South Downs Mercury

The monthly circular of South Downs Astronomical Society
Issue: 479 - November 2014 Editor: Roger Burgess

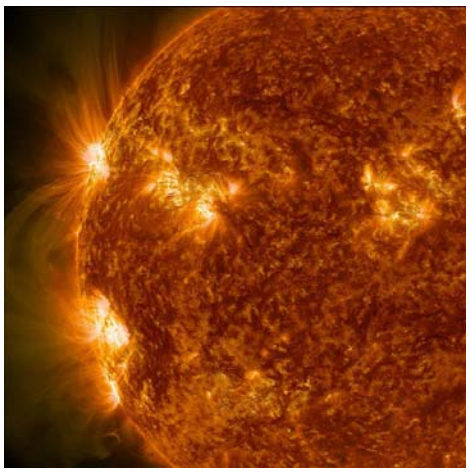
- Next meeting Friday 7th November Lecture room of the South Downs Planetarium, Chichester, at 7.30pm. Please support a raffle we are organizing this month to raise money to buy a Solar Telescope

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

- **Mars Rovers Tony Errington**

Trips to Mars may be off: The Sun has changed in a way we've never seen before

A drop in the solar wind of a kind never yet seen in the space age has made travel beyond Earth orbit a lot more dangerous, according to scientists – so much so that a manned mission to Mars may not be feasible for many decades. "The behaviour of the sun has recently changed and is now in a state not observed for almost 100 years," says Professor Nathan Schwadron. "Starting in about 2006, we observed the longest solar minimum and weakest solar activity observed in the space age."



There may not be much of this going

Some solar physicists, noting that the current "solar maximum" is an especially damp squib, suspect that the Sun may be entering a so-called "Maunder Minimum", a lengthy spell of low to no activity. Such a minimum occurred from 1645-1715. The down side of this from a deep-space astronaut's point of view is that the solar wind normally has the effect of reducing the amount of dangerous cosmic radiation that can reach the inner solar system. While particles and radiation from the Sun are dangerous to astronauts, cosmic rays are even worse, so the effect of a solar calm is to make space even more radioactive than it already is. Deep-space astronauts, of course, are even rarer than normal astronauts. A normal astronaut travels only to low Earth orbit - as on a mission to the International Space Station, for instance - where he or she remains well protected by the Earth magnetic fields. The only astronauts who have ever been further from Earth than this were the Apollo moon explorers of the 1960s and 70s, and they went only on brief missions, carefully timed to reduce radiation risks. Schwadron and his colleagues have been assessing data from an instrument called the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) aboard NASA's Lunar Reconnaissance Orbiter currently circling the moon. The LRO was originally intended to scout ahead of a new US manned moon programme, and as such one of its purposes was to assess the effects of radiation on astronauts. Lacking a President Kennedy to get them funded, the planned manned moon missions were cancelled - and judging by what Schwadron and his crew have found in the CRaTER data that might be just as well. They write:
Galactic cosmic radiation presents a more significant challenge: the time to 3 per cent

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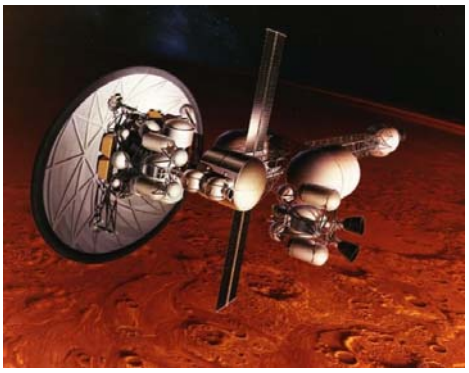
Risk of Exposure Induced Death (REID) in interplanetary space was less than 400 days for a 30 year old male and less than 300 days for a 30 year old female in the last cycle 23–24 minimum. The time to 3 per cent REID is estimated to be ~20 per cent lower in the coming cycle 24–25 minimum. If the heliospheric magnetic field continues to weaken over time, as is likely, then allowable mission durations will decrease correspondingly. For the sake of planning, a 3 per cent risk of an astronaut dying due to radiation exposure during a mission is seen as the acceptable limit: it's a dangerous job, after all (one should note that the death would probably be after the mission from cancer, perhaps many years later, rather than from severe radiation sickness while still in space). From Schwadron and his crew's analysis, if a lengthy solar quiet spell is indeed on the cards, the maximum time an astronaut can reasonably spend in space will be well under a year. That's potentially bad news for a Mars trip, as under current planning assumptions both outward and return flights would take six months - and further exposure would be suffered during time spent on Mars, though less than the same period spent in space. "While these conditions are not necessarily a showstopper for long-duration missions to the moon, an asteroid, or even Mars, galactic cosmic ray radiation in particular remains a significant and worsening factor that limits mission durations," says Schwadron, gloomily. It would seem that travel by living humans to and from the red planet may never be very practical using the current methods: feeble chemical rockets can propel only very lightweight spacecraft that offer little or no protection against radiation, and mean that they must coast unpowered most of the way, taking a long time. If human beings ever aspire to travel much beyond Earth orbit, we're going to need something better: something most likely nuclear powered, certainly for manned spaceflight purposes. That would cut journey times and allow for more shielding. The great science-fiction writers of the past almost unanimously assumed that nuclear space propulsion and/or power generation would have to appear for any serious space travel to take place

