South Downs Mercury

The monthly newsletter of South Downs Astronomical Society
Issue: 451 - May 2012

Next Meeting - Friday 4th May. Lecture room of the South Downs Planetarium, Chichester, at 7.30pm.

- **"What's Up!"** - guide to the month ahead by SDAS member John Whittington.
- **Short talk -** observing and/or short talk subject to be announced at the meeting.
- **"Galactic Archaeology"** - Dr. Chris Lintott is a post-doctoral researcher involved in various science projects aimed at bringing astronomy to a wider audience. Chris is also a presenter on *The Sky at Night* and co-author of *Bang!*

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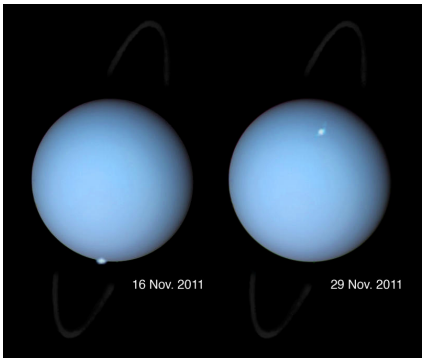
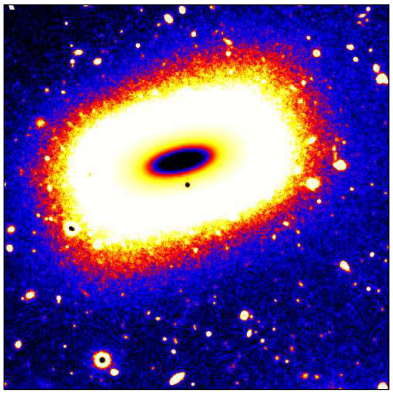
In the News:

Astronomers got their last good look at auroras on the giant ice planet Uranus some 25 years ago when the Voyager 2 spacecraft passed the planet as part of its exploration of the outer Solar System. Now, for the first time, carefully scheduled observations from the Hubble Space Telescope have captured images of aurora above the planet, finding further evidence of just how peculiar a world that distant planet is. Just published in the mid-April issue of *Geophysical Research Letters*, the observations were timed to coincide with active solar wind conditions, and reveal the aurora as faint, glowing dots. Appearing to only last a couple of minutes, a world of difference from the night-long colourful curtains of light that often ring Earth's poles, for more information go to: **10.1029/2012GL051312**



Last month we had an image of the Whirlpool Galaxy (M51) as seen by the Earl of Rosse in 1845; this month we have an image as seen by the Infrared Array Camera aboard the Spitzer Space Telescope. Marking 1000 days of operation, NASA has released what it considers to be Spitzer's "Ten Best Images"; included in the list is this one of the collision of M51 and its companion. Relatively nearby (only about 23 million LY distant) Spitzer sees the main galaxy as very red due to warm dust, a sign of active star formation that probably was triggered by the collision. NASAs full list of ten, plus other images can be found at: **http://www.cfa.harvard.edu/news/2012/pr201211.html**

The overwhelming majority of bright galaxies exist in one of three main forms. Many, including our own Milky Way galaxy, are in the shape of a flattened circular disk, typically hosting a spiral pattern of stars and a central bulge, and a significant number of galaxies are shaped something like an ellipsoidal football, with the remaining few being lumpy and irregular in appearance. Not fitting into any of these categories, astronomers have discovered an extremely rare example of a rectangular-shaped galaxy. Christened the *Emerald Cut* galaxy, LEDA 074886 appears to be almost unique, only 7 other previously observed galaxies appearing as "boxy". More information available in (very readable) scientific report at **http://arxiv.org/pdf/1203.3608v1.pdf**



By mapping the motions of more than 400 stars up to 13,000LY from the Sun, astronomers have calculated the mass of material in a volume four times larger than ever considered before in the vicinity of the Sun. "The mass that we derive matches very well with what we see - the stars, dust and gas" said team leader Christian Moni Bidin of the Universidad de Concepción, Chile. "But this leaves no room for the extra material - dark matter - that we were expecting. Our calculations show that it should have shown up very clearly in our measurements. But it was just not there!" According to widely accepted theories, the solar neighbourhood should be filled with dark matter, but this nil-result may mean astronomers should now concentrate on searches in the deep sky rather than attempting to directly detect dark matter particles on Earth. More information can be found at: **http://www.eso.org/public/news/eso1217/**

