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SYMMETRY AND CONVECTION IN FLUIDS WITH TEMPERATURE-DEPENDENT VISCOSITY

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The study of instabilities in fluids in which viscosity experiences a transition at a certain temperature range is of great interest for the understanding of planetary interiors, since this phenomena is suitable for representing a lithosphere over a convecting mantle. To this end, we study a 2D convection problem in which viscosity depends on temperature by abruptly changing its value within a narrow temperature gap. This is modeled by means of an arctangent law. We address the numerical study of this problem at infinite Prandtl number in the presence of O(2) symmetry. We perform a study which combines bifurcation analysis and time dependent simulations. The O(2) symmetry is particularly well described by spectral methods and this motivates the use of these methods in this context. To this end we propose a spectral numerical method to solve the time evolution of this problem [1].
The effects of two different widths on the viscosity transition are explored for the chosen law. Solutions such as traveling waves and limit cycles are found which are fundamentally related to the presence of the O(2) symmetry [2,3]. Bifurcations diagrams and time dependent solutions are described in different regimes. Of particular interest among the time dependent solutions is the existence of some in which spontaneous plate-like convection emerge. The plate-like evolution alternates motions towards either right or left, introducing temporary asymmetries on the convecting styles.

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