

## PLANETARY NEWS: HUBBLE SPACE TELESCOPE (2005)

### HUBBLE OBSERVATIONS ADD TWO NEW MOONS TO PLUTO

By Amir Alexander

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**As the [New Horizons](#) team prepares for the fast approaching January launch, they received startling news about the planet they are working so hard to reach. Images taken by the Hubble Space Telescope last May reveal that [Pluto](#) has not one moon, but three! These include Charon, the large moon discovered in 1978, and two previously unknown satellites, all orbiting within 60,000 kilometers (36,000 miles) of their home planet. As a result, when New Horizons visits the ninth planet in 2015 or thereabout, it will be able to study four separate objects, all in the immediate vicinity of Pluto itself.**

When New Horizons Principal Investigator Alan Stern of the Southwest Research Institute (SwRI), and Hal Weaver of the Johns Hopkins University Applied Physics Laboratory (APL), first proposed to use the Hubble Space Telescope to search for moons around Pluto, they were looking for something quite different. As co-leaders of a team of nine astronomers searching for Pluto companions, they thought they might find very distant moons orbiting Pluto, so faint that they have so far escaped detection. Other [Kuiper belt](#) objects (KBOs) are known to have such far-off moons.

Accordingly, they instructed Hubble to search the entire range of Pluto's gravitational control, stretching out over 2 million kilometers from the planet. On May 15, 2005, and again on May 18, the space telescope pointed its mirror in the direction of Pluto, and took a series of pictures. The images show no trace of the distant satellites Stern and Weaver had expected. They do, however, show two bright spots orbiting very close to Pluto itself – almost certainly two small moons.

"Pluto always baffles us" mused Stern. "We never expected Pluto to be a quadruple."

The first to notice the two bright points in the Hubble images was Max Mutchler of the Space Telescope Science Institute, who inspected the images on June 15, at Weaver's request. After informing Weaver of the possible discovery, both had to put any plans for further confirmation aside: for the next several months both researchers focused on the Hubble observations of comet Tempel 1, which was struck by an impactor from the spacecraft [Deep Impact](#).

In the meantime, at SwRI, Stern suggested to postdoctoral researcher Andrew Steffl that he too take a look at the images and see what he could find. Although this was done in coordination with Weaver, Weaver did not inform Stern and Steffl of Mutchler's suspicions so as not to bias their observations. By mid August Steffl too had found two apparent satellites of Pluto. By the end of the month it was clear that he had found the same objects as Mutchler in the very same images.

To confirm the discovery Stern and Weaver asked three of the largest ground-based telescopes to look for the moons. In September, The Keck and Gemini telescopes in Hawaii, and the European Southern Observatory's Very Large Telescope (VLT) in Chile all set their sights on Pluto. None, however, succeeded in imaging the elusive satellites, most likely because Pluto was already low in the sky at twilight and barely visible. In February, when Pluto is farther away from the glare of the Sun, a new series of observations is planned with Hubble.

Even without the confirming observations, Stern, Weaver, and their colleagues have very good reasons to believe the moons they have found are the "real thing." First there is the fact that the objects move through the sky with Pluto. Other KBOs, and background stars, which follow a different path through the skies, appear in the images as blurry streaks, while the suspected moons remain in focus.

Then there are the results of preliminary calculations of the two satellites' orbits. These appear to be nearly circular and on the same orbital plane as Pluto's large moon Charon. Stern, furthermore, suggests that the moons appear to be in resonance with Charon, meaning that the ratio of the moons' orbital periods and that of Charon is a simple integer ratio such as 2:1 or 3:2. The chances that such apparent orbits are artifacts of the random movement of background objects is miniscule.