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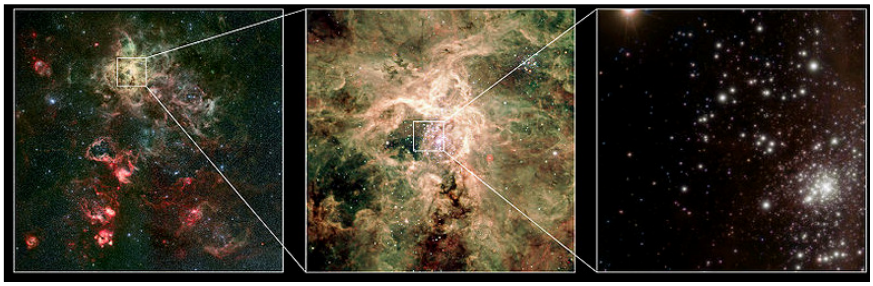
THE MAGELLANIC CLOUDS

If you are travelling south for your summer holidays this year, and particularly if you are venturing as far as the Antipodes, you will be well placed to view a couple of grey smudges in the Southern Hemisphere sky. Just visible with the unaided eye as a faint irregular "cloud", the larger of the two, the Large Magellanic Cloud (LMC) galaxy, has been described as an "*astronomical treasure-house, a great celestial laboratory for the study of the growth and evolution of the stars.*" Straddling the border between the constellations of Dorado and Mensa, surveys of the galaxy have found roughly 60 globular clusters, 400 planetary nebulae, and 700 open clusters, along with hundreds of thousands of giant and supergiant stars. It is also the home of SN1987a, the nearest supernova observed in recent years.

Through a small telescope (image at left), the LMC appears as an edge-on/elongated nebula with several outlying bright concentrations of stars. Closer inspection within the nebula (as in this composite image, at right) made from ESO, and Hubble Space Telescope mosaics) reveals bright concentrated areas of young, massive and hot stars.

The most striking of these regions appears to be the Tarantula Nebula (also known as *30 Doradus*, *NGC 2070)* with its long tendrils of gas and dust). Residing towards the edge of the LMC and originally thought to be a star, in 1751 the French astronomer Nicolas Louis de Lacaille recognised its nebular nature. With an apparent magnitude of 8 and about 160,000LY distant, the nebula is so bright that if it were as close as the Orion Nebula it would cast shadows on Earth.

About 650LY in diameter, the Tarantula Nebula is the largest and also the most active starburst, or star-forming, region known in the Local Group of more than 50 galaxies and dwarf galaxies. At its core lies an approximately 35LY in diameter compact star cluster, R136, that contains so many stars that on a scale equivalent to the distance between the Sun and the nearest star there are tens of thousands of stars. This montage (credit: ESO / C. J. Evans) shows a visible-light image of the Tarantula nebula (left) as seen through the Wide Field Imager on the MPG/ESO 2.2-metre telescope along with a zoomed-in visible-light image (middle) from the Very Large Telescope (VLT,). A more detailed image of the R136 cluster, (right-hand panel) obtained with the VLT near-infrared instrument shows the cluster at the lower right.



Within the cluster, astronomers have discovered, to date, the most massive stars ever seen, some weighing at birth more than 300 times the mass of the Sun, or twice as much as the currently accepted theoretical limit of 150 solar masses. The most massive of these (R136a1) is found to have a current mass some 265 times that of the Sun. Being a little over a million years old, this star is already “middle-aged” and has shed a fifth of its initial mass over its life. Despite this, its luminosity is still some 10 million times greater than that of the Sun.

