COUPLING THE OBSERVED LUNAR MAGNETIC FIELD WITH FULLY KINETIC SIMULATIONS: IMPLICATIONS FOR REINER GAMMA AND SWIRL FORMATION

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Discovered by early astronomers during the Renaissance, the Reiner Gamma formation is one of the most well-known lunar surface features. Observations have shown that the tadpole-shaped albedo marking found on the Oceanus Procellarum (centred at selenographic coordinates (7.5N, 59.0W)) is co-located with one of the strongest magnetic anomalies (LMAs) on our Moon. Understanding better the relationship between the LMA and the albedo pattern could have implications for our interpretation of the Moons thermal/geological history and to evaluate possible future lunar exploration opportunities.

In this work we analyse the first fully kinetic simulations of the solar wind interaction with the observed lunar magnetic field surrounding the Reiner Gamma albedo pattern. Using a Surface Vector Mapping model based on Kaguya and Lunar Prospector magnetic field measurements (Tsunakawa et al., JGR 2015), we reproduce a surface weathering pattern closely resembling the details of the Reiner Gamma swirl. We provide strong evidence that solar wind standoff is the dominant process to have formed the albedo markings in the region. The correlation is best when evaluating the proton energy flux rather than the proton density or number flux, favouring a sputtering process for surface darkening. We find the reflected proton flux from the simulation in excellent agreement with the in-orbit flux measurements from the Chandrayaan-1/SARA:SWIM mission. At 20 km above the lunar surface overhead Reiner Gamma we find the maximum reflection rate to be less than 10%.

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