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The Juno Magnetometer Investigation Provides the First Detailed Jovian Magnetic Field Model

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Characterizing the planetary magnetic field of Jupiter is one of the primary science objectives of the Juno Mission. The Juno spacecraft was launched on August 5th, 2011, and was inserted into polar orbit about Jupiter on July 4th, 2016. Observations acquired during 8 of Juno's first 9 orbits provide the first truly global coverage of Jupiter's magnetic field with a coarse longitudinal separation of ∼45 degrees between perijoves. The magnetic field investigation onboard Juno is equipped with two magnetometer sensor suites, located at 10 and 12 m from the spacecraft body at the end of one of the three solar panel wings. Each contains a vector fluxgate magnetometer (FGM) sensor and a pair of co-located non-magnetic star tracker camera heads that provide accurate attitude determination for the FGM sensors. Observations acquired within ∼7 Rj of Jupiter during the first 9 polar passes are used to characterize the planetary magnetic field with extraordinary spatial resolution. The magnetic field is represented with a degree 20 spherical harmonic model for the planetary ("internal") field, combined with an explicit model of the magnetodisc for the field ("external") due to distributed magnetospheric currents. Partial solution of the underdetermined inverse problem using generalized inverse techniques yields a model ("JRM09") of the planetary magnetic field with spherical harmonic coefficients determined through degree and order 10, providing the first detailed view of a planetary dynamo beyond Earth's. While only $\frac{1}{4}$ of the way through its baseline mission of 33 orbits, a detailed representation of the field has emerged. The Jovian magnetic field is unlike anything previously imagined, evidencing a complexity that portends great insight into the dynamo process in general and the dynamics of Jupiter's interior in particular. We present the first detailed spherical harmonic model of Jupiter's magnetic field obtained using observations in close proximity to the planet, and speculate on what wonders await as more longitudes are drawn across the global map (32 polar orbits separated by <12° longitude) that the Juno mission was designed to acquire.