Producing most of the energy that makes the nebula visible, the cluster is estimated at 450,000 solar masses, suggesting it will likely eventually develop into a globular cluster. In addition to R136, the Nebula also contains an older cluster, the most massive stars of which have already exploded as supernova, including the closest supernova observed since the invention of the telescope, SN1987a. The cluster also contains one of the fastest rotating stars as well as the fastest moving and most massive runaway stars.

The nebula is close enough to Earth that Hubble can resolve individual stars, giving astronomers important information about stellar birth evolution. But one of the unanswered questions about the strong star-forming activity currently seen in the LMC is what caused it to start in the first place.

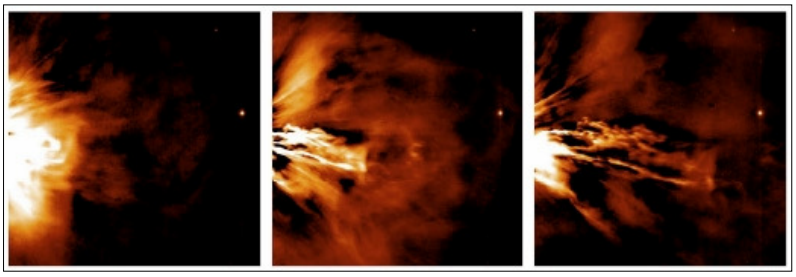
Originally thought to be a result of disruptions in the structure of the clouds by close passes with the Milky Way, the answer is now thought to be more localised, due predominately to the gravitational interaction between the LMC and its nearest neighbour, the Small Magellanic Cloud (SMC). Half the size of the LMC and slightly farther from us (at about 200,000LY), the two clouds are connected to each other, and to the Milky Way, by streams of neutral hydrogen gas (the *Magellanic Streams*).

Spanning 100 degrees of the sky from the Earth's viewpoint, each streamer points to a long-term and ongoing interaction between the galaxies. As a result, disruptions in the overall orbits of each of the galaxies as well as internal orbital disruptions causing gas compression fronts and shock waves may well be the most important initiator of new star formation within the clouds.

And the stars that we now see in the clouds, and particularly those in areas such as the Tarantula nebula, may be the result of bursts of activity rather than a continuous process, each burst being triggered by a particularly close passing of the clouds.

PRACTICAL ASTRONOMY

Storms caused by magnetic disturbances and temperature variations regularly erupt on the Sun's surface, sending gigantic magnetic loops (even a minor one can be 30 times the size of Earth's diameter) shooting into the corona. These keep most of the Sun's charged particles from escaping into space, but every so often the magnetic fields become tangled, and when they snap back into place solar particles can escape. Heading into space, and perhaps toward Earth, these outbursts are known as Coronal Mass Ejections (CMEs).



CMEs and other solar phenomena can have adverse effects on man-made objects, both on Earth itself as well as in orbit around our planet. Monitoring of solar activity of the Sun and, particularly, the occurrence and strength of CMEs and solar flares is undertaken by various agencies who make their observations publicly available.

There are numerous occasions when solar activity has caused flight interference, damaged satellites and debilitated power grids. One of the best-documented and most recent examples of terrestrial system damage was the failure of Quebec's power transmission system in 1989 when most of the province was in darkness for nine hours due to a strong solar storm hitting the Earth. The largest recorded geomagnetic perturbation, resulting presumably from a CME, coincided with the first-observed solar flare on 1st September 1859, and now referred to as the Carrington Event. Quite extraordinarily, the flare and the associated sunspots were visible to the naked eye, both as the flare itself appearing on a projection of the sun on a screen and as an aggregate brightening of the solar disc.

There are, of course, some totally benign effect, such as the increased brilliance and extent of auroras, the *Northern Lights* (aurora borealis) in the Northern Hemisphere, and the *Southern Lights* (aurora australis) in the Southern Hemisphere.

Scientists classify solar flares according to their X-ray brightness in the wavelength range 1 to 8 Angstroms. There are 3 categories: X-class flares are big; they are major events that can trigger planet-wide radio blackouts and long-lasting radiation storms. M-class flares are medium-sized; they can cause brief radio blackouts that affect Earth's Polar Regions. Minor radiation storms sometimes follow an M-class flare. Compared to X- and M-class events, C-class flares are small with few noticeable consequences here on Earth.

