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**Predicting Magnetic Constraint in MHD Convective Simulations**

IMOGEN CRESSWELL, University of Colorado, Boulder, EVAN ANDERS, Northwestern University, BENJAMIN BROWN, University of Colorado, Boulder, JEFFREY OISHI, Bates College, GEOFFREY VASIL, University of Sydney — Strong background magnetic fields inhibit fluid flow in convective regions, as seen in sunspot generation and phenomena such as flux separation. Understanding the nature of this convection is crucial to the developing theory of magnetoconvection and its effects on astrophysical systems. In this work, we study MHD Rayleigh-Bernard convection under the Boussinesq approximation using the Dedalus pseudospectral framework. We perform a suite of 2D simulations in which we vary the strength of the strong background magnetic field and the strength of convective driving (quantified by the Chandrasekhar number and the Rayleigh number, respectively) by many orders of magnitude. We measure & report the scaling of the magnitude of the evolved vertical magnetic field as well as the heat transport in terms of the Nusselt number. Using these measurements, we develop a predictive parameter that predicts *a priori* the degree of magnetic constraint felt by the nonlinear convective solution. This parameter will enable numericists to run targeted simulations in specific regimes of magnetic constraint in order to understand convection in sunspots and other magnetised natural environments.

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