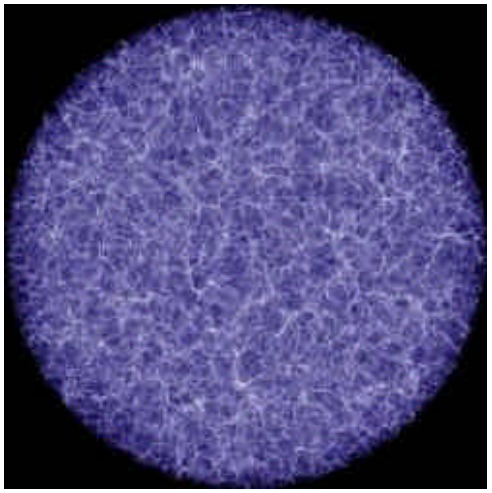
But there's new news to report.

NASA research by orbital debris experts now peg the number of fragments created by the ASAT shot as far higher than first reported - something like 150,000 or more bits of high-speed shrapnel that are one-centimeter and larger were created.
Furthermore, space debris authorities are puzzled at that number. It far exceeds all the fancy computer models used to gauge spacecraft breakups.

No word yet on any littering ticket issued to the Chinese. Where are the space cops when you need them?

Finding Dark Energy in a Supercomputer

written by Fraser Cain



Dark energy is probably the most influential force in the cosmos, overwhelming the pull of dark matter, and absolutely dominating the meager impact of regular matter. And scientists have absolutely no idea what it is. But a new supercomputer simulation by cosmologists at Durham University might give astronomers a few places to look; to know how to measure this mysterious force.

When dark energy was discovered in 1998, it came as a complete surprise. By measuring the distance to supernovae, astronomers were hoping to calculate the rate at which the Universe's expansion is slowing down. Instead of slowing down, though, they found that the expansion of the Universe is actually accelerating. Instead of coming together in a big crunch, it looks like dark energy will spread the Universe out faster and faster.

Physicists now believe that dark energy makes up 70% of the Universe, with the remaining amount made of mostly dark matter, and a sprinkling of regular matter. Since that discovery, astronomers haven't been able to find the source of this dark energy.

So a new simulation, run on Durham University's Cosmology Machine supercomputer could help astronomers in their search. The simulation looked at the tiny ripples in the distribution of matter in the Universe made by sound waves a few hundred thousand years after the Big Bang. These ripples have long since been destroyed by the 13.7 billion years of the lifetime of the Universe, but the simulations show they might have survived in some conditions.

By changing the nature of dark energy, the researchers found that the ripples changed in length. In other words, if astronomers can find the ripples in the real Universe, this can help constrain the parameters for dark energy.
Durham University Professor Carlos Frenk said, "the ripples are a gold standard. By comparing the size of the measured ripples to the gold standard we can work out how the Universe has expanded and from this figure out the properties of the dark energy."

An upcoming ESA mission called the SPectroscopic All-sky Cosmic Explorer (SPACE) should have the capabilities to detect these ripples, and so help put some constraints on the nature of dark energy.
If all goes well, SPACE will launch in 2017.

Original Source: Durham University News Release

Spy Satellite the Size of a Bus Coming Home Faster Than Planned

posted by Luke McKinney

Watch the skies - for the next few weeks there's a small but non-zero chance that nine tons of mysteriously unidentified United States property could fireball into your skull. And from the way people are talking, it seems like your crushed ashes would be scooped up into an envelope marked "ABOVE TOP SECRET" and interred in a sealed bank vault ten miles below Area 51.

A secret satellite believed to be the size of a bus has apparently lost power, propulsion, and ability to resist the saying about "what goes up". Satellites have fallen out of the sky before, burning up in the atmosphere, but this one is big enough to survive re-entry - survive not being a word applicable to anything under it when it arrives. Gordon Johndroe, spokesman for the UN Security Council, says that "We are looking at potential options to mitigate any possible damage this satellite may cause". One imagines he was a lawyer in a previous life because that statement contains more qualifications and reservations than a graduation ceremony in a hotel.

