

# The Origin of Pluto's Moons

Blake Hartley

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Pluto and its recently growing number of known moons are a system of rocky trans-Neptunian objects believed to have formed out of a planetesimal early in the lifespan of the Solar System. While such an explanation easily accounts for the composition and size of Pluto and its moons, detailed investigation reveals that in such situations it is difficult to produce systems with the small eccentricities and nearly resonant orbital periods characteristic of the Pluto-Charon system.

The basis of the work done for this presentation is (Pires dos Santos et al., 2012). In this paper, a planetesimal disk of similar nature to the one in which Pluto is believed to have formed is simulated. The results presented show that capture of objects with the sizes of Pluto's moons is possible. However, capturing objects with the orbital characteristics of Pluto's moons (large semimajor axes, low eccentricities) is unlikely.

In this paper, we expand upon the work presented in (Pires dos Santos et al., 2012) in two ways. First, we further expand upon the methods used in the article by simulating a randomly generated planetesimal disk in which we embed a binary system (representative of Pluto and Charon) and simulate interactions to investigate the parameters in phase space which allow for capture by the Pluto-Charon system. In the event of such a capture, we investigate the nature of the captured orbit, including the eccentricity, period, and duration of the capture event. We perform this analysis to both expand upon the work presented in (Pires dos Santos et al., 2012) and to check whether our simulations agree with theirs.

Second, we simulate tidal disruption events of the Pluto system with other trans-Neptunian objects. We begin by generating random initial conditions of a typical trans-Neptunian object with typical size and dynamical parameters on a near-collision course with the Pluto-Charon system. We simulate the course of this event to determine whether any of Pluto's moons were stripped. We determine the likelihood that a given trans-Neptunian object may strip the Pluto system of a moon through this analysis. By combining this result with the timescale of such interactions, we estimate the lifetime of Pluto's moons with respect to these sorts of tidal stripping events.

## References

Pires dos Santos, P. M., Morbidelli, A., & Nesvorný, D. 2012, *Celestial Mechanics and Dynamical Astronomy*, 114, 341