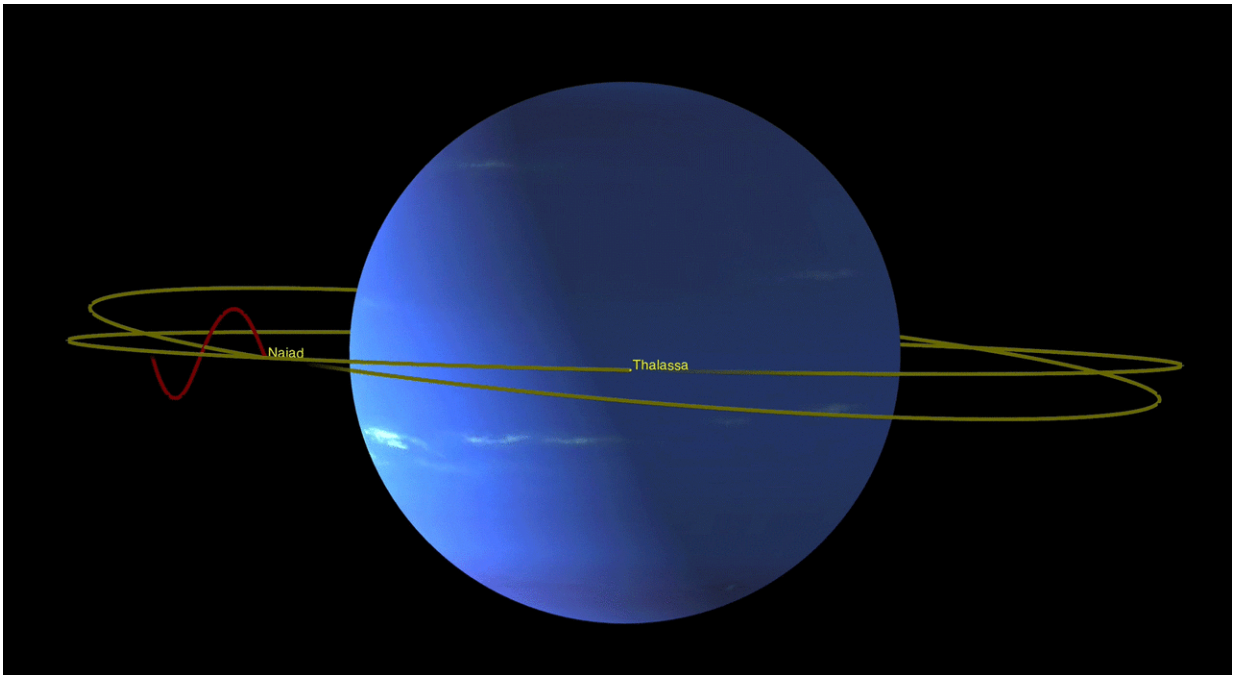


NASA finds Neptune moons locked in 'dance of avoidance'

November 15 2019, by Gretchen McCartney



Neptune Moon Dance: This animation illustrates how the odd orbits of Neptune's inner moons Naiad and Thalassa enable them to avoid each other as they race around the planet. Credit: NASA

Even by the wild standards of the outer solar system, the strange orbits that carry Neptune's two innermost moons are unprecedented, according to newly published research.

Orbital dynamics experts are calling it a "dance of avoidance" performed by the tiny moons Naiad and Thalassa. The two are true partners, orbiting only about 1,150 miles (1,850 kilometers) apart. But they never get that close to each other; Naiad's [orbit](#) is tilted and perfectly timed. Every time it passes the slower-moving Thalassa, the two are about 2,200 miles (3,540 kilometers) apart.

In this perpetual choreography, Naiad swirls around the ice giant every seven hours, while Thalassa, on the outside track, takes seven and a half hours. An observer sitting on Thalassa would see Naiad in an orbit that varies wildly in a zigzag pattern, passing by twice from above and then twice from below. This up, up, down, down pattern repeats every time Naiad gains four laps on Thalassa.

Although the dance may appear odd, it keeps the orbits stable, researchers said.

"We refer to this repeating pattern as a resonance," said Marina Brozović, an expert in solar system dynamics at NASA's Jet Propulsion Laboratory in Pasadena, California, and the lead author of the new paper, which was published Nov. 13 in *Icarus*. "There are many different types of 'dances' that planets, moons and asteroids can follow, but this one has never been seen before."

Far from the pull of the Sun, the giant planets of the outer solar system are the dominant sources of gravity, and collectively, they boast dozens upon dozens of moons. Some of those moons formed alongside their planets and never went anywhere; others were captured later, then locked into orbits dictated by their planets. Some orbit in the opposite direction their [planets](#) rotate; others swap orbits with each other as if to avoid collision.

Neptune has 14 confirmed moons. Neso, the farthest-flung of them,

orbits in a wildly elliptical loop that carries it nearly 46 million miles (74 million kilometers) away from the planet and takes 27 years to complete.

Naiad and Thalassa are small and shaped like Tic Tacs, spanning only about 60 miles (100 kilometers) in length. They are two of Neptune's seven inner moons, part of a closely packed system that is interwoven with faint rings.

So how did they end up together—but apart? It's thought that the original satellite system was disrupted when Neptune captured its giant [moon](#), Triton, and that these inner moons and rings formed from the leftover debris.

"We suspect that Naiad was kicked into its tilted orbit by an earlier interaction with one of Neptune's other inner moons," Brozović said. "Only later, after its [orbital tilt](#) was established, could Naiad settle into this unusual resonance with Thalassa."

Brozović and her colleagues discovered the unusual orbital pattern using analysis of observations by NASA's Hubble Space Telescope. The work also provides the first hint about the internal composition of Neptune's [inner moons](#). Researchers used the observations to compute their mass and, thus, their densities—which were close to that of water ice.

"We are always excited to find these co-dependencies between moons," said Mark Showalter, a planetary astronomer at the SETI Institute in Mountain View, California, and a co-author of the new paper. "Naiad and Thalassa have probably been locked together in this configuration for a very long time, because it makes their orbits more stable. They maintain the peace by never getting too close."

More information: Marina Brozović et al. Orbits and resonances of the regular moons of Neptune, *Icarus* (2019). [DOI:](#)

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