South Downs Mercury

The monthly circular of South Downs Astronomical Society
Issue: 477 - September 2014 Editor: Roger Burgess

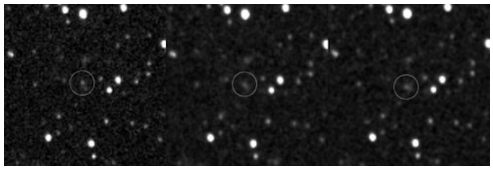
- Next meeting Friday 5th September Lecture room of the South Downs Planetarium, Chichester, at 7.30pm. Please support a raffle we are organizing this month to raise money to buy a Solar Telescope

- "**What's up" - Guide to the month ahead by SDAS member John Whittington**

- **Main Talk – Bob Turner Why the Solar System looks the way it does**

- **It is regret I have to report the passing of Dr Ted Howells A long standing member of SDAS, who will be sadly missed**

- **Amateur gets fifth confirmed discovery**
- It's too early to be certain, but with confirmation of a new, possibly near-Earth comet slated for a pass in early January 2015, sky-watchers will be working hard to calculate just how close it's going to come. The new object, C/2014 Q2 (Lovejoy), is the fifth discovered by Australian amateur Terry Lovejoy. As *Universe Today* describes, Lovejoy made the find on August 17 "using a Celestron C8 fitted with a CCD camera at his roll-off roof observatory in Brisbane, Australia." The IAU's Minor Planet Centre documents the comet observations here. Lovejoy's technique is straightforward: he takes three images per star field, then lets software identify moving objects (presumably also checking them off against known comets). When there's a "hit", he checks the suspects by eye. The "faint, fuzzy" magnitude +15 object now bearing his name is currently in the southern sky in the constellation Puppis and will be visible in the northern sky as it gets closer to Earth.



Terry Lovejoy's discovery. Image: Terry Lovejoy, from Universe Today
In spite of some early excitement that it was going to pass very close, the Minor Planet Centre currently gives perihelion at around 1.8 Astronomical Units, from 23 observations. NASA JPL's Small-Body Database Browser shows the orbit here.

Euro craft Rosetta to poke its probe in 10-BILLION-tonne comet

- The European Space Agency's Rosetta probe has made the first measurement of the mass of the comet it's chasing – and has come up with a mass of 10 billion tonnes, plus or minus 10 per cent.

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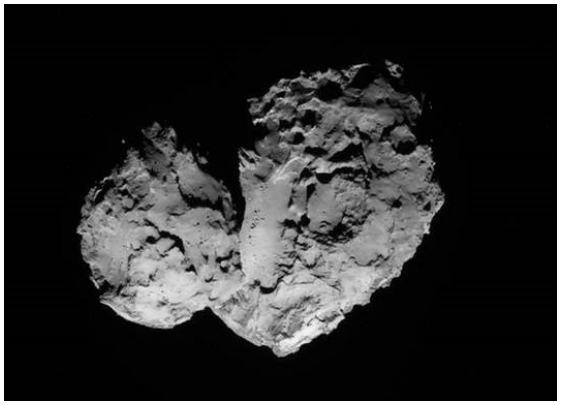
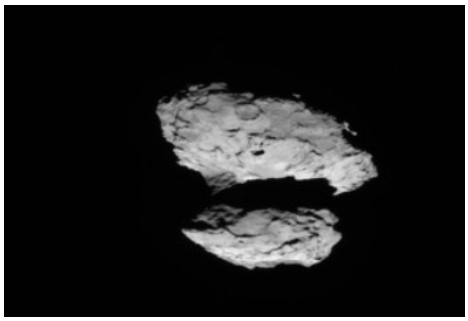


Does my mass look big in this? Rosetta has spent the past ten years, and six billion kilometres, getting up to speed with comet 67P/Churyumov-Gerasimenko as it falls sunwards. The spacecraft is now just 50km from its prey and made its measurement using the gravitation pull of the hurtling rock. The team are scrutinizing the readings, and could refine the mass value as the probe gets closer to its target in the coming weeks, ESA said in a blog post. "In order to be able to navigate the spacecraft close to the comet, ESA's flight dynamics and operations teams have also independently determined the mass and gravity parameters. These values fall within the same range as those derived by the radio science investigation team," the agency explained. Comet 67/P is a big old thing at 3.5 by 4 kilometres wide. The mass measurement from ESA shows that the comet isn't that dense, indicating that it may have significant amounts of water and hollows inside. We won't know for sure however until October. If all goes to plan, the Rosetta probe will make history when its Philae lander harpoons comet 67/P and anchors itself to the surface. Once there, it will use ground-penetrating radar, drilling equipment, and an on-board science laboratory to tell us more about this wandering snowball. Getting these early measurements in quickly is also important because the comet has started to slim down: as it approaches the Sun, the comet is shedding liquid as vapour, and will lose a lot more as it heats up. The ESA has created a handy solar system map so the public can follow the comet's course, and there's a chance that if the comet heats up enough it will be visible with basic astronomy equipment.

