Note on braking and stabilization laws for buoyant flows under a weak magnetic field

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Abstract

We consider the effect of a constant magnetic field on buoyant flows generated by temperature gradients. We focus on the domain of weak magnetic fields, i.e., small values of the Hartmann number $Ha$, for which general scaling laws can be derived. Concerning the braking of these buoyant flows, it was found to scale at small $Ha$ as even powers of $Ha$. Concerning the damping of the oscillations, it can be shown that the instability characteristics, critical threshold expressed through the critical Grashof number $Gr_c$, critical eigenvector, and critical pulsation also scale as even powers of $Ha$. In particular, this gives an initial MHD stabilization effect at small $Ha$ of the form $Gr_c - Gr_{c_0} \sim Ha^2$ where $Gr_{c_0}$ is the critical Grashof number at $Ha=0$. These findings have been illustrated by results obtained in the case of the flow in an infinite layer.

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