The Reiner Gamma Swirl and Magnetic Anomaly: Why We Should Go There

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All lunar swirls are known to be co-located with crustal magnetic anomalies (LMAs). Not all LMAs can be associated with albedo markings, making swirls, and their possible connection with the former, an intriguing puzzle yet to be solved.

Given favorable conditions, an LMA can deflect the solar wind enough to form a mini-magnetosphere that partially (and possibly only temporarily) shields the underlying lunar regolith. Recent modeling efforts have shown that the resulting energy flux pattern to the surface is consistent with the underlying albedo (swirl) patterns. In particular, coupling a fully kinetic particle-in-cell code with a downward-continued magnetic field model based on orbital-altitude observations, we are able to produce a pattern similar to Reiner Gamma’s alternating bright and dark bands, but only when integrating over the full lunar orbit. Although consistent with the solar-wind standoff hypothesis for the origin of swirls, the match is not perfect. A combination of reasons could be the cause.

Here we discuss some of the unexplained discrepancies between the flux profile and the surface brightness and why the Reiner Gamma swirl region should be a prime target for future low-orbiting spacecraft or even landers/rovers, and we consider the potential role of human exploration.