Magnetohydrodynamic duct flow at $Re = 10^5$ and strong magnetic field$^1$ OLEG ZIKANOV, University of Michigan - Dearborn, DMITRY KRASNOV, THOMAS BOECK, Ilmenau University of Technology — We present the results of high-resolution DNS of the magnetohydrodynamic flows in a duct of square cross-section. The walls of the duct are electrically insulating and the imposed magnetic field is constant, uniform, and parallel to one set of walls. The simulations are performed at the Reynolds number based on the mean velocity and duct half-width $Re = 10^5$ and the Hartmann number $Ha$ varying from 0 to 400, i.e. in the range of parameters never before addressed in computational analysis. The numerical model is based on a conservative finite-difference scheme and uses the grid consisting of up to $2048 \times 768^2$ points. The results show a sequence of flow regimes that appear with increasing $Ha$: a turbulent flow with suppressed momentum transfer in the sidewall (parallel to the magnetic field) boundary layers, a flow with laminar core and turbulent sidewall layers, a flow with laminar core and quasi-two-dimensional structures in the sidewall layers, and, at $Ha=400$, a completely laminarized flow.

$^1$The work is supported by the DFG through Graduiertenkollegs GRK 1567 and by the NSF through grant CBET 096557.

Oleg Zikanov
University of Michigan - Dearborn

Date submitted: 04 Aug 2011