A MAGNETIZED ELLIPTICAL DISK ON THE MOON. I. Garrick-Bethell[1,2], [1]University of California, Santa Cruz. [2]Kyung Hee University, Korea (igarrick@ucsc.edu).

Introduction: Lunar crustal magnetic anomalies have been used to infer the history of the lunar spin axis and the nature of the Moon's ancient dynamo [1,2]. However, there is wide disagreement about the interpretation of these results and even the assumptions behind them. Here we present evidence for a highly symmetric magnetized disk ideally suited for assessing the nature of the lunar dynamo.

Reiner Gamma: Swirls are magnetic anomalies with soil optical patterns that are correlated with the underlying magnetization and near-surface field direction [3]. The Reiner Gamma anomaly is unique among swirls in that its optical pattern is exceptionally symmetric. We report here an interesting coincidence: three different studies have inferred its magnetization direction to be almost perfectly perpendicular to the semi-major axis of the optical pattern (Fig. 1a). We use this observation as a clue, and model the source bodies as a disk uniformly magnetized in the same way (Fig. 1b). A disk model is more physical than previous models using lines of dipoles [3]. We find that a disk model produces cusps in the field that would likely produce the dark lanes inside Reiner Gamma (Fig. 1d) [3]. Such cusps appear at low altitudes and therefore are not visible with the best available data (Fig. 1c).

Conclusions: These findings offer the best evidence to date that the Reiner Gamma main body is uniformly magnetized, satisfying the most critical criterion for inversions. Combined with its well-constrained source body geometry, we argue that Reiner Gamma is the best anomaly to confidently infer the paleo-orientation of the lunar field. Previous studies have found the implied paleopole to be within ~10° of the present pole. The age of Reiner Gamma is likely ~3.3-3.9 Ga [4]. Thus, Reiner Gamma provides evidence for a dipole-dominated spin-aligned dynamo like the Earth's, after a pure thermal convection dynamo was likely possible [5].

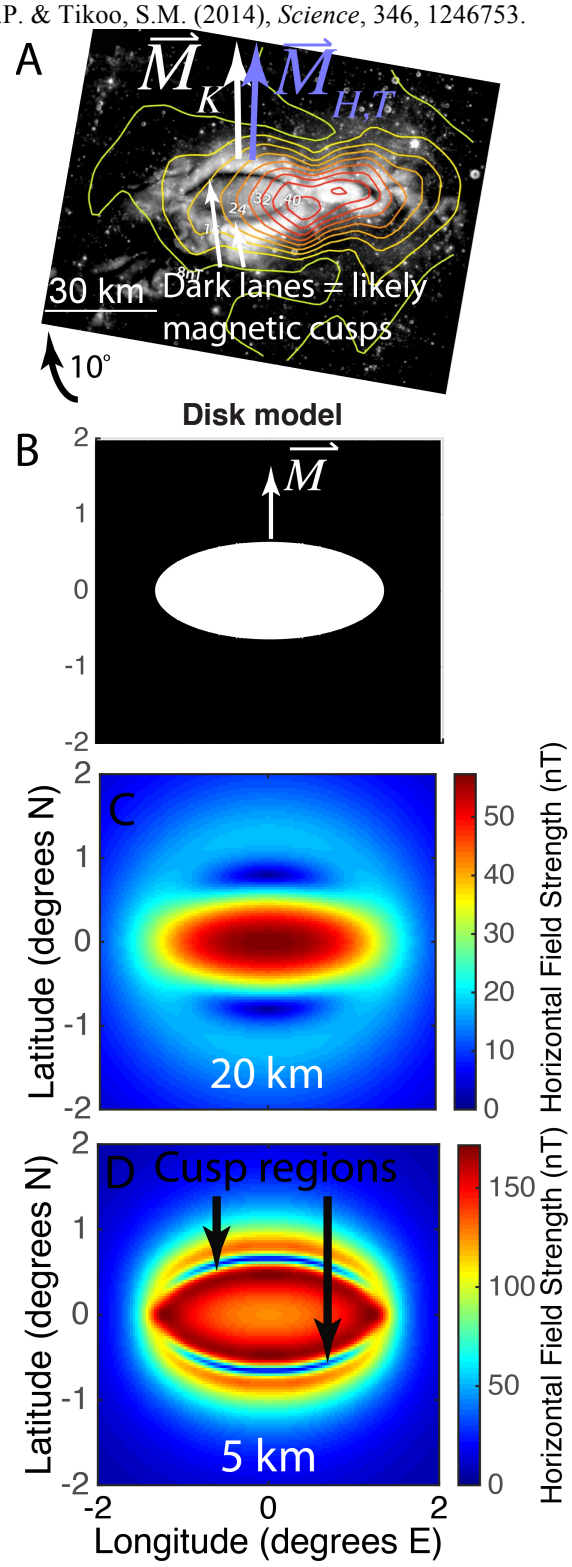

Fig. 1. A) Reiner Gamma anomaly with the observed horizontal field strength at ~20 km (contours). Three inferred magnetization directions from previous studies are shown. **B)** Magnetized disk model of the Reiner Gamma anomaly. **C&D)** Horizontal field strength at 20 and 5 km from the disk model. Cusp regions in the field are found with the same geometry as the dark lanes at Reiner Gamma. The scale in panels B-D is approximately the same as for panel A.

References: [1] Takahashi, F. et al. (2014), *Nat. Geo.* 7, 409. [2] Nayak et al. (2017), *Icarus* 286, 153. [3] Hemingway, D. & Garrick-Bethell, I. *JGR* 117, E10012 [4] Kelley et al. (2018), this vol. [5] Weiss, B.P. & Tikoo, S.M. (2014), *Science*, 346, 1246753.