INFLUENCE OF THE VERTICAL HOMOGENEOUS FIELD ON THE STABILITY OF THE SYSTEM PERMEATED BY A SHEARED MAGNETIC FIELD

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System formed by a horizontal unstably stratified layer rotating at angular velocity $\mathbf{\Omega} = \Omega_0 \hat{\mathbf{z}}$ about the vertical z and permeated by a non-homogeneous sheared horizontal magnetic field of the form $\mathbf{B}_0 = B, \tanh \gamma (z - z_0) \hat{\mathbf{y}}$ will be examined. The parameter γ measures the sharpness of the tanh-function in vicinity of z_0. Heating is secured by the adverse temperature gradient $\boldsymbol{\beta} = -\beta \hat{\mathbf{z}}$, ˆz, where $\beta = -\frac{dT}{dz}$, T being the temperature. Addition of the vertical homogeneous field $\mathbf{B}_v = B_v \hat{\mathbf{z}}$, which should represent the poloidal part of the geomagnetic field, will enrich the system by a new dynamic feature and will influence its stability conditions. In the dimensionless form the value B_v measures the ratio of the poloidal part of the field and the toroidal one.

A finite electric conductivity of the fluid is a destabilising factor in the homogeneous layer and the obtained instabilities are resistive ones. The important feature of the proposed system is the presence of the critical level defined by the condition $\mathbf{k} \cdot \mathbf{B} = 0$, around which the horizontal part of the field is sheared, where $\mathbf{k}$ is the wave vector of a perturbation and $\mathbf{B}$ is the total imposed ambient magnetic field. The position of the critical level is determined by the parameter z_0. Motivation for sheared magnetic fields stability investigation lies in the attribute of the toroidal magnetic field in the Earth's liquid core that is anti-symmetric with respect to the equator. The stability of the system will be examined for various positions of the critical level determined by z_0. It was found that in the case when $B_v = 0$ the obtained convection patterns strongly depended on z_0 and mostly the preferred motions were stationary. Addition of the nonzero vertical field influences not only the stability conditions of the system, but it also makes the convective motions non-stationary. Conditions for the onset of magnetically and thermally driven instabilities are studied also in dependence on various boundary conditions (perfectly conducting, insulating boundaries or mixed thereof).

resistive instabilities, magnetohydrodynamics

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