Considering that every word about the issue seems to be painfully forced out of the government by the legal liability equivalent of a thumbscrew-equipped waterboard, one has to wonder what goodies this high-velocity prodigal satellite contains. Hydrazine, a highly unstable and toxic rocket fuel component, is one suspect - a jolly concept since the list of organs the stuff damages reads like an anatomy chart. If it's a body part and hydrazine doesn't destroy it, you probably didn't need it to begin with.

The most likely explanation for all the secrecy is that it's a spy satellite that got tired of sneaking snaps of the globe and is coming down for an extremely permanent rest. Internet experts aren't ruling out more esoteric possibilities of it being a secret weapons platform, but that's because internet experts haven't yet ruled out the possibility that Elvis killed JFK, and can be safely discounted.

What you can be sure of is that even the controlled re-entry of human-capable craft gets up past twenty times the speed of sound, and this burning hunk of

rocket-fuel filled whatever is going to be coming down faster than that, unhindered by such concerns as "survival of passengers", "survival of cargo" or "survival of anything within a blast radius or two of wherever the hell it hits". Once its orbital decay becomes more advanced it should be possible to predict where it will hit to within a few miles.

This could all turn out to be academic (but still cinematically awesome if anyone films it), with a seventy percent chance that it'll do nothing but scare the daylights out of a lot of fish. Even should it strike land the fact is that, outside Hong Kong, most land isn't covered with a solid carpet of people. The odds of it hitting a major city are almost negligible - but you can be sure that, somewhere, a group of news-network executives are praying to their dark gods that it does.

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The Results of the recent Transit questionnaire

The answers used one of the following three codes after the question :

Y = Yes N = No and S = ummmm? So so

Comments were requested to accompany the answers if you considered it necessary, some of them were hilarious, some were unprintable but I thank you for taking part, I will take heed of your preferences in future issues of Transit.

Of interest we have 63 members on e-mail, **only 11 responded**. We have 17 members who receive a printed paper Transit, **only 8 responded**. The results below are based on a **total** of 19 respondees.

The question : Are you interested in the following?

- naked eye observing …….. 19Y
- binocular observing ……... 18Y, 1N
- telescope observing ……... 19Y
- film camera imaging ……... 3Y, 1S, 15N
- digital camera imaging ……... 8Y, 2S, 9N
- astronomy software on disc and Internet …….. 9Y, 3S, 7N
- The Moon …….. 17Y, 1S, 1N
- The Planets …… 17Y, 1S,
- Comets, asteroids and meteor showers ……. 16Y, 3S

- The Sun …….. 13Y, 3S, 3N
- other Suns (stars) …….. 17Y,
- variable stars …….. 15Y, 2S, 2N
- double stars…….. 12Y, 5N, 2S
- galaxies …….. 17Y, 2N
- transits, occulltations and eclipses ……10Y, 9N
- astral navigation …….. 8Y, 11Y
- exoplanets …….. 13Y, 2S, 4N
- sundials …….. 5Y, 3S, 11N
- spectroscopy …….. 8Y, 4S, 7N
- astrometry …….. 6Y, 2S, 11N
- exotic sky conditions (zodiacal light, noctilucents, sun dogs etc) 15Y, 2S, 3N
- radio astronomy …….. 7Y, 1S, 11N
- cosmology …….. 12Y, 3S, 4N
- investigative spacecraft (eg Cassini, Mars Rovers etc).. 10Y, 2S, 2N
- manned spacetravel …….. 14Y, 2S, 3N
- astronomy distance learning …….. . 10Y, 4S, 5N
- astronomy history …….. 13Y, 2S, 4N
- planetaria …….. 10Y, 6S, 3N
- light pollution eradication …….. 2S, 1N
- astronomy book reviews …….. 11Y, 6S, 2N
- observatories …….. 10Y, 7S, 2N
- do you have a telescope at home? …….. 17Y, 2N

Will the Earth Survive When the Sun becomes a Red Giant?

written by Fraser Cain

Billions of years in the future, when our Sun bloats up into a red giant, it will expand to consume the Earth's orbit. But wait, you say, the Earth travels the Earth's orbit… what's going to happen to our beloved planet? Will it be gobbled up like poor Mercury and Venus?

Astronomers have been puzzling this question for decades. When the sun becomes a red giant, the simple calculation would put its equator out past Mars. All of the inner planets would be consumed.

