South Downs Mercury

The monthly circular of South Downs Astronomical Society
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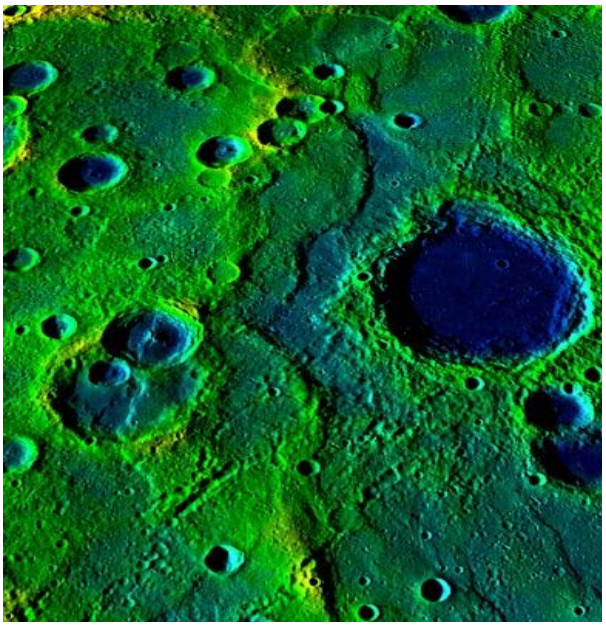
Next meeting Friday 4th April Lecture room of the South Downs Planetarium, Chichester, at 7.30pm.

- "**What's up**" - Guide to the month ahead by SDAS member John Whittington
- **Main Talk - Bob Mizon Wierd Astronomy**
- **Mercury**

The planet Mercury has shrunk by up to 7km in radius over the past four billion years – much more than astronomers had previously thought.



Ridges and scarps on Mercury, stretching over 540km. The colours correspond to elevation - yellow-green is high and blue is low. *Credit: NASA/Johns Hopkins University AP Lab/Carnegie*

For some reason, older images of the wrinkly surface of the planet showed that despite the fact that its interior was cooling, the rocky world had hardly shrunk at all. But the scientific models of how the planet was evolving couldn't explain why Mercury would not be getting smaller.

Researchers have used evidence gathered by NASA's Messenger spacecraft at the planet to build up a comprehensive map of its tectonic features that's detailed enough to show that the celestial body withered considerably as its interior rocks and metals cooled.

"With messenger, we have now obtained images of the entire planet at high resolution and, crucially, at different angles to the sun that show features Mariner 10 could not in the 1970s," said Steven Hauck, a professor of planetary sciences at Case Western Reserve University and the paper's co-author.

Mariner 10 took images and data of Mercury in three flybys in 1974 and 1975, getting details for just 45 per cent of the surface. But Messenger, first launched in 2004 and, while getting data from the planet since 2011, has completed 2,900 orbits of Mercury.

The Earth is the only planet so far known to have a whole bunch of tectonic plates bumping up against each other. Most worlds are like Mercury, whose surface has one tectonic plate known as the lithosphere. To figure out how the world could have shrunk, the Astronomers looked at features on this plate called lobate scarps and wrinkle ridges, which look like long ribbons and indicate interior cooling and surface compression.

The scarps are cliffs caused by faults that have broken through the surface and can be nearly two miles high. Wrinkle ridges are faults that aren't as deep, so tend to be

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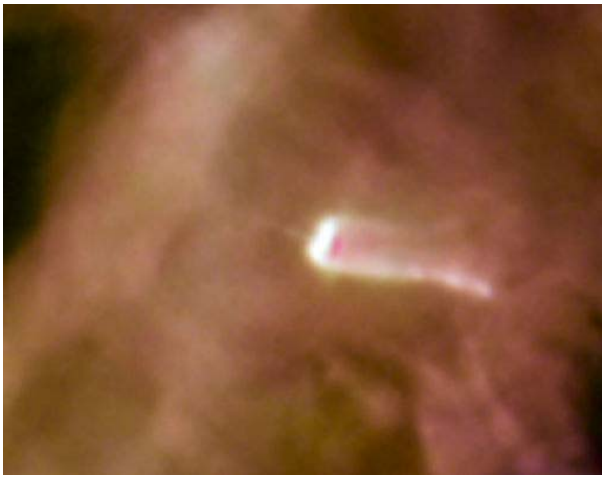
lower. Either can range from five to more than 550 miles long.
Messenger has helped scientists to map a total of 5,934 of these features, allowing them to estimate the shortening across broad sections and thereby guess at the decrease in the planet's radius, which they estimate at between 4.6 and 7km.
"These new results resolve a decades-old paradox between thermal history models and estimates of Mercury's contraction," said Paul Byrne, lead author and Messenger visiting investigator at Carnegie's Department of Terrestrial Magnetism. "Now the history of heat production and loss and global contraction are consistent.
"Interestingly, our findings are also reminiscent of now-obsolete models for how large-scale geological deformation occurred on Earth when the scientific community thought that the Earth only had one tectonic plate. Those models were developed to explain mountain building and tectonic activity in the nineteenth century, before plate tectonics theory.

