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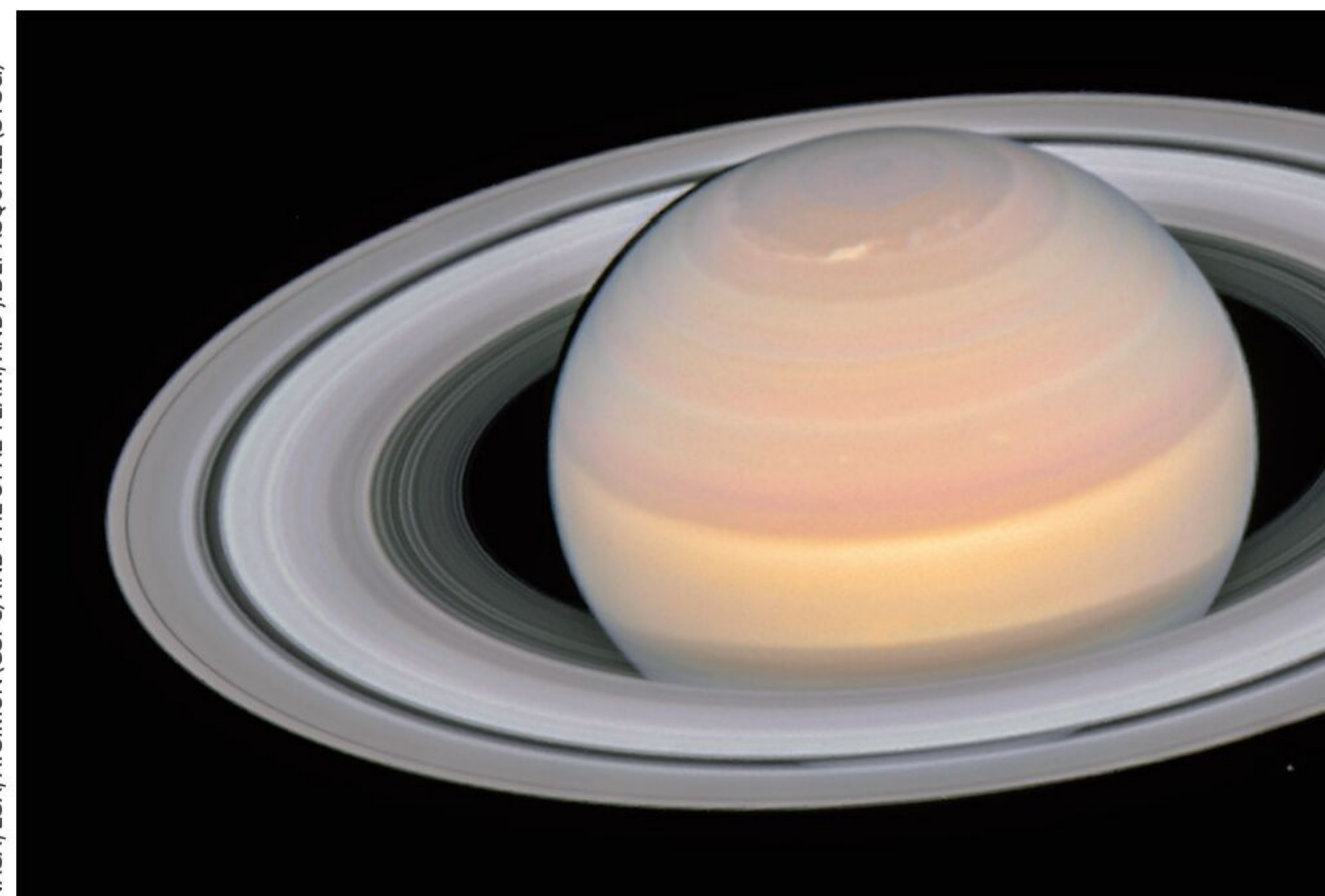
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## Solar system

# Saturn has 128 new moons with perhaps more to come

Matthew Sparkes



NASA, ESA, A. SIMON (GSFC) AND THE OPAL TEAM, AND J. DEPASQUALE (STSCI)

so with no counter-examples possible, the Kakeya conjecture must be true.