However, as the Sun reaches this late stage in its stellar evolution, it loses a tremendous amount of mass through powerful stellar winds. As it grows, it loses mass, causing the planets to spiral outwards. So the question is, will the expanding Sun overtake the planets spiraling outwards, or will Earth (and maybe even Venus) escape its grasp.

According to scientists Schroder and Smith, when the Sun becomes a red giant star 7.59 billion years, it will start to lose mass quickly. By the time it reaches its largest radius, 256 times its current size, it will be down to only 67% of its current mass.

When the Sun does begin to bloat up, it will go quickly, sweeping through the inner Solar System in just 5 million years. It will then enter its relatively brief (130 million year) helium-burning phase. It will expand past the orbit of Mercury, and then Venus. By the time it approaches the Earth, it will be losing 4.9×10^{20} tonnes of mass every year (8% the mass of the Earth).

But the habitable zone will be gone much sooner. Astronomers estimate that will expand past the Earth's orbit in just a billion years. The heating Sun will evaporate the Earth's oceans away, and then solar radiation will blast away the hydrogen from the water. The Earth will never have oceans again. It will eventually become molten again.

One interesting side benefit for the Solar System. Even though the Earth, at a mere 1.5 astronomical units, will no longer be within the Sun's habitable zone, much of the Solar System will be. The new habitable zone will stretch from 49.4 AU to 71.4 AU, well into the Kuiper Belt. The formerly icy worlds will melt, and liquid water will be present beyond the orbit of Pluto. Perhaps Eris will be the new homeworld.

Back to the question… will the Earth survive?

According to Schroder and Smith, the answer is no. Even though the Earth could expand to an orbit 50% larger than today's orbit, it won't get the chance. The expanding Sun will engulf the Earth just before it reaches the tip of the red giant phase. And the Sun would still have another 0.25 AU and 500,000 years to grow.

Once inside the Sun's atmosphere, the Earth will collide with particles of gas. Its orbit will decay, and it will spiral inward.

If the Earth were just a little further from the Sun, at 1.15 AU, it would be able to survive the expansion phase. Although it's science fiction, the authors suggest that future technologies could be used to speed up the Earth's spiraling outward from the Sun.

I'm not sure why, but thinking about this far future of the Earth gives an insight into human psychology. People are genuinely worried about a future billions of years away. Even though the Earth will be scorched much sooner, its oceans boiled away, and turned into a molten ball of rock, it's this early destruction by the Sun that feels so sad.

Seeking Thin Crescent Moons

by Roger W. Sinnott

For amateur astronomers and photographers alike, each young Moon makes an inviting target. The sunlit part encircles the Moon's night side, which is not fully dark but is bathed in sunlight reflected back toward the Moon from Earth. This earthshine theoretically gets brighter the closer the Moon is to new, except that it can easily be washed out by twilight. On rare occasions it has even been seen during a total solar eclipse.

When it comes to sighting the *youngest possible* crescent in the evening sky — or, for that matter, the thinnest waning crescent in the predawn sky — we are no longer talking about a bewitching sight that you might notice casually. Spotting such a Moon is no accident — you have to plan for it very carefully and pay close attention to the astronomical conditions under which a record sighting is even possible.

The instant of new Moon occurs when our satellite's celestial longitude (along the ecliptic) matches that of the Sun. Some 16 to 24 hours later, if the Sun has just set at your location, you might catch sight of a very slender crescent low in the western sky.

The record for the youngest Moon ever seen with optical aid, 11h 40m past new, goes to Mohsen G. Mirsaeed of Tehran who saw it on September 7, 2002. The youngest crescent ever seen by the naked eye, 15h 32m, is still that observed in May 1990 by *Sky & Telescope* contributing editor Stephen James O'Meara. Any given year there are only a handful of specific dates and locations on Earth where the thinnest crescent sightings are possible. To see why, we need to explore the interplay of astronomical factors affecting visibility.

In Pearce, Arizona, Matt BenDaniel recorded the Moon at dawn on October 15, 2001, only 30.8 hours before new. He took the 4-second exposure on Kodak E200 film with a 130-millimeter Astro-Physics refractor at f/6.7.
Courtesy Matt BenDaniel.