Former NASA astronaut Dr Franklin Chang Díaz has suggested that nuclear plants of the type used in submarines could power his

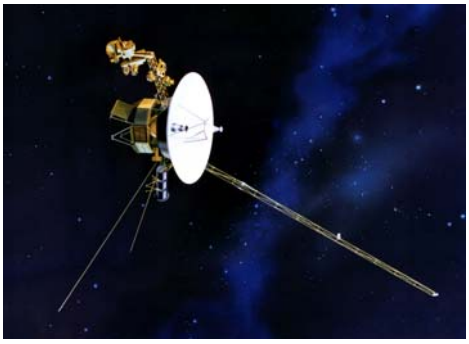


VaSIMR plasma rockets to take a crewed ship to Mars in a month. SpaceX, the rocket firm run by famous tech tycoon Elon Musk - well-known to be keen to get people to Mars - has expressed the opinion that NASA should work on nuclear-thermal rockets for manned flight to the red world. Many decades into the "space age" there's no sign that NASA is seriously moving to produce anything like that, however, and the general fear, distrust and intensive regulation surrounding anything nuclear means that only a powerful national space agency has much prospect of success.

- **Voyager 1 now 18 Light Hours from home**

Something just a little bit remarkable happened last week. Launched on September 5th, 1977, Voyager 1 visited Jupiter in 1979 and Saturn 1980, sending back marvellous photos and data from both. The craft is not fitted with brakes and has been sailing out of the solar system since, most recently encountering a “roar” caused by a coronal mass ejection. The circumstances in which the sound was detected led Astronomers to believe the probe has definitively left the solar system. As of last Tuesday, the craft's journey ticked over another small milestone: it's now 18 light hours from the Sun. NASA measures both Voyagers distance from the Sun, rather than Earth, because our home planet's orbit means we're sometimes closer to the probes. Measuring distance from the Sun therefore gives a more

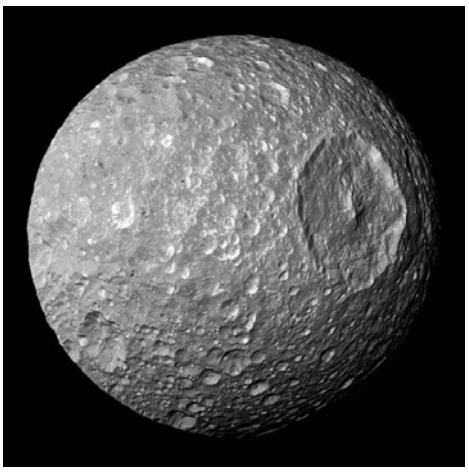
objective way of tracking the spacecraft's' progress.



The Voyager Mission Operations and Status Report page lags the probes' journey by about a month, but the most recent report from the week ending September 19th found "performance was nominal" for instruments and flight systems aboard Voyager 1. The probe looks to be putting about three light minutes between itself and Sol each week, as it hurtles towards who knows and perhaps – just perhaps – someone or something capable reading its famous cargo of a golden record that attempts to explain its origins.

- **Death Star Moon 'could be full of life-friendly water**

Mimas has long been thought to be one of the less noteworthy moons of its vast ringed primary, Saturn – apart from its frankly worrying resemblance to the Death Star, that is. But now, a new study indicates that the humdrum space boulder could have, hidden depths.

