Flying to (hypothetical) Planet 9: Why visit it, how could we get there and would it surprise us like Pluto?

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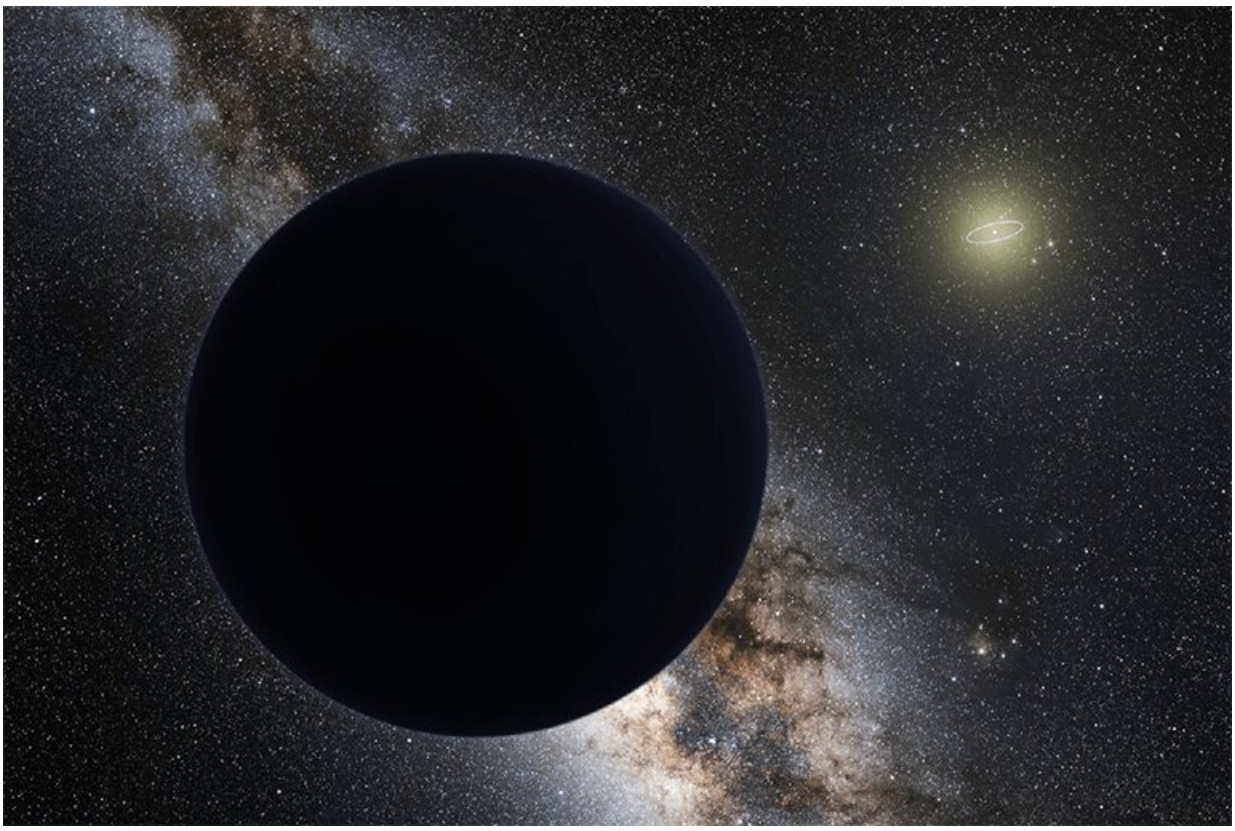

Artist's rendition of the hypothetical Planet 9, with Neptune's orbit displayed as a bright ring orbiting the sun. Credit: European Southern Observatory/Tom Ruen/nagualdesign

In a recent study submitted to *Earth and Planetary Astrophysics*, an international team of researchers discuss the various mission design options for reaching a hypothetical Planet 9, also known as "Planet X," which state-of-the-art models currently estimate to possess a semi-major axis of approximately 400 astronomical units (AU). The researchers postulate that sending a spacecraft to Planet 9 could pose scientific benefits much like when NASA's New Horizons spacecraft visited Pluto in 2015. But does Planet 9 actually exist?

"It is hard to put a specific number on the confidence level because so many uncertainties remain," said Dr. Manavsi Lingam, who is an Assistant Professor at the Florida Institute of Technology, and a co-author on the study. "For now, I would say that it seems likely that there is an unusual clustering of extreme trans-Neptunian objects. We do not know what is causing this clustering, but Planet 9 appears to be a promising candidate."

Before NASA's New Horizons arrived at Pluto in 2015, the only images scientists had of Pluto were fuzzy pictures from Earth-based telescopes, and even the Hubble Space Telescope couldn't get anything better. The science about Pluto was equally scant, as we had an estimate for its mass, but since we couldn't make out surface features, we knew very little about its atmosphere, geologic diversity, and interior. As the researchers point out, the "wealth of new data" from New Horizons surpassed the old, but could we be just as surprised with Planet 9 data if a spacecraft were to visit there?

"It is very likely," said Dr. Andrew Hein, who is an Associate Professor/Chief Scientist at the University of Luxembourg, and a co-author on the study. "Even the best telescopes are vastly inferior to close-up observations from a probe flying by a celestial body. This is even more true for bodies which are far away and faint, which is the case for Planet 9. The reason is physics. The fainter an object, the larger your

telescope needs to be to collect more light from that object and the longer you need to observe. The farther away the object, the more light you need to collect and the larger the telescope needs to be."

For how to get to Planet 9, the researchers propose several mission designs. These include, Jupiter gravity assist, using either Jupiter's or the sun's gravity well to accelerate the spacecraft, chemical rockets, nuclear propulsion, and laser sails. With the exception of laser sails, the amount of time each method would need to reach Planet 9 ranged from just under 40 years to 100 years. With laser sails, the researchers estimated that a spacecraft could reach Planet 9 within 6.5–7 years. But what steps are being taken to make this technology a reality?

"Laser sail technology is currently being pursued by Breakthrough Starshot, a project I am part of, and which has significantly advanced the technology over the last 6 years, including laboratory prototypes," said Hein. "While flight technology is conceptual for now, some of the technology building blocks already exist in the lab. The project's aim is to launch a laser sail to another star, but a small-scale version should be feasible to develop within the next 10–15 years or so with a budget of less than the one for a traditional space probe (few hundreds of millions of dollars). This small-scale version could be used to reach Planet 9 within a few years, once developed. But once the laser beamer is developed, such probes could be launched on a weekly basis at costs hundreds of times cheaper than current probes."

For now, Planet 9 remains purely a hypothesized member of our vast and illustrious solar system, but would the vast time it takes to get there using conventional methods prevent us from potentially visiting this mysterious object so far from the sun?

"Although we find that minimum mission times of 40–50 years are required (except for light sails), this long flight time ought not deter us,"

said Lingam. "The Voyager spacecraft have been functional for roughly the same duration and continue to provide a wealth of data. A putative mission to Planet 9 (should it exist) would not only revolutionize our understanding of the outer Solar system, but it can also enable us to study other targets along the way—for instance, some of the maneuvers take us close to Jupiter and the sun, indicating that these worlds could also be surveyed."

More information: Adam Hibberd, Manasvi Lingam, Andreas M. Hein, Can We Fly to Planet 9? arXiv:2208.10207v1 [astro-ph.EP], arxiv.org/abs/2208.10207

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