On the morning of August 13, 1931, French astronomer André Danjon observed a Moon only 16h 12m before new with a 3-inch refractor. Much to his surprise, the thin crescent appeared to extend only 75° to 80° along the Moon's limb — considerably less than the expected 180° (halfway around). When Danjon compiled many other observations of this "deficiency" effect, he came to a remarkable conclusion: Whenever the Moon is 7° or less from the Sun, there can be no visible crescent at all!

Danjon believed that mountains and other roughness along the lunar limb must be blocking some of the sunlit surface that would otherwise be seen, thereby clipping off the ends of the crescent. Bradley E. Schaefer (Louisiana State University, Baton Rouge) has modeled the crescent's perceived length by including physiological factors and atmospheric extinction. In any event, Danjon's 7° limit should actually be revised to 7.5°, according to a 1998 study by Louay J. Fatoohi and his colleagues at the University of Durham.

What's interesting is that a hard-and-fast Danjon limit of 7.5° still gives would-be record breakers a certain amount of leeway. Four other astronomical factors play a significant role in whether a crescent of minimum age can be seen:

- The Moon should be at perigee (the near point of its elliptical orbit around Earth), for it will then draw away from the Sun most quickly and reach an elongation of 7.5° at the youngest possible age.
- The Moon should be near its greatest ecliptic latitude, +5½° or –5½°, further adding to its elongation angle.
- A nearly new Moon is most likely to be seen from a place on Earth where it has roughly the same azimuth as the setting (or rising) Sun, for the Moon is then highest above the observer's horizon.
- Those seeking to break a record should get as high above sea level as possible, Schaefer stresses, where the air is less hazy and the sky darker

Observing Iridium Flares

by Joshua Roth

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Of the roughly 3,000 spacecraft in Earth orbit, nearly 100 stand apart: the Iridium communications spacecraft, which skim the uppermost, most rarefied region of the atmosphere (the *exosphere*) at altitudes around 800 kilometers in six steeply inclined orbital planes (orbits that nearly pass overhead at the North and South Poles).

In financial circles, the Iridium "constellation" of satellites stands apart because it was built at a cost of roughly $5 billion, only to be sold for $25 million when its first corporate owner, Iridium LLC, went bankrupt in 1999.

The spacecraft (and the ground stations supporting them) were intended to enable owners of special portable telephones to communicate from any point on the surface of the globe. However, Iridium LLC never obtained the millions of customers needed to make the project profitable. The U.S. Department of Defense and Federal Emergency Management Agency are among the principal customers of the satellites' current corporate owner, Iridium Satellite LLC of Leesburg, Virginia.

In skywatching circles, the Iridium satellites stand apart because their flat, shiny, door-size antenna arrays (three per spacecraft) periodically reflect sunlight toward the ground, causing brief (seconds-long) but brilliant flares that can momentarily reach an apparent magnitude of –8 — outshining the planet Venus. What's more, these flares are predictable, thanks to the satellites' publicly available orbital elements and to software and Web sites that satellite-watching aficionados have made available free of charge.

How To Plan Your Watch

Most would-be Iridium-flare watchers need go no further than Heavens Above. This fascinating Web site is maintained by Chris Peat, a physicist and space-industry veteran who now works for the German Space Operations Center. A few mouse clicks should produce a list of any Iridium flares occuring over your location in the next several days. Each listing will tell you where in the sky to look — and when! — to see sunlight glint off an Iridium spacecraft's antenna panel. The site also will tell you how bright the flare should appear (in magnitudes), and where to go to see that particular flare at its very brightest (traveling just a few

kilometers can make a big difference in the flare's brightness). Note that you can see some Iridium flares in daylight if your skies are very clear and you look in precisely the right direction!

When deployed as intended, an Iridium satellite's spin axis points to the center of the Earth, while three silvered Main Mission Antennas lean outward, peppering Earth with data-bearing radio transmissions and the occasional glint of sunlight. Flares also reportedly may be generated by the satellites' two solar panels.

