New insights into our Solar System's formation, as gleaned from the MESSENGER, Dawn and Cassini-Huygens spacecraft missions
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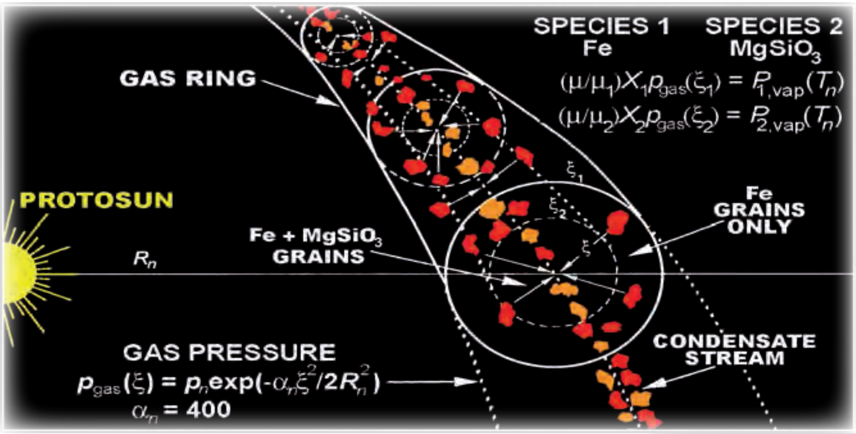
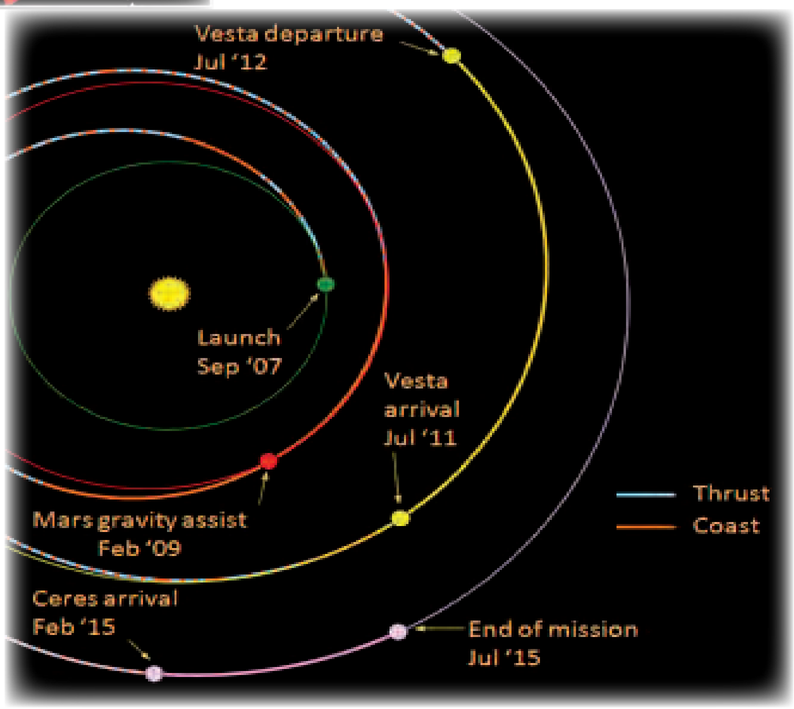
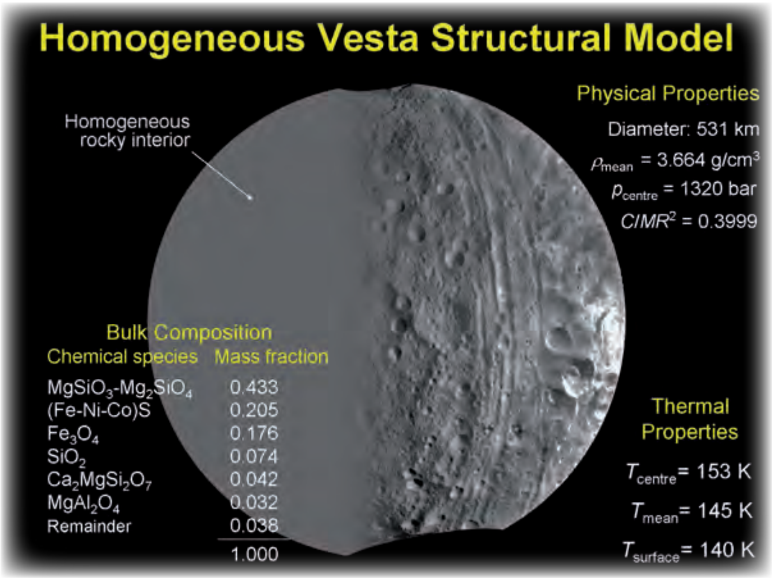
It is always a pleasure to welcome back Dr Andrew Prentice. His inimitable style of presentation is informative and enjoyable at the same time; even on such an esoteric subject as 'Supersonic Turbulence', the MLT (Modern Laplacian Theory) and 'Mantle Moments of Inertia'.
I am in good company in appreciating Andrew's teaching style. Late last year Dr Andrew Prentice was among 14 Monash staff members who received the Monash Vice-Chancellor's Research and Education Awards, recognising teaching excellence, outstanding contributions to student learning and excellence in honours supervision. Here is a picture of Vice-Chancellor and President Professor Ed Byrne congratulating Andrew on behalf of the University. Furthermore, Dr Andrew Prentice has also been awarded a 2011 Citation of 'Outstanding Contributions to Student Learning' by the Australian Learning and Teaching Council (ALTC).