“It completely resolves a problem that has been attacked by a variety of techniques by a number of the leading figures

**“It completely resolves a problem that had been attacked by a number of leading figures in the field”**

in the field, most of whom obtained only modest partial results,” says Katz.

Besides the satisfaction of cracking this longtime problem, proving the Kakeya conjecture will also help mathematicians solve related problems using the mathematical tools Zahl and Wang developed. “In my subfield of analysis, it’s certainly the biggest advance in 10 years,” says Tao. “This conjecture is part of this whole family of problems that seemed impossible.”

Answering those problems could in turn help unpick some of the biggest questions in areas like general relativity or harmonic analysis, the mathematical study of how waves behave, says Guth. The proof could even help reveal the origin of prime numbers by tackling one of the most infamous unsolved problems in maths: the Riemann hypothesis.

“The Kakeya conjecture is just one tiny component of what’s going on with the [Riemann hypothesis], but it was one of many obstacles, and so now that’s gone, lots of things are now unlocked,” says Tao. “I foresee years and years of activity now on this whole tree of harder problems in number theory, partial differential equations, combinatorics and so forth, which were just considered hopeless, now they seem just very difficult.” ■

**A FURTHER 128 moons have been discovered orbiting Saturn, bringing the planet’s total to 274 – more than there are around all the other planets in our solar system combined. But as advances in telescope technology allow us to spot smaller planetary objects, astronomers face a problem: how tiny can a moon be before it is just a rock?**

Edward Ashton at Academia Sinica in Taipei, Taiwan, and his colleagues found the new moons with the Canada-France-Hawaii Telescope, revealing dozens that have previously evaded astronomers. They collected

# 274

The total number of moons orbiting Saturn

numerous images of Saturn, adjusted them for the planet’s movement through the sky and stacked them on top of each other to reveal objects that would otherwise be too dim to see.

All the new moons are between 2 and 4 kilometres in diameter and are likely to have been formed hundreds of millions or even billions of years ago in collisions between larger

Saturn has more moons than the other planets combined

moons, says Ashton.

“These are small little rocks floating in space, so some people might not find it quite an achievement,” says Ashton. “But I think it’s important to have a catalogue of all the objects in the solar system.”

Despite the wealth of data gathered by his team, these latest moons still only appear as “fuzzy blobs”, says Ashton. There are more powerful telescopes that could potentially resolve the moons in more detail, although many have smaller fields of view, which would mean taking many more images, he says.

The newly discovered moons have been recognised by the International Astronomical Union (IAU), and Ashton and his team will now get the right to name them. Ashton, a Canadian, has approached a representative from Canada’s Indigenous peoples for suggestions, but is also mulling a public naming contest.

Scientists have spent decades scanning the area around Saturn with increasingly powerful telescopes, which has

paid off in recent years. In 2019, 20 new moons were found, and Ashton and his colleagues had already discovered 62 in 2023, in addition to the 128 they most recently found. Ultimately, it is likely that further discoveries will require advances in telescope technology, says Ashton, who believes there are easily thousands of moons in orbit around Saturn, even discounting the smaller, rocky debris found in the planet’s rings.

Mike Alexandersen at the Minor Planet Center, which logs planetary bodies for the IAU, says there are likely to be many more moons yet to be found in our solar system as improvements to telescopes allow them to see smaller objects.

“I do know that the IAU decided that, due to the number of moons that are likely to exist, they’re not going to prioritise naming anything that’s smaller than 1 kilometre. But that’s not the same as them not recognising it as a moon,” says Alexandersen.

He suggested that the cutoff between what is a moon and what is just a rock particle that makes up part of a planetary ring is probably going to be somewhere between 1 metre and 1 kilometre in diameter. “In the end, it probably won’t be my decision, it’ll be the IAU, which will make up some cutoff which will be more or less controversial – just like the cut for what’s a planet or not,” says Alexandersen.

Elizabeth Day at Imperial College London says that, one day, there may be commercial reasons for having accurate maps of the solar system. “We might want to extract resources from asteroids and moons in the solar system, so having a great understanding of what is where is important for that,” says Day. ■