Heavens Above tabulates the altitude and azimuth of each flare event, but you also can use the site to plot a particular flyover against the stars as follows: once you have the list of flares generated by the steps given above, click on a particular spacecraft ("Iridium 53," say), and then on "Passes." This will give you a list of that spacecraft's passes over your location for the next several days. Click on one of those passes by date, and you can get a star chart showing the spacecraft's quickly changing position among the stars.

To explore the Iridium-flare phenomenon in more detail, check out the Visual Satellite Observer's Home Page, whose Iridium section provides links to orbital elements, aficionados' custom flare-predicting software, and other resources. More information — launch history; financial and political developments — on the Iridium satellite constellation (and others) is available on a Web site maintained by University of Surrey (U.K.) communications specialist Lloyd Wood.

While most flare-seekers won't need these numbers, the so-called "two line elements" that describe an Earth-circling satellite's orbit can be obtained from Thomas S. Kelso's frequently updated celestrak.com Web site.

Mercury Surprises from MESSENGER

from NASA

The recent flyby of Mercury by NASA's MESSENGER spacecraft has given scientists an entirely new look at a planet once thought to have characteristics similar to those of Earth's moon. Researchers are amazed by the wealth of images and data that show a unique world with a diversity of geological processes and a very different magnetosphere from the one discovered and sampled more than 30 years ago.

After a journey of more than 2 billion miles and three and a half years, NASA's MErcury Surface, Space ENvironment, GEochemistry and Ranging spacecraft made its first flyby on Jan. 14. The mission is the first sent to orbit the planet closest to our sun. The spacecraft's cameras and other sophisticated, high-technology instruments collected more than 1,200 images and made other science observations. Data included the first up-close measurements of Mercury since the Mariner 10 spacecraft's third and final flyby on March 16, 1975.

"This flyby allowed us to see a part of the planet never before viewed by spacecraft, and our little craft has returned a gold mine of exciting data," said Sean Solomon, MESSENGER's principal investigator, Carnegie Institution of Washington. "From the perspectives of spacecraft performance and maneuver accuracy, this encounter was near-perfect, and we are delighted that all of the Science data are now on the ground"

Unlike the moon, the spacecraft showed that Mercury has huge cliffs with structures snaking up hundreds of miles across the planet's face. These cliffs preserve a record of patterns of fault activity from early in the planet's history. The spacecraft also revealed impact craters that appear very different from lunar craters.

Instruments provided a topographic profile of craters and other geological features on the night side of Mercury. The spacecraft also discovered a unique feature that scientists dubbed "The Spider." This formation never has been seen on Mercury before and nothing like it has been observed on the moon. It lies in the middle of a large impact crater called the Caloris basin and consists of more than 100 narrow, flat-floored troughs radiating from a complex central region.

"The Spider has a crater near its center, but whether that crater is related to the original formation or came later is not clear at this time," said James Head, Science team co-investigator at Brown's University.

Now that the spacecraft has shown scientists the full extent of the Caloris basin, its diameter has been revised upward from the Mariner 10 estimate of 800 miles to perhaps as large as 960 miles from rim to rim. The plains inside the Caloris basin are distinctive and more reflective than the exterior plains. Impact basins on the moon have opposite characteristics.

The magnetosphere and magnetic field of Mercury during the flyby appeared to be different from the Mariner 10 observations. The spacecraft found the planet's magnetic field was generally quiet but showed several signatures indicating Significant pressure within the atmosphere.

Magnetic fields like Earth's and their resulting magnetospheres are generated by electrical dynamos in the form of a liquid metallic outer core deep in the planet's center. Of the four terrestrial planets, only Mercury and Earth exhibit such a

phenomenon. The magnetic field deflects the solar wind from the sun, producing a protective bubble around Earth that shields the surface of our planet from those energetic particles and other sources farther out in the galaxy. Similar variations are expected for Mercury's magnetic field, but the precise nature of its field and the time scales for internal changes are unknown. The next two flybys and the yearlong orbital phase will shed more light on these processes.

The spacecraft's suite of instruments has provided insight into the mineral makeup of the surface terrain and detected ultraviolet emissions from sodium, calcium and hydrogen in Mercury's exosphere. It also has explored the sodium-rich exospheric "tail," which extends more than 25,000 miles from the planet.

