A possible explanation for Uranus's odd tilt angle and opposite spin

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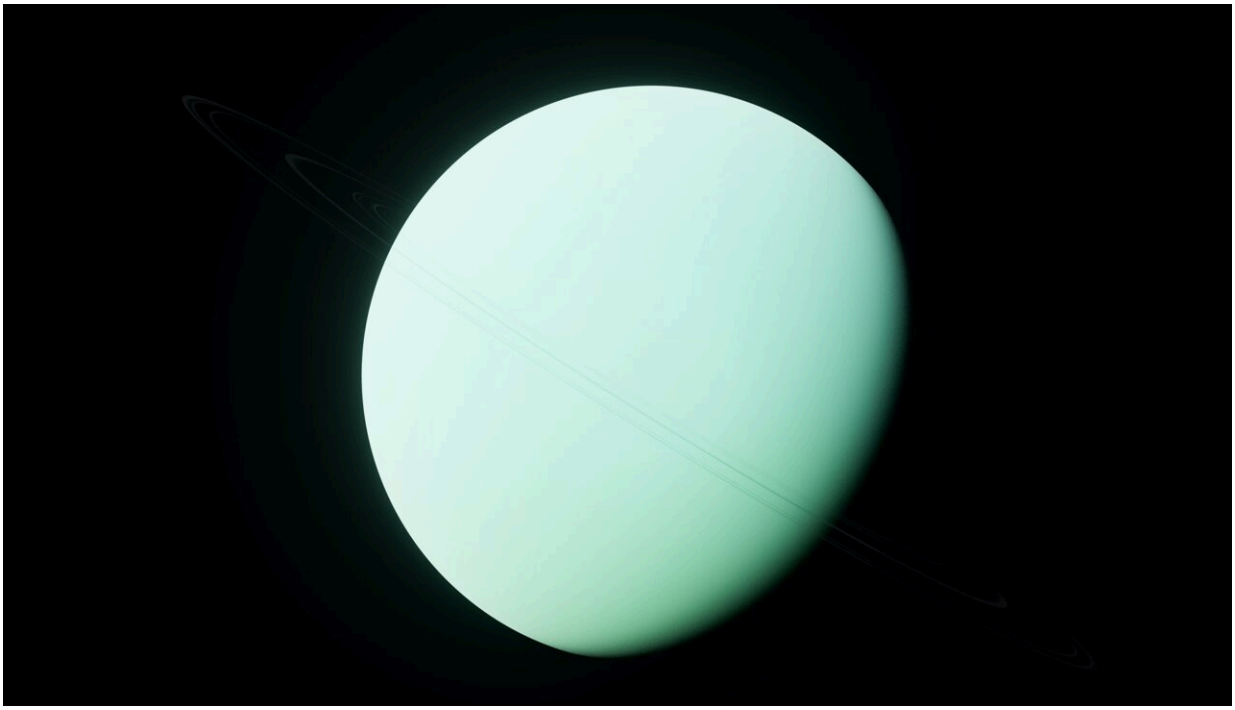

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A small team of researchers with members from Sorbonne Université, the University of Maryland College Park, the University of Pisa and Université Côte d'Azur has developed a theory to explain the odd tilt of Uranus and its opposite spin. The group has published a paper describing their work on the preprint server arXiv and are awaiting results of peer

review before it is published in the journal *Astronomy & Astrophysics*.

Among the planets in our solar system, Uranus stands out for two reasons. The first is its odd tilt angle of 98° from its orbital plane—that is much steeper than any other planet. The other is its clockwise spin direction, differing from most of the other planets in the solar system.

Over the past several years, space scientists have put forth theories to explain the unique characteristics of Uranus. Some have suggested, for example, that the tilt was caused by a collision with another large body; others have said it could have been influenced by a group of smaller bodies. Either scenario has been difficult to back up due to the absence of evidence of such bodies. In this new effort, the researchers have come up with a new theory—they suggest the unique tilt angle is due to the migration of its moons.

A few years ago, members of the team noticed that Jupiter's tilt was increasing due to migration of its moons. Math calculations predict that its tilt will change dramatically over the next few billion years. And when they looked at Saturn, they found similar results, mostly due to migration of its largest moon, Titan. That prompted the researchers to look at Uranus and its unique tilt angle.

To find out if moon migration could be behind the large tilt angle, the researchers created computer simulations showing a range of moon migrations, varying the size and speed of the moons. They found that a moon with just half the mass of the one circling Earth could raise Uranus' tilt angle to close to 90° over millions of years.

But they also found that the moons that now circle Uranus do not have enough mass to create such a tilt. But their simulations also showed that if a large moon pushed Uranus's tilt to 80°, things would become unstable and the moon would crash into the planet—and that, the

researchers found, could explain the amount of tilt and also the planet's opposite spin.

More information: Tilting Uranus via the migration of an ancient satellite, arXiv:2209.10590 [astro-ph.EP] arxiv.org/abs/2209.10590

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