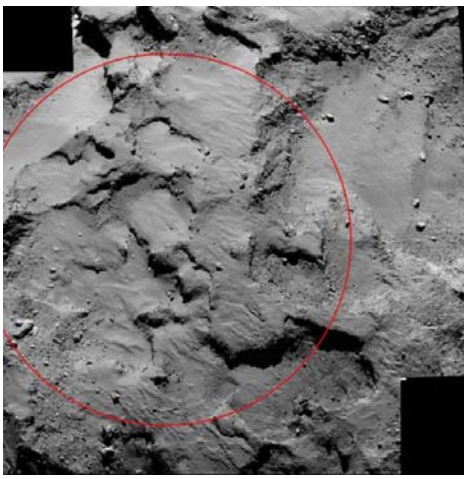


Actually, that *is* a moon. Not a space

A team of Astronomers have been studying the moon using the Cassini-Huygens spacecraft, which has been orbiting Saturn for the last ten years, and discovered Mimas' orbit wobbles much more than theoretical models allow. "After carefully examining Mimas, we found it librates – that is, it subtly wobbles – around the moon's polar axis," said Radwan Tajeddine, Cornell research associate in astronomy and lead author of the paper published in *Science*. "We're very excited about this measurement because it may indicate much about the satellite's insides. Nature is essentially allowing us to do the same thing that a child does when she shakes a wrapped gift in hopes of figuring out what's hidden inside." The team used data from Cassini to build a 3D model of the moon's orbit and found it wobbles twice as much as it ought. Such wobbles can be caused by the gravity of passing of planetary masses, but Mimas' motion points to two other possibilities. Firstly, it's possible that the rocky surface of the moon is hiding an ocean deep within the planet. At just 400 kilometres in diameter Mimas won't have enough mass to have a hot core but tidal kneading caused by the close proximity of Saturn could provide enough heat for some of the moon's innards to be liquids. Based on the 3D modelling the ocean would have to be around 24 to 31 kilometres beneath the surface of the moon's crust to account for the wobble. The second possibility is that Mimas' birth left it somewhat abnormal. Mimas is the smallest body in the solar system to be rounded due to self-gravitation – having enough mass to form into a ball without being torn apart. The team postulates that the core of Mimas has been stretched out as it formed around Saturn and is slightly elongated. This would make the moon's orbit more unstable. Ultimately we're not going to know until mankind and/or our machinery get to the surface and find out but the team will be making more Mimonian measurements to refine their theory for as long as Cassini still functions.

- **On Nov 12, a human-made space lab will try to HARPOON a COMET and land on it**

The European Space Agency (ESA) has officially set the date for its Rosetta probe's Philae lander to touch down on comet 67P/Churyumov–Gerasimenko. The craft will harpoon and set down on the high-speed cosmic rock on November 12



ESA hoping for a safe touchdown

The Rosetta space probe is orbiting the comet at a distance of 10 kilometres. On October 31 the ESA team will push the probe into a wider orbit and at 0835 UTC on November 12, the Philae lander will detach from Rosetta and start moving towards its target. It should land about seven hours later. "Now that we know where we are definitely aiming for, we are an important step closer to carrying out this exciting – but high-risk – operation," says Fred Jansen, ESA's Rosetta mission manager. "However, there are still a number of key milestones to complete before we can give the final Go for landing." The space agency has already picked the landing site: Philae will approach at about one metre per second. Two harpoons on the lander will fire into the surface and anchor it in position. Philae is then on a tight timeline. The machine has enough battery power to carry out 64 hours of science experiments, but it does come equipped with solar panels that should extend its lifespan. That will depend on how much dust accumulates on the solar cells. The lander has 10 tools to investigate the comet, which right now is 481 million km from Earth. These include a drill capable of bringing up samples from 23 centimetres down and conveying them to an oven for chemical analysis, a combined gas chromatograph and time-of-flight mass spectrometer, and a sonar system to give a view of the internal structure of the rock.

No matter how clean Philae's solar cells are, the lander is ultimately doomed. By March 2015, the comet will come very close to the Sun and the lander will almost certainly perish from the heat. By August the comet will make its closest approach to the star, and cook Philae – if it isn't damaged by outgassing as the rock heats up and starts to seriously melt. Rosetta will remain in orbit chronicling the changes, however, and act as a relay station for Philae's data while it can.

- **Human spacecraft dodge comet chunks pelting off Mars**

Comet Siding Spring has made a close pass by Mars, apparently without incident to the human-built machines in the neighbourhood. NASA says the “Mars Reconnaissance Orbiter … continues operating in good health after sheltering behind Mars during the half hour when high-velocity dust particles from comet C/2013 A1 Siding Spring had the most chance of reaching the paths of Mars orbiters.” The craft remained in radio contact with Earth throughout the event and is beaming back its observations as we speak. The limitation of IDSL – that's interplanetary digital subscriber line for those unfamiliar with the made-up acronym – mean it will be a few days before all the data lands. And of course it will take rather longer before boffins are ready to draw sensible conclusions about it. The Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft also survived its cometary counter. NASA says “it reported back to Earth in good health after about three hours of precautions against a possible collision with high-velocity dust particles”. NASA's third Martian Orbiter, Odyssey, is yet to phone home.

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