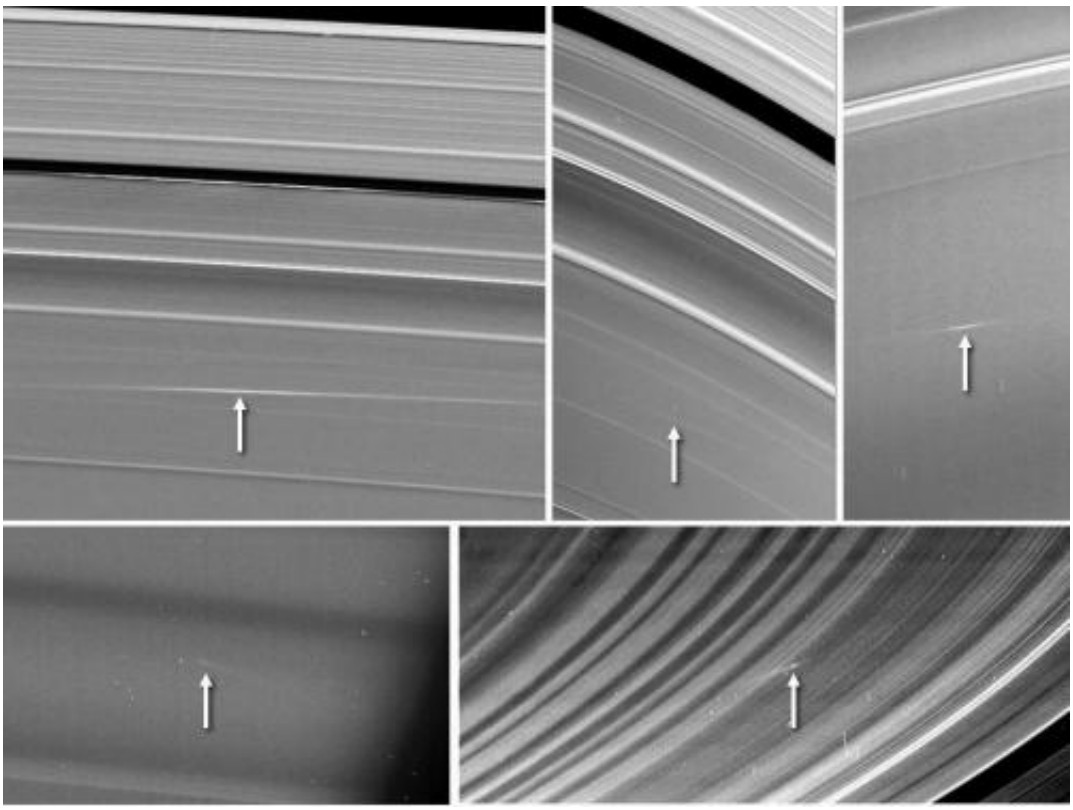
Cassini observes meteors colliding with Saturn's rings

April 25 2013



Five images of Saturn's rings, taken by NASA's Cassini spacecraft between 2009 and 2012, show clouds of material ejected from impacts of small objects into the rings. Clockwise from top left are two views of one cloud in the A ring, taken 24.5 hours apart, a cloud in the C ring, one in the B ring, and another in the C ring. Arrows in the annotated version point to the cloud structures, which spread out at visibly different angles than the surrounding ring features. The clouds of ejected material were visible because of the angle sunlight was hitting the Saturn system and the position of the spacecraft. The first four images were taken near the time of Saturn equinox, when sunlight strikes the rings at very shallow angles, nearly directly edge-on. During Saturn equinox, which occurs only every

14.5 Earth years, the ejecta clouds were caught in sunlight because they were elevated out of the ring plane. The last image was taken in 2012 at a very high-phase angle, which is the sun-Saturn-spacecraft angle. This geometry enabled Cassini to see the clouds of dust-sized particles in the same way that dust on a surface is easier to see when the viewer is looking toward a light source. The angle that the clouds are canted gives the time elapsed since the cloud was formed. The A ring cloud formed 24 hours before its first apparition in the top left box; it formed 48.5 hours before the top middle image. The other three clouds were approximately 13 hours, four hours, and one hour old (respectively) at the times they were seen. Credit: NASA/JPL-Caltech/Space Science Institute/Cornell

(Phys.org) —NASA's Cassini spacecraft has provided the first direct evidence of small meteoroids breaking into streams of rubble and crashing into Saturn's rings. These observations make Saturn's rings the only location besides Earth, the moon, and Jupiter where scientists and amateur astronomers have been able to observe impacts as they occur. Studying the impact rate of meteoroids from outside the Saturn system helps scientists understand how different planet systems in the solar system formed.

