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The Revelations of Planets' Shadows

by Govert Schilling on 5 October 2011, 4:21 PM | 0 Comments

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NANTES, FRANCE—Centuries after astronomy and astrology went their very separate ways, the study of the universe is again dabbling in the occult. This time, though, it's all sound science. Yesterday, at a joint meeting here of the European Planetary Science Congress and the Division for Planetary Sciences of the American Astronomical Society, planetary researchers showed how distant dwarf planets in the outer solar system—some of them named after mythological spirits—reveal hidden properties when they pass in front of even more remote stars, a process known as "occulting." Some of these icy bodies are "truly exotic," says astronomer Thomas Müller of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany.

ENLARGE IMAGE

Occulting dwarf. Artist's impression of the dwarf planet Eris and its satellite Dysnomia.

Credit: Robert Hurt/IPAC

Dwarf planets like Pluto and smaller icy bodies populate the Kuiper Belt beyond the orbit of Neptune. These leftovers from the solar system's formation, known as Kuiper Belt Objects (KBOs), hold clues about its origin. But they're small, dark, and extremely far away, making it difficult to determine even their sizes, let alone their shape, density, and composition. Fortunately, they sometimes happen to slide in front of a distant star as they slowly orbit the sun. Astronomers are able to deduce the objects' sizes by timing these stellar occultations precisely from various spots on Earth. In the past, researchers have used this method several times to measure Pluto and its large moon, Charon, but only recently have they applied the technique to other KBOs.

On 23 April 2011, seven telescopes at five sites in Chile and Brazil spotted the dwarf planet Makemake—named after the creator of humanity in the mythology of the native inhabitants of Easter Island—passing in front of a very faint star known as USNO-B1 1181-0235723, says Spanish astronomer José Luis Ortiz of the Astrophysical Institute of Andalusia. The seven telescopes included the 3.5-meter New Technology Telescope at the European La Silla Observatory in Chile. The observations revealed a slightly elliptical profile for the dwarf planet, measuring 1610 by 1444 kilometers. "This shape fits in with Makemake's short rotation period of just 7.7 hours," Ortiz says, suggesting that the object is strongly flattened by its rapid spin.

Even more exciting are the occultation results of Quaoar, a relatively large Kuiper Belt Object named after the creator god of the Tongva Native Americans. Eight years after Mike Brown of the California Institute of Technology in Pasadena discovered the object in 2002, he and his Caltech colleague Wesley Fraser used observations from the Hubble Space Telescope to estimate its diameter at some 890 kilometers. Because Quaoar's mass is known from the orbital motion of its satellite Weywot, the researchers could calculate its density. They came up with a surprisingly high value (for an icy body): over 4 grams per cubic centimeter. But according to Brazilian physicist Felipe Braga Ribas of the Valongo Observatory in Rio de Janeiro, observations of a stellar occultation by Quaoar on 4 May 2011 indicate a much larger diameter, between 1045 and 1095 kilometers. "The mystery of the high density has evaporated," he says.

However, the lost mystery has been replaced by a new one. The occultation results, from five observatory sites (again in Chile), are incompatible with a regularly shaped object. Instead, at one side of Quaoar, there appears to be "a lack of object," as Braga Ribas describes it. The missing chunk could be due to a giant impact, smashing away part of KBO's icy mantle, or it could mean Quaoar is actually a "contact binary," consisting of two more-or-less spherical bodies that touch each other. And the way in which the light of the occulted star faded and reappeared suggests that Quaoar may have an extremely tenuous methane atmosphere, with a surface pressure 10 million times smaller than Earth's.

Meanwhile, observations of dwarf planets by the European Space Agency's Herschel infrared space telescope are revealing mysteries of a different nature. Combining Herschel measurements with earlier results from NASA's Spitzer Space Telescope, Thomas Müller concludes that the surface of Makemake must consist of "hot" and "cold" zones right next to each other. Darker, warmer areas (still at a mere 50° above absolute zero) probably resemble dirty comet material, whereas the colder, brighter areas (at 30 Kelvin) might consist of freshly condensed methane ice. Müller, who has the same name as a famous German soccer player, jokes that, with alternating dark and bright regions, Makemake may look like a soccer ball.

So what about the largest dwarf planets in the Kuiper Belt? Might the new "occult astronomy" shed light on the lingering question of whether Pluto is indeed smaller than its rival, Eris (named after the Greek spirit of strife and discord), as many have suggested since Eris's discovery in 2005? At the Nantes meeting, Paris Observatory astronomer Bruno Sicardy, who regularly teams up with Braga Ribas, Ortiz, and others in KBO occultation studies, presented the results of their fruitful 6 November 2010 observations of the occultation of the star NOMAD1 0856-0015072 by Eris. However, the results will not be released until late October, when Sicardy's team publishes them in *Nature*. Says Sicardy: "Let's just say Eris is a twin of Pluto."

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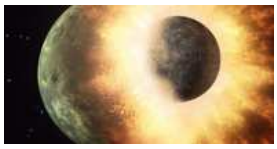

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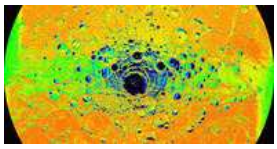

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