Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Penetrative internally heated convection in two and three dimensions DAVID GOLUSKIN, University of Michigan, ERWIN VAN DER POEL, University of Twente — We carry out 2D and 3D direct numerical simulations of penetrative convection in a fluid layer. The convection is driven by uniform internal heating between top and bottom plates of equal temperature. The Prandtl number is varied between 0.1 and 10, and a Rayleigh number based on the heating rate is varied up to 5×10^{10}. The asymmetry between upward and downward heat transport is greatly affected by spatial dimension. The fraction of internally produced heat escaping across the bottom plate, as opposed to the top one, is 1/2 without flow and initially falls as convection strengthens. As convection becomes very strong, however, this fall continues in 3D but reverses in 2D. The mean fluid temperature is much less sensitive to dimension, growing with the heating rate (H) like $H^{4/5}$ in both 2D and 3D. We draw analogy between the inverse of this fluid temperature and the Nusselt number in ordinary Rayleigh-Bénard convection.

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Date submitted: 29 Jul 2015