Contributed Talk

Splinter Computation

Simulating the Jupiter's interior dynamics

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With Juno orbiting Jupiter, new insights on the planets magnetic field and interior structure have started to arrive. We conduct numerical simulations of the internal dynamo process to help interpreting the measurements. The simulations were performed with the MHD code MagIC freely available at GitHub. MagIC uses pseudospectral methods to solve for convection and magnetic field generation in a rotating spherical shell, using the anelastic approximation. We explore various parameter combinations as well as different internal density and electrical conductivity profiles using the Max-Planck super computer in Garching. Key to a Jupiter-like dynamo process is a combination of a steep density stratification and an electrical conductivity profile that captures the transition from the weakly conducting outer molecular hydrogen envelope to inner metallic hydrogen layer. In addition, the vigor of the convective driving (Rayleigh number) needs to be adjusted. Weak driving yields too simplistic field geometries while strong driving promotes multipolar rather than dipole dominated magnetic fields. The surface magnetic fields only closely resemble known magnetic field models when the convective driving is intermediate. The convective flow is dominated by a realistic prograde equatorial jet but lacks multiple mid to high latitude jets which, according to our simulations, seem incompatible with a Jupiter like magnetic field. Dynamo action is a combination of two processes: A primary process generates the large scale dipole dominated field in the deeper metallic region. At the transition to the weakly conducting outer layer, the equatorial jet drives a secondary dynamo that produces strong low-latitude magnetic features reminiscent of the recent Juno observations.