- **TRIANGULAR orbits will help Rosetta to get up close with Comet 67P**

The European Space Agency (ESA) has revealed just how its Rosetta comet probe will close to within just 10km of comet 67P/Churyumov-Gerasimenko. Rosetta arrived at the comet on August 6th and has since sent back lovely photos of the rock.

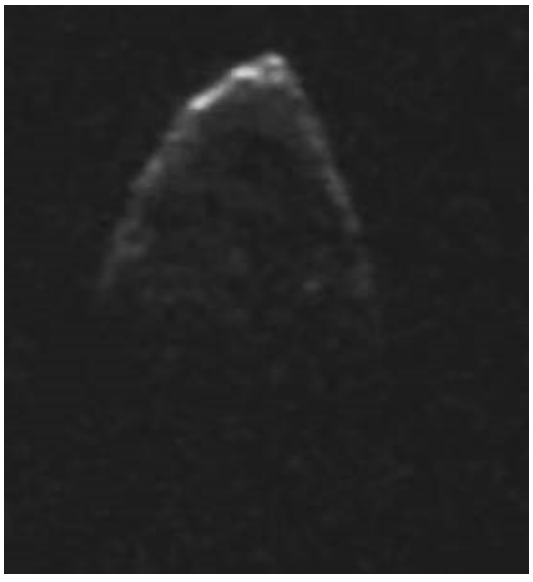


The mission plan calls for even better photos to become possible by bringing Rosetta closer to the comet. Manoeuvres to do so have already commenced, with "burns" to adjust the probe's orbit having taken place on August 10th, 13th and 17th. Further burns scheduled for August 20th, 24th and 27th comprise part of the mission called "Close Approach Trajectory" (CAT) that are designed to change Rosetta's direction while also nestling in closer to 67P. As the video below shows, the combined effect of the CAT burns and the "Transfer to Global Mapping" (TGM) manoeuvres in the mission's next phase will see Rosetta just 10km from 67P by October. Between September 10th and October 7th, the craft will circle the comet at between 29km and 19km. It is hoped to keep Rosetta in view of the sun, so it can continue to gather solar energy and also take better shots of the comet in Sol's light. Further orbital adjustments will mean 67P had better get ready for its close up, because by October 10th Rosetta will close to just 10km. Observations recorded during this phase of the mission will play a part in selecting

a landing site for Philae, the lander Rosetta has borne to 67P. ESA scientists are meeting this week to draw up a shortlist of five candidate touchdown zones. Philae is due to touch down on November 11th. A radio signal currently takes 22 minutes and 49 seconds to reach Rosetta, so when Philae touches down we'll all have to endure many nail-biting minutes before it is known if the craft made it down intact.

- **Spin doctors crack 'impossible' asteroid hurtling towards Earth**

Scientists studying a mysterious asteroid that could hit Earth in the 29th century think they've found the reason why the fast-spinning object hasn't blown itself apart. The asteroid, 1950 DA, is over a kilometre (0.62 miles) across and rotates completely every 2.1 hours, a speed once thought impossible since the forces involved should pull it apart. Radar imaging has shown that the asteroid is a clump of rubble that should have disintegrated – but a team from the University of Tennessee thinks it may have cracked the conundrum. "We found that 1950 DA is rotating faster than the breakup limit for its density," said postdoctoral researcher Ben Rozitis. "So if just gravity were holding this rubble pile together, as is generally assumed, it would fly apart. Therefore, interparticle cohesive forces must be holding it together." In a paper in *Nature* the team posits that van der Waals forces are keeping the rubble clump together. These forces, named after the Dutch physicist who noticed them, involve all attractive and repulsive forces between molecules or parts of them that *cannot* be chalked up to covalent bonds or electrostatics. These include close-range quantum effects and dipole-dipole interaction, and are used by gecko lizards to climb sheer surfaces.