- **Planet Killers**

A group of astronomers using Chile's high-desert Atacama Large Millimetre / sub millimetre Array (ALMA) have peered into the Orion Nebula's planetary nursery and discovered that massively powerful stars can be so intense that they blow away any chance of planets forming around new stars being born in their neighbourhoods.
"Using ALMA," research lead Rita Mann told Astronomy Magazine, "we looked at dozens of embryonic stars with planet-forming potential and, for the first time, found clear indications where protoplanetary disks simply vanished under the intense glow of a neighbouring massive star."
Mann and her team of Canadian and US scientists published their findings in a paper in the Astrophysical Journal titled "ALMA Observations of the Orion Proplyds" — proplyds being protoplanetary disks, rotating masses of dust and gas surrounding nascent stars that could accrete into planets.
No planet-forming accretion will occur in some of the proplyds Mann and her team studied, however — their dust and gas is being heated, broken up, and swept away by the highly energetic photon attack of nearby hot blue-white O-type stars.

"O-type stars, which are really monsters compared to our Sun, emit tremendous amounts of ultraviolet radiation and this can play havoc during the development of young planetary systems," Mann said.
One of the proplyds studied by the research team is the well-known and mind-bendingly large 114-426, which is about 1,000 astronomical units in diameter – if you missed that day in Cosmology 101, 1AU is the distance between the Sun and the Earth. The orbit of excommunicated ex-planet Pluto, by comparison, averages around 39.5AU from the Sun.
Unfortunately, proplyd 114-426 was not one of the 30 embryonic planetary systems in the Orion Nebula that were stunningly imaged by the Hubble Space Telescope (HST) in 2009, but the HST did catch a snap of it a decade earlier. HST's glamour shot of proplyds in the Orion Nebula, with a few called out for close-ups. In the HST image, you'll notice that a few of the proplyds aren't simple disks, but instead have irregular shapes with dust and gasses streaming away from their centres.
That's the work of O-type stars a tenth of a light year away or closer (600 billion miles, give or take), whose energies are forcing matter away from the star-forming centre of the proplyds. Poor proplyd 109-327's disk is being blown away by the Orion Nebula's big blue Theta 1 Orionis C.

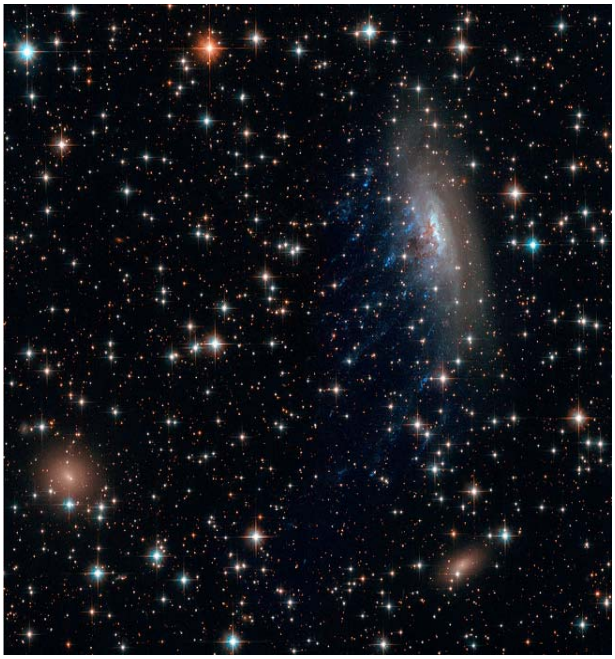


That matter won't have time to congeal into planets, and will instead join the morass of gas and dust that forms the Orion Nebula itself, perhaps to accrete into another proplyd and try again. Ironically, massive stars such as the O-types ruining the planetary ambitions of nearby proplyds are also one of the sources for their dust and gas in the first place. These big boys lead short but highly energetic lives, and don't merely burn out quietly, but often explode as supernovae.

When that happens, they litter their neighbourhoods with dust and heavy elements, which in turn eventually combine into new stars.

