Thermal convection in a rotating Navier-Stokes-Voigt fluid saturating a porous medium using a non-equilibrium model

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Abstract

This study investigates the onset of thermal convection in a rotating Navier-Stokes-Voigt fluid within a porous medium, considering thermal non-equilibrium by employing separate temperature equations for the fluid and solid phases. The rotational effects are incorporated through the Coriolis term in the Navier-Stokes equations. Nonlinear and linear analyses are conducted using the energy method and normal mode analysis to formulate eigenvalue problems. The fluid is constrained by three different combinations of free and rigid bounding surfaces. The nonlinear and linear analyses yield identical Darcy-Rayleigh numbers, indicating global stability. Asymptotic analysis provides insights into the system's behavior under extreme thermal conditions. Graphical analysis examines the effects of rotation, medium permeability, heat transfer, and porosity on the onset of thermal convection. The study also observes the impact of the viscoelastic parameter on energy dissipation, revealing an exponential decay under the Kelvin-Voigt parameter condition.