In an article published in *Nature* last month, according to Professor Mike Hapgood, chairman of a group advising the UK Government on space weather risks, virtually all sectors of commerce and industry need to be better prepared for the downside of such major solar events. Failure to take adequate precautions and build-in safeguards in the design and operation of their systems will mean billions of pound expenditure to repair damage caused when the next 1859-size storm hits the Earth.

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NEUTRON STARS - DIFFICULT TO IMAGINE

Most of us have at least a qualitative "feel" for most of the astronomical objects that we read about in the popular press and scientific journals. We might find it difficult to visualise *exactly* how big a million kilometres is, but we are not too surprised that that's about the size of an average star such as our Sun. And we are not too dismayed by the idea that some stars are much bigger, and some are a bit smaller. And the same goes for other stellar quantities - for example, we know from everyday experience that white-hot is hotter than red-hot, and so it is with stars - we understand those white pinpoints in the telescope are hotter stars than the yellow points of light.

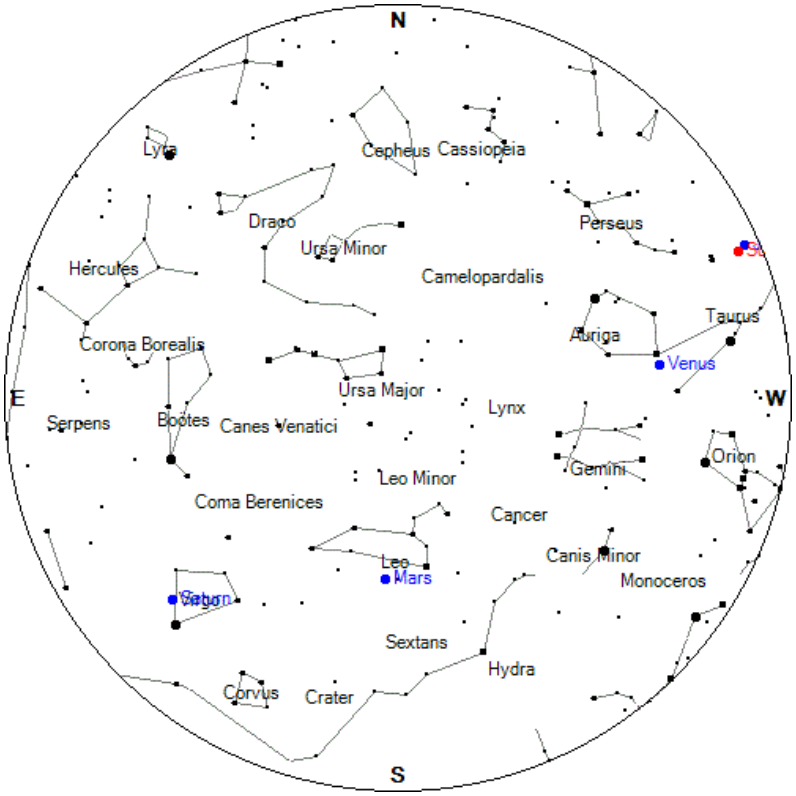
But there are some naturally occurring things in the Universe that defy imagination - how about something that performs or has qualities that are so unimaginably out of this world that they couldn't possibly be right - except that they are! Imagine, for example, a star only a few times more massive than our Sun. Imagine, towards the end of its life, it has swollen to many times its original size and consumed nearly all its hydrogen fuel. Internally, it will be layered, with increasingly lighter elements overlaying an iron core. Slowly spinning, with its nuclear fuel exhausted, the star suddenly and catastrophically collapses, throwing off its outer layers and leaving only a rapidly spinning dense remnant.

So far so good, but now its becomes difficult to get a feel for what this remnant is, and how it behaves. Probably only several tens of kilometres in diameter (that's only 1/100,00th the diameter of the original star) it will have a density of about 400-billion tons/cubic metre (that's about 100 billion times denser than granite). And it could be spinning at up to several hundreds times per second (that a few million times faster than the original star).

