

Uranus (left) and Neptune (right), imaged by Voyager 2, the only probe to have visited them.

RARE CHANCE TO REACH ICE GIANTS EXCITES SCIENTISTS

A planetary alignment provides a favourable window for visiting Uranus and Neptune – but time is tight.

By Elizabeth Gibney

Momentum is building among planetary scientists to send a major mission to Uranus or Neptune – the most distant and least explored planets in the Solar System. Huge gaps remain in scientists' knowledge of the blueish planets, known as the ice giants, which have been visited only once by a space probe. But the pressure is on to organize a mission in the next decade, because scientists want to take advantage of an approaching planetary alignment that would cut travel time.

Interest in the ice giants has grown exponentially, says Amy Simon, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who co-organized a meeting at the Royal Society in London in January, dedicated to exploring ideas for such a mission. NASA's Voyager 2 is the only spacecraft to have visited Uranus and Neptune, in brief fly-bys in the 1980s. The ice giants therefore represent fresh territory for a wide range of researchers – including the study of planetary rings, atmospheres, moons and oceans, says Simon.

Jovian boost

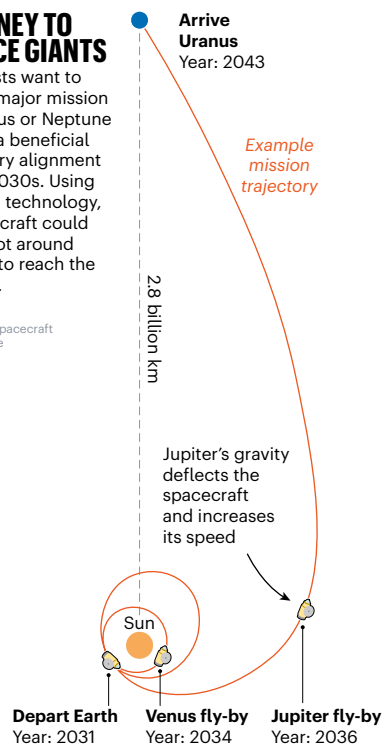
The celestial alignment, between Neptune, Uranus and Jupiter, next occurs in the early 2030s, and would allow a spacecraft to slingshot around Jupiter on its way to the planets. This would reduce the travel time, and allow the craft

to arrive within the lifetimes of its instruments and power systems – usually about 15 years. It would also cut fuel mass, enabling the craft to carry a full suite of scientific instruments (see 'Journey to the ice giants'). To take advantage of the alignment, a mission to Neptune would need to launch by around 2031 and

JOURNEY TO THE ICE GIANTS

Scientists want to send a major mission to Uranus or Neptune during a beneficial planetary alignment in the 2030s. Using existing technology, a spacecraft could slingshot around Jupiter to reach the planets.

Planets & spacecraft not to scale



one to Uranus by the mid-2030s.

The window is “the right time to launch”, Mark Hofstadter, a planetary scientist at the Jet Propulsion Laboratory in Pasadena, California, said at the London meeting. “We don’t want to miss this one.” But the timing is tight. NASA is the most likely space agency to lead the kind of multibillion-dollar ‘flagship’ mission that scientists want. These typically take seven to ten years to prepare, and any green light from NASA would depend on the mission being prioritized in the agency’s Planetary Science Decadal Survey, which reports in 2022. A mission to Neptune or Uranus would also face competition from proposals to return a sample from Mars or explore Venus.

But whereas Mars and Venus scientists are building on decades of exploration, “Uranus and Neptune are genuinely out on their own, as we haven’t completed the very first phase of their exploration yet”, says Leigh Fletcher, a planetary scientist at the University of Leicester, UK, who co-organized the meeting.

Fletcher says that a mission to either planet should include going into orbit around it and sending a probe into its atmosphere or to one of its moons, as the Cassini–Huygens mission did at Saturn.

Blue mysteries

Scientists think of the two planets as twins because of their similar sizes and masses. But no one knows how similar they are, their composition or how they formed, Ravit Helled, a planetary scientist at the University of Zurich, Switzerland, told the meeting. Models struggle to explain the planets’ structures, and why more distant Neptune seems to be warmer than Uranus. It’s assumed that they are made of forms of water, or maybe ammonia ice, said Helled. “But actually we don’t really know that.”

A major mission to the ice giants would also benefit exoplanet studies, said Hannah Wakeford, an exoplanet scientist at the University of Bristol, UK. About 40% of known exoplanets are ice-giant-sized; understanding what these planets’ sizes and atmospheres reveal about their formation relies on understanding those in our own Solar System.

Delegates at the meeting agreed that they would be happy to visit either planet, because both would yield rich results. Studies show that it would be feasible to send probes in a single mission to both planets, but this would be prohibitively expensive. Neptune is appealing because its moon Triton seems to be geologically active and might host a subsurface ocean, potentially of liquid water.

But Uranus – which has a magnetic field that is tilted relative to its rotation axis – has more “odd” features than Neptune does, which challenge existing scientific models, said Hofstadter. The later launch window for Uranus also makes the planet a more realistic target, says Fletcher.