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Transition in MHD duct flow OLEG ZIKANOV, University of Michigan - Dearborn, DMITRI KRASNOV, Ilmenau University of Technology, MAURICE ROSSI, Universite Pierre et Marie Curie, THOMAS BOECK, Ilmenau University of Technology — A magnetic field applied to a flow of an electrically conducting fluid (e.g., a liquid metal) suppresses turbulence and can transform the flow into a weakly turbulent or laminar state. This situation is common in technological applications, such as metallurgy, materials processing, and liquid metal cooling for fusion reactors. The understanding and prediction of transition in MHD flows is therefore not only of interest from a theoretical perspective. We investigate the transition in the flow in a rectangular duct with electrically insulating walls and uniform transverse magnetic field. The essential features of the flow are the sidewall and Hartmann boundary layers on the walls parallel and perpendicular to the applied field. The transition mechanism based on the transient finite-amplitude growth is analyzed using numerical simulations with a highly conservative finite-difference scheme. The presented results include the identification and parametric study of optimal modes, which are found to be three-dimensional and localized in the sidewall layers. We also investigate, using the DNS approach, the growth and breakdown of the optimal modes leading to turbulence. Financial support is by the DFG (Bo 1668/2-4, 1668/5-1) and NSF (CBET 096557).

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