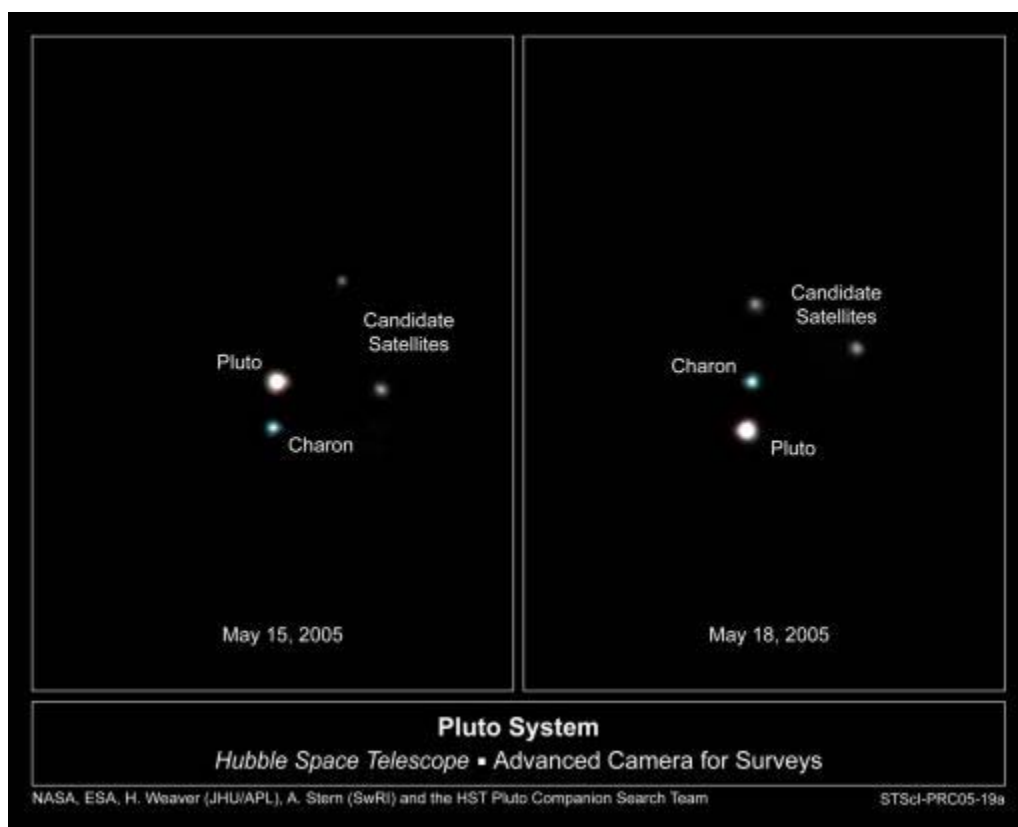
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#### A View from Pluto's Moon

An artist's conception of the view from one of Pluto's new moons showing Pluto, Charon, and the other small moon. Credit: NASA, ESA, G. Bacon

However, these would be precisely the orbits that one would expect of moons formed by the same impact that created Charon.

Finally, and perhaps most convincingly – the two moons have been imaged before. Marc Buie of the Lowell Observatory and Eliot Young of SwRI found the moons in images of Pluto taken by Hubble in 2002.



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#### Pluto's Quadruple System

These images taken by the Hubble Space Telescope's Advanced Camera for Surveys (ACS) on May 15 and 18, 2005, show that Pluto has two small moons in addition to its large moon Charon. Credit: NASA, ESA, H. Weaver (JHU/APL), A. Stern (SwRI), and the Hubble Space Telescope Pluto Companion Search Team

The two moons, provisionally known as S/2005 P1 and S/2005 P2, are tiny compared to their two companions. Whereas Pluto is 2,400 kilometers (1,400 miles) in diameter, and Charon is half of that, the diameter of S/2005 P1 – the larger of the two moons – is anywhere between 50 and 160 kilometers (30 and 100 miles). Since size estimates depend on the object's brightness, the exact diameter of the moon depends on its reflectivity (or albedo), which right now can only be guessed at. The smaller moon, S/2005 P 2, is likely 10% - 15% smaller than its sibling.

Pluto's newfound companions could provide scientists with new insights on the Kuiper belt and the Pluto system. If the findings prove correct, said Weaver, Pluto "will become the first body in the Kuiper belt known to have more than one satellite." This suggests that among the estimated 40,000 Kuiper belt objects that have moons, many may have more than one. Furthermore, the size and orbits of moons are a crucial resource for learning about their host planets. The two new satellites will soon enable scientists to calculate better estimates of the mass and density of Pluto and Charon. Down the road, when more is known about S/2005 P1 and S/2005 P2, they could help us understand the origins and history of the Pluto system as well.

Apart from their importance to our understanding of the Kuiper belt, and their influence on plans for New Horizons, the discovery of two new moons orbiting close to one of the traditional nine planets is a remarkable discovery in itself. Stern put

it most aptly: "It blew our socks off," he said.

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