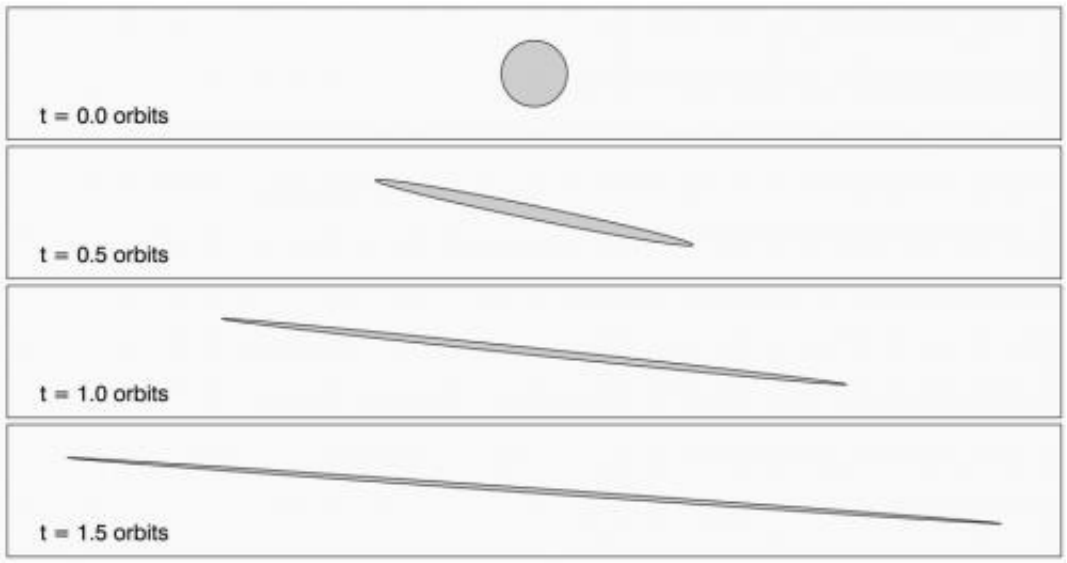
Our solar system is full of small, speeding objects. Planetary bodies frequently are pummeled by them. The meteoroids at Saturn range from about one-half inch to several yards (1 centimeter to several meters) in size. It took scientists years to distinguish tracks left by nine meteoroids in 2005, 2009 and 2012.

Details of the observations appear in a paper in the Thursday edition of *Science*.

Results from Cassini already have shown Saturn's rings act as very effective detectors of many kinds of surrounding phenomena, including

the interior structure of the planet and the orbits of its moons. For example, a subtle but extensive corrugation that ripples 12,000 miles (19,000 kilometers) across the innermost rings tells of a very large meteoroid impact in 1983.

"These new results imply the current-day impact rates for small particles at Saturn are about the same as those at Earth— two very different neighborhoods in our solar system, and this is exciting to see," said Linda Spilker, Cassini project scientist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif. "It took Saturn's rings acting like a giant meteoroid detector—100 times the surface area of the Earth—and Cassini's long-term tour of the Saturn system to address this question."



This illustration depicts the shearing of an initially circular cloud of debris as a result of the particles in the cloud having differing orbital speeds around Saturn. The numbers in the lower left of the panels in the still image show how quickly a

cloud can be elongated. After the cloud is formed, each particle within it follows its own simple orbit. The cloud begins to elongate as particles closer to the planet orbit at a faster speed than the particles farther from the planet. Scientists can use the angle the clouds are canted to infer the time elapsed since it was formed. This method was used to determine the times of the impacts that created the clouds in Saturn's rings that were captured by NASA's Cassini spacecraft. Credit: NASA/Cornell

The Saturnian equinox in summer 2009 was an especially good time to see the debris left by meteoroid impacts. The very shallow sun angle on the rings caused the clouds of debris to look bright against the darkened rings in pictures from Cassini's imaging science subsystem.

"We knew these little impacts were constantly occurring, but we didn't know how big or how frequent they might be, and we didn't necessarily expect them to take the form of spectacular shearing clouds," said Matt Tiscareno, lead author of the paper and a Cassini participating scientist at Cornell University in Ithaca, N.Y. "The sunlight shining edge-on to the rings at the Saturnian equinox acted like an anti-cloaking device, so these usually invisible features became plain to see."

Tiscareno and his colleagues now think meteoroids of this size probably break up on a first encounter with the rings, creating smaller, slower pieces that then enter into orbit around Saturn. The impact into the rings of these secondary meteoroid bits kicks up the clouds. The tiny particles forming these clouds have a range of orbital speeds around Saturn. The clouds they form soon are pulled into diagonal, extended bright streaks.

"Saturn's rings are unusually bright and clean, leading some to suggest that the rings are actually much younger than Saturn," said Jeff Cuzzi, a co-author of the paper and a Cassini interdisciplinary scientist specializing in planetary rings and dust at NASA's Ames Research

Center in Moffett Field, Calif. "To assess this dramatic claim, we must know more about the rate at which outside material is bombarding the rings. This latest analysis helps fill in that story with detection of impactors of a size that we weren't previously able to detect directly."

Provided by NASA