Pluto’s moons move in synchrony

Gravity binds together three satellites of dwarf planet.

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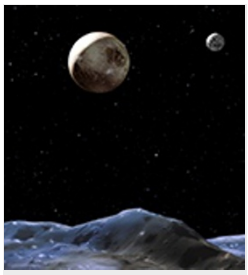
Pluto's moons are shown in a composite image from NASA's New Horizons spacecraft.

Three of Pluto’s small moons are locked together in a mutual orbital dance, planetary scientists have found. The discovery provides important context for NASA’s New Horizons spacecraft, which is hunting for undiscovered moons as it hurtles towards a 14 July fly-by of the dwarf planet.

The finding is also a step towards understanding Pluto’s peculiar assortment of at least five moons. “This is telling us some piece of the story of how the system formed,” says Mark Showalter, a planetary scientist at the SETI Institute in Mountain View, California, and lead author of a paper appearing in the 4 June issue of *Nature*[1]. “We just don’t know what that piece is yet.”

Pluto’s biggest moon, Charon, weighs in at a hefty 11% of the mass of Pluto itself. It may have formed during a cosmic collision early in the Solar System's history, billions of years ago. Debris from that smash may have coalesced into the much smaller moons Styx, Nix, Kerberos and Hydra.



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Now, researchers have found that the orbits of Styx, Nix and Hydra became gravitationally locked together at some point. “If you lived in the Pluto system and were sitting on Nix, you would see Hydra go around three times every time Styx goes around twice,” Showalter says. This pattern, known as a three-body resonance, remains stable over time. It is similar to the so-called Laplace resonance that links Jupiter's moons Io, Europa and Ganymede.

“If you know where Hydra and Nix are, you can determine where Styx is,” says Showalter. “It is a little piece of order in the system.” Styx is the smallest of the three moons, and was probably captured into a communal dance by the others.

Hide and seek

Working with Douglas Hamilton, a planetary astronomer at the University of Maryland in College Park, Showalter searched for the resonance by combing through Hubble Space Telescope observations of how the moons move over time. The researchers also found that Kerberos is much darker than either Nix or Hydra — suggesting that it could be made of a different material — and that Nix and Hydra rotate chaotically on their axes, the only moons known to do so other than Saturn’s moon Hyperion.

The work will help researchers to understand how the Pluto system came to be, says Marina Brozović, a planetary scientist at the Jet Propulsion Laboratory in Pasadena, California, who has hunted for resonances among Pluto’s moons[2]. “But off the top of my head, I do not see how a Laplace resonance between Styx, Nix and Hydra will shape the science results that come out of New Horizons,” she says.

New Horizons is less than 49 million kilometres from Pluto and closing in fast. It is now searching for small, faint moons that Hubble could not spot. None have been found so far, but unseen moons could be lurking in several places — including along the orbits of moons already known to exist.

Even smaller moons, less than 10% the mass of Styx, could also be lurking between Styx and Hydra, says Simon Porter, a planetary scientist at the Southwest Research Institute in Boulder, Colorado. Porter has been putting hypothetical moons of Pluto into orbital models and seeing which ones might be able to exist in real life[3].

Showalter thinks that any new moons, if they exist, are likely to be small and orbiting farther out than Hydra, the outermost moon currently known. “But anything I say about Pluto right now could easily be obsolete by next week,” he says. “Or tomorrow.”

References

1. Showalter, M. R. & Hamilton, D. P. *Nature* **522**, 45–49 (2015).
2. Brozovic, M., Showalter, M. R., Jacobson, R. A., & Buie, M. W. *Icarus* **246**, 317–329 (2015).
3. Porter, S. B. & Stern, S. A. Preprint at http://arxiv.org/abs/1505.05933 (2015).