- **High speed galaxy hurls star-making fuel during violent passage**

Spiral galaxy ESO 137-001 is ramming through the Norma galaxy cluster so hard it's spilling its guts out, leaving bright blue streaks of its own gases behind. The spiral is zooming in between other galaxies in the Norma cluster, over 200 million light years away, at a speed of nearly 4.5 million miles an hour. The galaxy is ploughing through so rapidly that much of its own gas is being caught and torn away in a process called "ram pressure stripping". Only the binding force of the galaxy's stars' gravity keeps them intact. The brown smoky region at the centre of the spiral is also being pushed by the ram pressure, but it leaves dust particles, rather than gas, behind it.

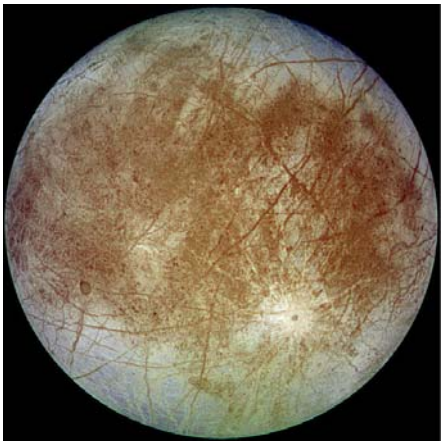


The violent passage is illustrated by the tattered threads of gas captured by the Hubble Space Telescope as blue jellyfish-like tendrils trailing behind the galaxy. The pressure has pulled the gas out of the spiral galaxy and out across intergalactic space, where it has erupted with young, massive stars which pump out light in vivid blues and ultraviolet.
The effect of ESO 137-001's journey is to leave the seeds of star-making in its wake, but the galaxy is losing so much of its stellar fuel in this way, it's likely to have trouble making its own stars in the future.

- **Mission to Europa**

NASA is plotting a mission to send its robotic lander to Europa, one of Jupiter's moons and the place deemed most likely to host life.
The American space agency has reserved $15m of its $17.5bn annual budget to pay for a robotic journey to the icy moon.
"Europa is a very challenging mission operating in a really high radiation environment, and there's lots to do to prepare for it," NASA’s chief financial officer Beth Robinson said. "We're looking for a launch sometime in the mid-2020s.”
The moon was recently spotted spurting giant columns of water out into space, which strongly suggests that a big wet ocean lurks beneath its icy crust.

NASA has been working on an unmanned craft called The Europa Clipper which can speed through these plumes and gather samples, a process that is far easier than attempting to drill through the ice crust.



It is thought that Jupiter's gravity tugs and pulls the water beneath Europa's ice, generating heat through friction and keeping it from freezing entirely.

- **Hyper giant star is 1,300 times the size of our Sun**

Sixty years of professional and amature observations have turned up a new surprise in the constellation of Centaur: a huge, heavy and bright monster that's the largest yellow star ever seen. The hyper giant, HR 5171 A, has impressive vital statistics: the European Southern Observatory's Very Large Telescope Interferometer team estimates that it's equivalent to 39 solar masses, has a diameter 1,300 that of the Sun, and is about a million times brighter. To get that diameter in perspective: drag-and-drop HR 5171 A in place of our sun, and its good-bye to Mercury, Venus, Earth, Mars, the asteroid belt, Jupiter and Saturn. The “A” in HR 5171 A indicates that it's part of a binary system, but only just: so big is the “A” of the pair, that it's in physical contact with its companion, which has a mere six solar masses and 400 solar radii. The companion is only 2.8 AUs from HR 5171 A, and their combined centre-to-centre distance is 10 AUs. The hyper giant was analysed by linking a bunch of telescopes together, using interferometry to create the equivalent of a 140-metre telescope. As the ESO states: “Spectral data were obtained using the Anglo–Australian Telescope with the University College London Echelle Spectrograph (UCLES), at the South African Astronomical Observatory (SAAO), with PUCHEROS, from the Pontificia Universidad de Chile (PUC) and through corona graphic observations with the Near-Infrared Corona graphic Imager (NICI) on the Gemini South telescope.”

“The new observations also showed that this star has a very close binary partner, which was a real surprise,” says Olivier Chesneau, who led the analysis. “The two stars are so close that they touch and the whole system resembles a gigantic peanut.”

Artist's impression of the HR 5171 binary. Image: ESO

These observations were compared with photometric data from South Africa's Astronomical Observatory (dating from 1975 to 2013), and other datasets including amateur observations. The ESO also notes that “HR 5171 A has been found to be getting bigger over the last 40 years, cooling as it grows, and its evolution has now been caught in action. Only a few stars are caught in this very brief phase, where they undergo a dramatic change in temperature as they rapidly evolve.”