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(M)HD: The surprisingly weak role of Lorentz forces in planetary dynamo models ERIC KING, UC Berkeley — It is often thought that the fluid dynamics occurring within Earth's liquid metal outer core (and within the magnetic field generating regions of other planets) are governed by two dominant forces: the Coriolis force, resulting from rapid planetary rotation; and the Lorentz force, caused by the resistance of magnetic field lines to bending by flow. These two forces, acting together, are typically thought to reach an equilibrium state known as the magnetostrophic balance. We investigate the role of the Lorentz force in these systems using numerical models and laboratory analogs of core fluid dynamics. First, results from hydrodynamic rotating convection studies are applied to planetary dynamo models. Second, we investigate specifically the role of Lorentz forces by directly comparing planetary convection models with and without magnetic field generation. Both studies indicate, perhaps surprisingly, that the influence of magnetic fields is (in many ways) secondary, suggesting that convection motions in planetary dynamos may not be in magnetostrophic balance, as is typically assumed. We explain this result by reformulating the customary non-dimensional parameter used to define the force balance in a way that is more appropriate to dynamos.

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