Impact of rotation on thermal instability in compressible partially ionized plasma: Linear and nonlinear analysis

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ABSTRACT

This study examines the effect of rotation on the thermal instability of compressible partially ionized plasma using both linear and nonlinear analyses. The plasma is confined between various combinations of rigid and free-bounding surfaces. Nonlinear stability is analysed via the energy method, while linear stability is assessed through normal mode analysis, with the eigenvalue problems formulated for both analyses. The Galerkin-weighted residual method is employed to solve these eigenvalue problems for different boundary conditions. Results show that collisional effects significantly influence energy decay but do not impact system stability in stationary convection. The identical Rayleigh numbers obtained from both analyses indicate the absence of subcritical region, confirming global stability. Additionally, the study explores the impact of various parameters on oscillatory convection, noting that both rotation and compressibility stabilize the system. It is found that at low rotation rates, the plasma is most stable when confined between rigid-rigid surfaces, whereas at high rotation rates, it is most stable between free-free surfaces.

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