New chronology of the Saturn system

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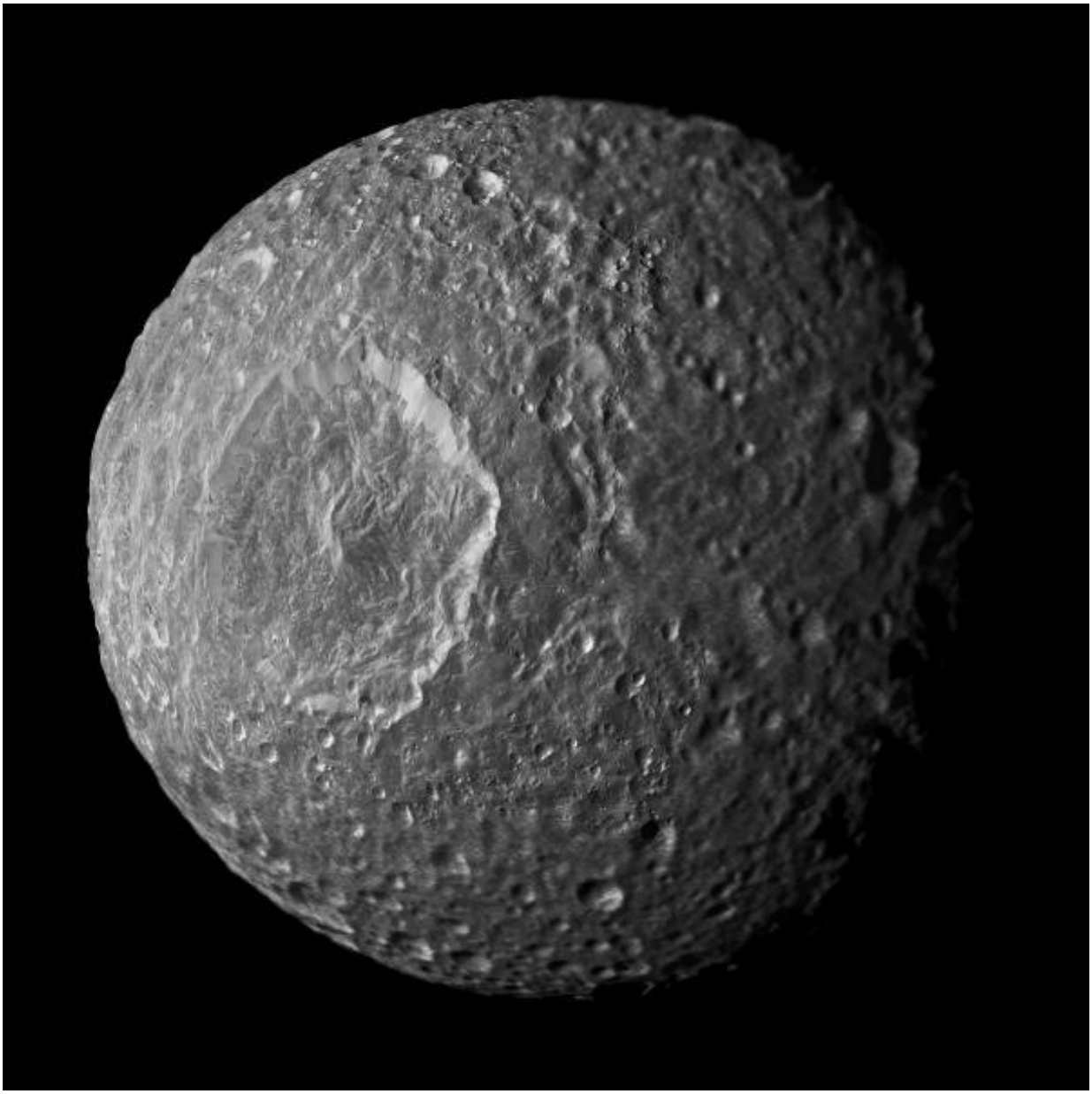

This mosaic of Saturn's moon Mimas showing its cratered surface was created

from images taken by NASA's Cassini spacecraft. Credit: NASA/JPL-Caltech/Space Science Institute

A new chronology for the moons of Saturn has been developed by Planetary Science Institute Associate Research Scientist Samuel W. Bell.

"Most studies dating surfaces on the Moon or Mars rely on counting how many impact craters have formed and knowing the cratering rate, but on the moons of Saturn, we do not know the cratering rate," said Bell, author of "Relative Crater Scaling Between the Major Moons of Saturn: Implications for Planetocentric Cratering and the Surface Age of Titan" appearing in the *Journal of Geophysical Research: Planets*. "Previous chronologies of the Saturn system have assumed that the craters on the moons of Saturn virtually all came from objects orbiting the sun."

Bell said, "If the impacts came solely from sun-orbiting objects, the relative cratering rate would be much, much higher the closer the moons are to Saturn. However, the crater densities of the oldest surfaces of Mimas, Tethys, Dione, Rhea, and Iapetus are all relatively similar. It would be too much of a coincidence for the ages of the oldest surfaces on each moon to vary by the exact amounts necessary to produce broadly similar crater densities. As a result, it seems much likelier that the impactors actually come from objects orbiting Saturn itself, moonlets that would be too small to detect with current technology. There are many important implications of this new chronology," Bell added.

"For instance, under the assumption that all the impactors orbit the sun, the possibility that any of the moons are younger than 4 billion years old is ruled out. However, with impactors orbiting Saturn itself, the moons could be younger, as has been suggested from astrometric observations of tidal orbital evolution. The assumption of impactors orbiting the sun

results in the conclusion that the surface of Titan is probably at least 4 billion years old, even though Titan shows clear evidence of active weathering," Bell said.

"With the new chronology, Titan could be quite young, which is much more consistent with observations of lakes, riverbeds, dunes, and mountains. With the new chronology, we can much more accurately quantify what we do and don't know about the ages of the moons and the features on them," Bell said. "The grand scale history of the Saturn system still hides many mysteries, but it is beginning to come into focus."

More information: Samuel W. Bell. Relative Crater Scaling Between the Major Moons of Saturn: Implications for Planetocentric Cratering and the Surface Age of Titan, *Journal of Geophysical Research: Planets* (2020). DOI: 10.1029/2020JE006392

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