Lunar swirls: Dust transport, solar wind deflection, and a low-cost mission to determine their origin

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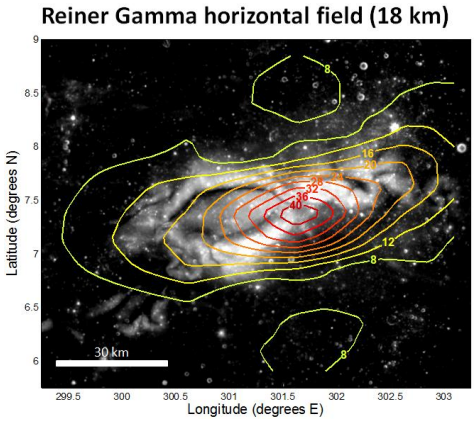
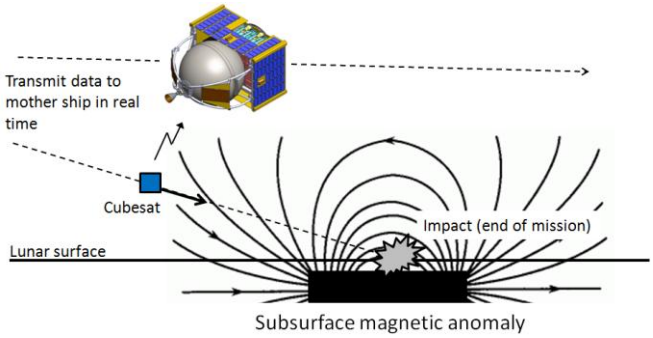
Abstract. Lunar swirls are one of the most enigmatic geologic features on the Moon. Swirls are high albedo features associated with strong crustal magnetic fields and understanding their formation has implications for space weathering, lunar surface water phenomena[1], and the history of the lunar dynamo. Recently, a new model for their formation was proposed that involves dust transport above the lunar surface[2]. Briefly, under this model, charge separation effects generated by the solar wind interaction with the crustal magnetic field leads to electric fields than can influence the motion of fine, charged, lofted dust. Accumulations of fine dust can lead to color changes on the surface. We have also recently tested the hypothesis that the bright portions of swirls are due to deflection of solar wind protons by the solar wind[3,4]. Specifically, we have examined the correlation of the horizontal component of the magnetic field measured by Lunar Prospector, with albedo, at Reiner Gamma (below, left) and Airy swirl.

We will review the two above hypotheses with new data and also present a low-cost mission concept being designed by NASA Ames, UC Berkeley, and UC Santa Cruz, that can help determine the origin of swirls. This mission would release several cubesat probes on impact trajectories into the hearts of lunar swirls, and measure the magnetic field, solar wind flux, and dust flux, until the moment of impact, <100 m above the surface (below, right).





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