All rather fanciful you might think, but these are only some of the extraordinary properties of Neutron Stars - the remnants of long dead stars that only signal their presence by the radiation emitted from their spin axis. Radiation that, if directed towards Earth, results in a regular short-duration signal such as that first detected by (then) Jocelyn Bell in 1967. Now termed Pulsars, more than 1000 (such as this one in this optical/X-ray image of the Crab nebula) have now been detected, scattered throughout the sky.

MAY SKY DIARY

Chart for Chichester, mid-month at 21:00.
(Contributed by Peter Littlejohns)



Mercury at superior conjunction on the 27th of the month so will not be visible
Venus: at magnitude-4.4, sets at the start of month 4.5hrs.after the sun and fades to mag.-3.9 as it disappears into the twilight at the end of the month.
Earth/Moon: distance to our satellite Moon shrinks to its closest on the 6th, to 356,953km and to its furthest on the 19th, at 406,450km, both at 03:00hrs.
Mars: pulls away from the Earth and dims from mag.0.0 to +0.5, setting around 02:00 by the months' end.
Jupiter: in conjunction with the Sun so is not visible at present.
Saturn: at mag.+0.6 is in Virgo close to the blue/white star Spica and is passed by the Moon by 7° to the south on the 4th.
Uranus: too close to the Sun for observation.
Neptune: is difficult at mag.+7.9 in Aquarius, rising in the early hours of the morning.
Meteors: Eta Aquarids peak on the 4th/5th with a rate of about 35/hour and are associated with comet Halley but the Moon makes them unfavourable this time round. Maximum of the Alpha Scorpids is on the 13th but with a rate of only about 5/hour.
Other events: Keep a watch for the ghostly Noctilucent (*night shining* in Latin) clouds which form at high altitude (80km+) and glow by being lit from below by sunlight. Visible in a deep twilight, they are made of crystals of water ice and are most commonly observed in the summer months at latitudes between 50° and 70°.

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Last Month's (April) Meeting

The meeting started with John's what's up, followed by, probably, our last observing outside until next autumn. The evenings are getting much lighter now and it was only just dark enough, but fair views of Jupiter, Mars and the Moon where seen.

Tuning into the Universe, the main talk by Dr David Bacon, was on LOFAR, (the low frequency array), groups of antennas consisting of vertical poles with guide wires, located at sites all across Europe.

The UK's site is next to the famous Chilbolton weather radar dish on the A303, and consists of two types of antenna: a low frequency array at 30-70MHz and a medium frequency array (like small dishes) at 120-200 MHz. These frequencies were chosen because hydrogen emits radio waves due to spin changes in electrons in these bands. The radio bands used are protected for astronomy related activity, meaning they are reasonably quiet. By combining the radio signals from all the sites across Europe, astronomers are able to achieve very good resolution of signal, meaning they can pick up radio signals from gas jets emanating from galaxies containing a black hole. Interestingly, the antennas are randomly placed in a large field, ensuring that the resulting radio 'image' does not contain any uniform pixels that could introduce flare artefacts into the resulting image.

Using LOFAR the team will be able to detect the hydrogen emissions which occurred even before the cosmic microwave background, and thus hope to be able to image even closer to the big bang than has previously been achieved. This way they are able to test their computer simulations of the Universe to see which set of parameters produces the structure we see today.

Thank you David for an interesting presentation.

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Planetarium Shows in May

Fri. 4th 7:30 p.m. Hubble's Glorious Universe
Mon. 7th 1:30 p.m. All Aboard - A Tour of the Planets
Mon. 7th 3:30 p.m. All Aboard - A Tour of the Planets
Fri 11th 7:30 p.m. Saturn: Lord of the Rings
Sun. 13th 3:30 p.m. Springtime Stars and Galaxies

Do remember - a discounted ticket price of only £5 is available for SDAS members attending these shows.
Booking by telephone: 01243 774 400 or 07818 297 292