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Transitional liquid metal duct flow near a magnetic dipole SASKIA TYMPEL, THOMAS BOECK, JOERG SCHUMACHER, University of Technology Ilmenau, Germany — The flow transformation and the generation of vortex structures by a strong magnetic dipole field in a liquid metal duct flow is studied by means of three-dimensional direct numerical simulations. The dipole is considered as the paradigm for a magnetic obstacle which will deviate the streamlines due to Lorentz forces which act on the fluid elements. The duct is of square cross-section. The dipole is located above the top wall and is centered in spanwise direction. Our model uses the quasi-static approximation which is applicable in the limit of small magnetic Reynolds numbers. The analysis covers the stationary flow regime at small hydrodynamic Reynolds numbers Re as well as the transitional time-dependent regime at higher values which may generate a turbulent flow in the wake of the magnetic obstacle. We present a systematic study of these two basic flow regimes on Re and on the Hartmann number Ha, a measure of the strength of the magnetic dipole field. Furthermore, several orientations and positions of the dipole are compared. The most efficient generation of turbulence at a fixed distance above the duct follows for the spanwise orientation which is caused by a certain configuration of Hartmann layers and reversed flow at the top plate.

Saskia Tympel
University of Technology Ilmenau, Germany

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