Aluminizing Mirrors

A repeat and valuable article from Jack Youdale

Many of our modern telescopes are of the Cassegrain form, either Maksutov or Schmidt design. In both cases the optics are sealed within the telescope and the reflecting coatings are less prone to atmospheric deterioration. Also many of the reflecting surfaces in these telescopes have special coatings of multi-layers to enhance reflectivity. However, some of us still use the classical Newtonians or pure Cassegrain optics.

These telescopes have reflecting surfaces which are open to the atmosphere and therefore in time will deteriorate due to oxidization. A freshly aluminized surface will reflect some 90% of the image-forming light. To check your surfaces you can simply examine the surface by eye, carefully removing your mirror and look through the mirror towards a bright light. You will see a myriad of pin holes in the aluminium surface! If your mirror requires re-aluminizing you will be faced with the cost of packaging, postage and insuring your optics. Recently I have had an excellent job done locally so I will pass the information on to those who wish to use it.

Mr John Palmer until recently was employed at the Sinden Optical Co. in Newcastle. Since the death of David Sinden John acquired the aluminizing plant and has set it up in his home in Langley Park near Durham. His contact details are given below:-

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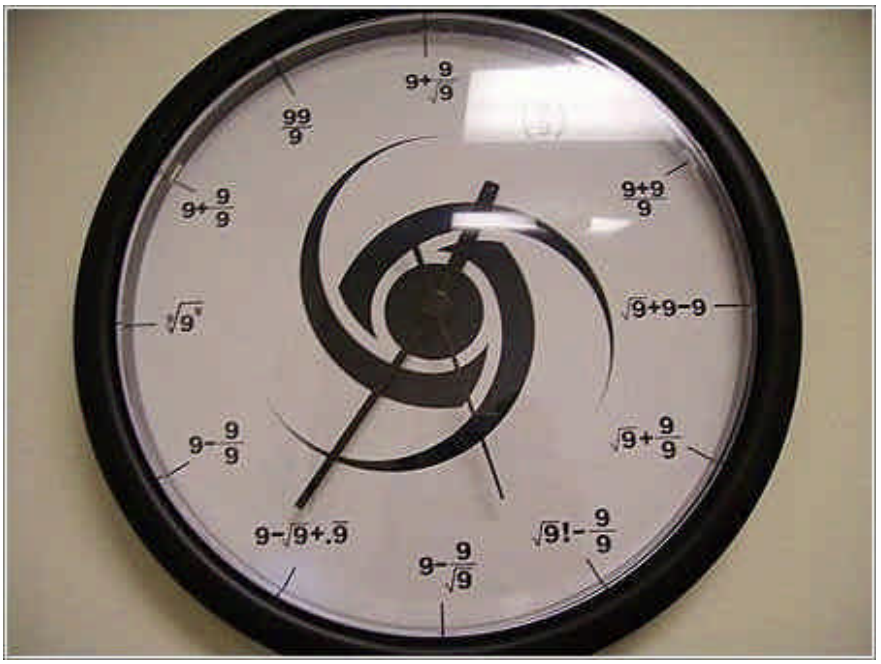
Transit Tailpieces

For Sale : 10" Meade 2120 LX6 Schmidt – Schmidt Cassegrain Telescope with Quartz Drive System, tripod and wedge, lots of eyepieces and filters plus other goodies. £500 ono. Also an Observatory Shed with sliding roof specially manufactured by Hodgson's, £200 ono. Please contact John McCue or Bob Mullen.

For Sale : Tal reflector 2M 150mm with motorised equatorial mount, 1200mm focal length, misc eyepieces and filters, with wooden boxes for telescope and motor. Offers. Contact Wynyard Planetarium 01740 630544 or e-mail b2mullen@hotmail.com (seller has lots of astro bits and pieces including Mamiya and Vivitar 35mm SLR film cameras).

Articles : Please send contributions for the newsletter to Bob Mullen,

18 Chandlers Ridge, Nunthorpe, Middlesbrough, TS7 0JL, 01642 324939 (b2mullen@hotmail.com) Copy deadline date is the 20th of each month.).



Not the 9 o' clock Clock!

How would *1984* open? "It was a bright cold day in April, and the clocks were striking 9 + root(9) + 9/9." Not quite the same ring to it?

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