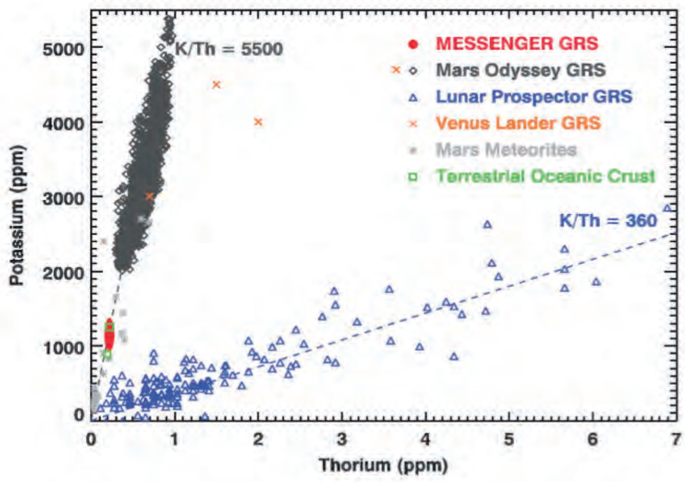


In his previous visit to the ASV in January 2011 (see CRUX Vol. 29 No.2) Andrew was evaluating the results from NASA's Cassini-Huygens mission to Saturn and Titan, demonstrating how many of his predictions on their composition and shape have been confirmed. Recapping some of these Saturnian findings, Andrew focussed on the moon Titan with its unusual atmosphere and gravitational anomalies (Xanadu). Both of these, Andrew predicts, came from two smaller, Rhea sized, native moons that Titan absorbed at the time it entered the Saturnian system.
He then went on to talk about the ongoing "Dawn" spacecraft mission to Mars and the asteroids Vesta, and the dwarf planet Ceres, the two most massive residents of the asteroid belt (see Dawn Interplanetary Trajectory). During its nearly decade long mission Dawn will study these Asteroid Belt object, believed to have accreted early in the history of the solar system. The mission will characterize the early solar system and shed more light on the processes that dominated its formation (a theme dear to Andrew's heart). While both these objects speak of conditions and processes early in the formation of the solar

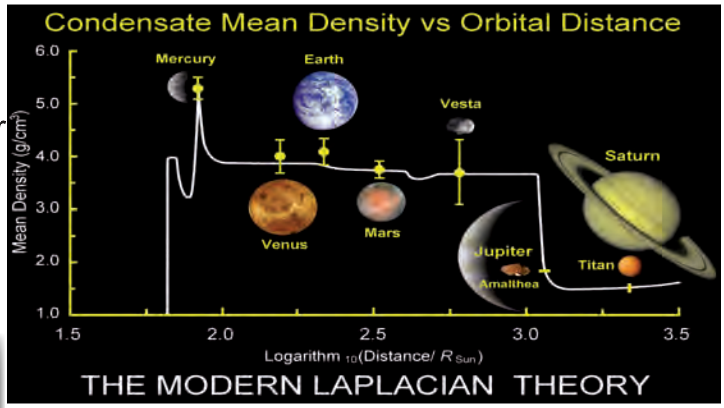


system, they developed into two different kinds of bodies: Vesta is a dry, differentiated object with a surface that shows signs of resurfacing. It resembles the rocky bodies of the inner solar system, including Earth. Ceres, by contrast, has a primitive surface containing water-bearing minerals, and may possess a weak atmosphere. It appears to have many similarities to the large icy moons of the outer solar system. The Dawn mission, by studying both bodies with the same complement of instruments, hopes to compare the different evolutionary path each took as well as create a picture of the early solar system overall. Data returned from the Dawn spacecraft could provide opportunities for significant breakthroughs in our knowledge of how the solar system formed. No doubt confirming many more of Andrew's predictions (see Potassium / Thorium Ratio).





Andrew's Chemical Condensation Sequence graph places Vesta close to the Earth Line. First found on March 29, 1807 by Heinrich Olbers it was the fourth asteroid discovered and is about 578 by 560 by 458 km across, nearly spheroid, with a massive chunk missing out of the south pole. This unique surface feature is thought to have been caused by a massive collision blasting over one million km^3 of rock into space. Scientist believe that five percent of all meteorites we find on Earth are a result of this single ancient crash in deep space. Ceres was discovered on 1 January 1801 by Giuseppe Piazzi (the first asteroid/dwarf planet discovered). It is approximately 975 by 909 km spheroid and rotates once every 9 hours, 4.5 minutes. Suspected to have a differentiated interior - meaning that, like Earth, it has denser material at the core and lighter minerals near the surface, and because its crust density is less than that of the Earth, astronomers believe up to 25 percent water ice may be buried under Ceres' crust.



The Dawn spacecraft combines innovative state-of-the-art technologies with the reliability of triple redundancy. An Ion propulsion system will provide the spacecraft with the power to reach its targets. Dawn carries 425kg of Xenon propellant, sufficient for 2100 days of thrust time. Although the Ion propulsion thrust is less than 0.1 Newton (it would take four days to accelerate to 100km/hr), over the course of the mission the total change in velocity from Ion propulsion will be comparable to the total push provided by the Delta II rocket that carried it into space in the first place.

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