It is thought that the same forces are holding 1950 DA together, but what is good news for the asteroid could be bad news for Earth. There is a small chance the asteroid could hit our planet in 2880, based on its orbital path, and the van der Waals forces could make dodging that a lot trickier. One of the methods of dealing with Earth-threatening asteroids initially favoured by NASA and much beloved of Hollywood is to blow them up. But this approach is highly problematic – we don't have the explosives necessary to destroy really massive hunks of space rock. But the makeup of 1950 DA raises another problem with this approach. If a kinetic impactor is sent out to hit the asteroid, the weak van der Waals forces would fail and the asteroid would break up, causing lots of smaller impacts on Earth that could be almost as deadly as one big one. "With such tenuous cohesive forces holding one of these asteroids together, a very small impulse may result in a complete disruption," said Rozitis.

- **RIDDLE of odd BULGE FOUND on MOON is SOLVED**

An analysis of the shape of the Moon has shown it is not actually a sphere – but is in fact slightly lemon-shaped. This has revealed important clues as to how the Earth's satellite body formed (and no, it still doesn't involve any cheese). A paper published in the July 30 issue of *Nature* by Ian Garrick-Bethell – an assistant professor of Earth and planetary sciences at University of California Santa Cruz – examines the shape of the Moon as it would be had not millions of meteorite collisions knocked chunks off it, and ponders how it got that way. "If you imagine spinning a water balloon, it will start to flatten at the poles and bulge at the equator," Garrick-Bethell said. "On top of that you have tides due to the gravitational pull of the Earth, and that creates sort of a lemon shape with the long axis of the lemon pointing at the Earth." The Moon formed about four billion years ago and was initially much closer to Earth, and spinning rather more than it does today. As the Moon cooled and hardened, the effects of tidal forces exerted by Earth froze the surface into a slightly elongated shape with a bulge pointing towards Earth and a corresponding bump on the other side. At the same time the gravitational influence of the Earth kneaded the Moon's core and caused variable thickness of its crust. The Moon has a thinner crust at the poles and is slightly fatter at its equator. "The moon that faced us a long time ago has shifted, so we're no longer looking at the

primordial face of the moon," Garrick-Bethell said. "Changes in the mass distribution shifted the orientation of the moon. The craters removed some mass, and there were also internal changes, probably related to when the moon became volcanically active."

❖ Auckland University of Technology (AUT) is celebrating “first light” from its new radio telescope – a 30m, 30-year-old former satellite Earth station that was once New Zealand's primary link to the outside world. The AUT telescope is now getting ready for a mission studying star formation, the centre of the Milky Way, galactic gases, and tectonic plate motion on Earth. As a communications system the Warkworth 2 dish's mission, when it was built in 1984, was to carry analogue telephony and TV signals. After decommissioning by Telecom New Zealand in 2010, the AUT began the long process of turning the system into a radio-telescope. That process involved considerable engineering effort. As a geosynchronous satellite antenna, Warkworth 2 wasn't manoeuvrable enough for astronomy, so its azimuth limits had to be changed from ±170° to ±270°, which in turn meant changes to the motors and cables that move the 270-ton (imperial) instrument. It also needed a new control system, and because of its seaside location, rusty components had to be changed.

The Auckland University of Technology's converted 30m satcom dish the differences between the control system of a satellite communications antenna and a radio-telescope are also significant. Instead of tracking the small movements of a satellite, the dish has to track objects across the sky, and has to be able to shift from one object to another quickly. That's the task of an Integrated Antenna Controller (IAC), built from standard commercial components, cycling through its position control algorithms every four milliseconds. The dish's surface also had to be laser scanned to compensate for what the university calls “a noticeable gravitational deformation of the antenna along the vertical direction” when the antenna was at an elevation of 6°. Further surveys of the surface are being undertaken to measure deformation in other configurations. The dish's original satellite transceiver has been replaced by a C-band receiver from Jodrell Bank, and it's now fitted with a digital baseband converter covering five frequency bands up to 2100 MHz The group's Arxiv paper notes that with the right receivers fitted the instrument would be able to carry out science at frequencies up to 22 GHz “and possibly higher”. The telescope is also networked to a nearby 12m receiver to increase its resolution.