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Analysis of initial Juno magnetometer data using a new method of magnetic field analysis

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Data from the first perijove pass (PJ1) of Juno at Jupiter suggests that Jupiter's magnetic field is both much stronger and more spatially complex than indicated by previous models such as VIP4 [Connerney et al., 1998]. Here we apply a new method of magnetic field analysis in order to gain an indication of what magnetic field structures may explain these intriguing observations.

Our method cosnsists of three steps: first, we remove VIP4 from the Juno observations to create a residual dataset; second, we use an elastic net [Zou and Hastie, 2004] to fit a set of magnetic pixels on a spherical surface at a given radius to this residual dataset; and finally, we add the resulting magnetic pixels back onto VIP4, creating an enhanced VIP. The set of magnetic pixels consists of approximately 10,000 nearly uniform and mostly hexagonal elements on a spherical surface (at say r= 1.0 Rj or 0.85 Rj). Crucially in this method, the elastic net, which is a combination of L1 and L2 regularizations, ensures that magnetic pixels, or groups of correlated magnetic pixels, will only be nonzero if required by the data.

The structure we obtain suggests the possible presence of both equatorial spots, as might result from flux expulsion, and low polar flux, as might result from the effect of a tangent cylinder.