

Saturn ring toss: Hubble finds more moons

Circling the gaseous globe like myriad brilliant belts, they've fascinated observers since the time of Galileo. Nothing quite compares with the rings of Saturn.

Except, perhaps, their absence.

Using the Hubble Space Telescope to observe Saturn during a rare moment when the planet's icy rings nearly vanish from sight, astronomers announced that they have discovered two previously unknown moons orbiting the planet.

Amanda S. Bosh of Lowell Observatory in Flagstaff, Ariz., and Andrew S. Rivkin of the University of Arizona in

Tucson reported the findings in a July 26 circular of the International Astronomical Union.

Hubble made the observations on May 22, when Earth crossed the plane of Saturn's equator—the same plane in which the rings circle the planet. In this configuration, which only occurs every 15 years, the rings appear edge-on and their brilliance narrows to a razor-thin band of light that all but disappears. Faint moons ordinarily hidden by the ring's glare then become visible. Astronomers have found 13 of Saturn's 18 known moons during such events.

Ice's age? More than 8 million years

A piece of a glacier buried under a layer of volcanic ash in East Antarctica has lain undisturbed for at least 8.1 million years, says an international team of scientists. The presence of the ancient ice lends support to the theory that the East Antarctic ice sheet, which includes the bulk of the South Pole's ice, has stayed much the same for the past 15 million years—frozen and barren.

Not all geologists agree, however. Some believe that the frozen continent we now know had trees, vegetation, and much less ice as recently as 3 million years ago, during the Pliocene epoch. To them, the discovery does not rule out the possibility of a dynamic East Antarctic ice sheet before that time, with some areas melting and refreezing several times over the ages.

Earth was about 3°C warmer during the Pliocene, so determining what Antarctica looked like then can help scientists predict how global warming might affect the ice sheet in the future. If the East Antarctic ice sheet melted, it would raise the global sea level 60 meters, enough to submerge many coastal cities.

The new research, published in the Aug. 3 *NATURE* by David E. Sugden of the University of Edinburgh, George H. Denton of the University of Maine in Orono, and several others, fuels this spirited debate over the stability of the coldest continent on Earth.

The team established the age of the ice by dating the layer of ash on top. By comparing the abundances of different isotopes of argon trapped in the ash particles, they determined that the ash settled into a crack on top of the glacier during the Miocene epoch, several million years before the Pliocene.

The ash showed no signs of disturbance by wind or moisture. "There's no other mechanism we can think of to get glacier ice underneath," Sugden says. "We argue that the ice has been there at least as long."

The ice's longevity, the group says, supports the idea of a polar climate persisting in Antarctica right through the Pliocene.

David Harwood of the University of Nebraska at Lincoln, however, offers a different interpretation. The presence of the ancient ice may signify "selective preservation," a local phenomenon that needn't apply to the entire continent. "I'm sure there was ice in Antarctica 8 million years ago," he says. "If you're trying to take evidence from any particular area... and apply it for all of Antarctica, that's a bit dangerous."

Harwood and Peter Webb of Ohio State University in Columbus have argued that the East Antarctic ice sheet fluctuated in size up until the Pliocene. High up in the mountains, they have found tiny marine fossils called diatoms. These creatures must have lived, 2 to 3 million years ago, in watery basins deep in the heart of the continent. Glaciers later carried them up and deposited them at a high elevation.

Most experts agree on the present stability of the East Antarctic ice sheet but disagree on its sensitivity to a global warming of a few degrees. "It's so cold that all you do by raising the temperature is to increase the amount of water vapor in the atmosphere and therefore the amount of snow," Sugden says. "And it still doesn't melt."

Harwood, on the other hand, emphasizes the insulating property of the frozen ocean surrounding the continent, which keeps it very cold and dry. "With a 3° warming of ocean temperature, that would cause at least a 15° to 18° warming of mean annual temperatures on the continent. So if you warm the oceans a little bit and remove the sea ice, then the atmosphere would warm significantly."

Although Harwood applauds the accurate dating of this one piece of ice, he says that resolving the larger debate will need "lots of little bits of information like this." —C. Wu

Hubble data now appear to have added two more to that list. In analyzing 27 Hubble pictures taken over 10 hours, Bosh and Rivkin found four moons at distances between 137,000 and 147,000 kilometers from the center of Saturn. Two of the bodies, temporarily dubbed S1 and S2, probably correspond to known moons. But the other two, S3 and S4, don't fit any known orbit, Bosh and Rivkin assert. These bodies lie outside Saturn's narrow, outer F ring, with S3 adjacent to the ring and S4 about 6,000 km farther out.

After reviewing the projected orbits of Saturn's known moons, which NASA updates regularly for the planned Cassini mission to the planet, Robert A. Jacobson of NASA's Jet Propulsion Laboratory in Pasadena, Calif., concurs with that conclusion. But both he and Bosh caution that the calculated orbits rely on a set of quick observations taken in 1980 and 1981, when the two Voyager spacecraft flew past Saturn. "The projected orbits are from 15 years ago, and errors in position build up," says Bosh.

Such uncertainties hinder firm identification of S1 and S2. Both lie between Saturn's A and F rings. Although these moons have somewhat different orbital longitudes than predicted, Bosh and Rivkin suggest that S1 is Atlas and S2 is Prometheus, moons discovered by Voyager 1. Jacobson says it's possible that S1 is the moon Pan, while S2 could be either Prometheus or Atlas.

Just in time to help settle these questions, Hubble will watch as Earth again crosses Saturn's ring plane on Aug. 10. At the next two series of plane crossings, in 2009 and 2025, the sun's glare will hide Saturn. Astronomers won't get another chance for such observations until 2038. —R. Cowen

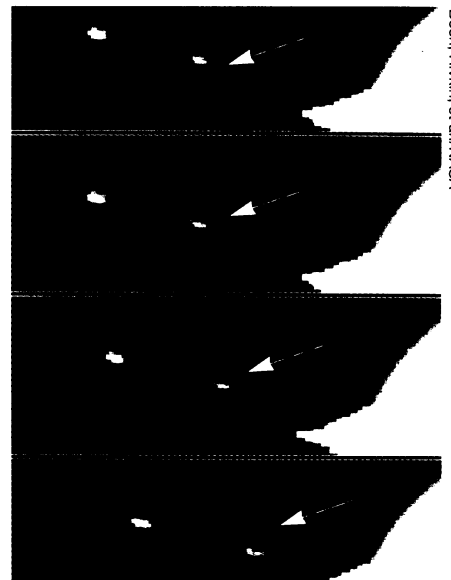


Image sequence shows one of two newly discovered moons of Saturn, dubbed S3 (arrows). Object to the left is a known moon, Epimetheus. Saturn is at right.

Bosh, Rivkin, et al./NASA