

David Minton – Colloquium Seminar – April 27, 2023  
Purdue

## “The Many Mysteries of the Moons of Mars”

Phobos and Deimos are the only natural satellites of the terrestrial planets apart from the Earth’s Moon, however they are quite different from the Moon in shape, size, and surface appearance. They are both quite small, with average diameters of ~22.5 km for Phobos and ~12.km for Deimos, are both significantly prolate, and have low densities. Observations by the Viking Orbiter spacecraft in the 1970s showed that Phobos was most similar to carbonaceous chondrites in its visible to near infrared spectra. On the basis of their small size, density, and surface spectra, it was proposed that they were captured carbonaceous asteroids originating in the main asteroid belt. However, both Phobos and Deimos orbit deep in the gravity well of Mars, have orbits that are nearly circular, aligned with the equator, and moving in the same direction as the spin of Mars. Such orbits are characteristic of bodies formed from an accretion disk, like the regular satellites of the outer planets and the Earth’s Moon, and not those of captured bodies. However, the disk-origin hypothesis for Phobos and Deimos presents its own set of challenges.

In this talk, I will discuss ongoing efforts to understand the origin of the enigmatic moons of Mars. I will describe a novel hypothesis for the long-term evolution of the martian satellite system that involves an ongoing ring/moon cycle of destruction and rebirth of the innermost satellite. I will show how this ring/moon cycle model is a consequence a particular regime of satellite formation called the “Boomerang Regime,” and the discuss observations in support of the hypothesis for Phobos and Deimos and also against it. I will demonstrate that observations of oft-neglected Deimos provide some of the strongest

constraints on any model for the origin of martian satellite system as a whole. I will also discuss how observations from the upcoming Japanese mission called the Mars Moons eXploration (MMX) mission will help uncover new clues to help us unlock the many mysteries of the moons of Mars.