Study finds that Pluto satellites' orbital ballet may hint of long-ago collisions

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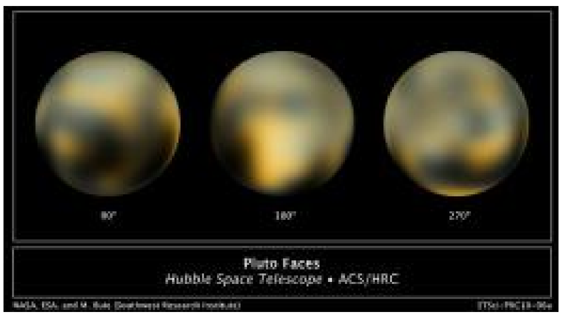

A best-fit color image/map of Pluto generated with the Hubble Space Telescope and advanced computers. Image: NASA

A large impact 4 billion years ago may account for the puzzling orbital configuration among Pluto's five known satellites, according to a new model developed by planetary scientists from Southwest Research Institute (SwRI).

Starting with Charon, Pluto's nearest and largest moon, each of the successively more distant—and much smaller—moons orbits Pluto according to a steadily increasing factor of Charon's own orbital period. The small satellites, Styx, Nix, Kereberos and Hydra, have orbital periods that are almost exactly 3, 4, 5 and 6 times longer than Charon's.

"Their distance from Pluto and the orbital arrangement of the satellites has been a challenge for theories of the small satellites' formation," said lead investigator Dr. Harold "Hal" Levison, an Institute scientist in SwRI's Planetary Science Directorate at Boulder, Colo.

Models for the formation of Charon leave plenty of small satellites, but all of them are much closer to Pluto than the current system that we see today," said Levison. A major problem has been understanding how to move these satellites outward, but not lose them from the Pluto-Charon system or have them crash into Charon. He said, "This configuration suggests that we have been missing some important mechanism to transport material around in this system."

The SwRI study, funded by a grant from NASA's Outer Planetary Research program and Lunar Science Institute, considered the earliest and most dynamic epoch of the Pluto/Charon system. It is thought that Charon was formed by a large impact during a period in solar system history when such collisions were dramatically more frequent. Any initially surviving satellites would likely be destroyed in collisions, but these shattered moons wouldn't be lost; rather, their remains would stay in the Pluto/Charon system and become the starting point for building new satellites. Thus there would have been many generations of satellite systems over the history of Pluto and Charon.

In modeling the destruction of the satellites, the SwRI study found that there may be a method for moving them, or their building blocks, outward, due to the competing effects of Charon's gravitational kicks and collisions among the debris of the disrupted satellites. Charon is the largest satellite of any planet or dwarf-planet, weighing in at 1/10 the mass of Pluto (the Moon is just 1/81 the mass of Earth), and so it could rapidly slingshot the small satellites outward if they were to approach too closely. Meanwhile, collisions among small satellites can change orbits to keep things away from Charon. When combined, this leads to a series of satellites colliding, breaking to pieces, moving outward and then rebuilding.

"The implications for this result are that the current small satellites are the last generation of many previous generations of satellites," said Dr. Kevin Walsh, another investigator and a research scientist in SwRI's Planetary Science Directorate at Boulder, Colo. "They were probably first formed around 4 billion years ago, and after an eventful million years of breaking and rebuilding, have survived in their current configuration ever since."

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