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Direct numerical simulation of laminar MHD pipe flow at high Hartmann number STIJN VANTIEGHEM, Universite Libre de Bruxelles, XAVIER ALBETS-CHICO, University of Cyprus, BERNARD KNAEPEN, Universite Libre de Bruxelles — We investigate the laminar flow of an incompressible electrically conducting fluid through a straight circular pipe under influence of a homogeneous magnetic field. The magnetic Reynolds number is small compared to one, such that the quasi-static approach is valid. The morphology of the flow is then determined by the boundary condition for the electric potential, and one single parameter, the Hartmann number (Ha). In this study, we present cases up to Ha=2000 for different values of the wall conductivity. The velocity profile is calculated on a non-structured mesh with a finite-volume method. Comparison between numerical results on the one hand, and analytical solutions or asymptotic approximations (for high Ha) on the other hand, allow us to estimate the number of required grid nodes needed to obtain an accurate and stable solution. Our simulations show that this number increases rapidly with Ha. The stability of the numerical procedure also depends strongly on the spatial discretisation scheme. Furthermore, we highlight the presence of side jets in the case of conducting walls. These jets were not previously observed with other computational methods such as the asymptotic approximation.

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