Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Direct numerical simulations of turbulent MHD flow in a 2:1 aspect ratio rectangular duct subjected to transverse and span-wise magnetic fields R. CHAUDHARY, A.F. SHINN, B.G. THOMAS, S.P. VANKA, University of Illinois at Urbana-Champaign — Magnetic fields are used to control flows in a variety of applications, notably in materials processing. One such process is continuous casting of steel which uses different types of magnetic fields to alter the flow, inclusion transport and multiphase flow in order to reduce defects in cast steel. Under a strong magnetic field, a turbulent flow can be altered significantly to the point that turbulence is completely suppressed and the flow is laminarized In the present study, we have considered a periodic duct with an aspect ratio of 2:1 and subjected to a magnetic field either on the broad side or on the narrower side. We have conducted DNS of five different cases, with two magnetic field intensities in either direction and compared them with the case of no magnetic field. Calculations have been performed for Hartmann numbers of 0, 6.0 and 8.5 at a Reynolds number (based on bulk velocity) of 5000. The grid used consisted of 512 x 120 x 224 control volumes with grid stretching in the cross-stream directions. Various turbulence and mean flow statistics have been computed to characterize the effects of the magnetic field. We believe these results can be valuable additions to the databases that can be used for turbulence model development.

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Date submitted: 04 Aug 2010 Electronic form version 1.4