Magnetohydrodynamic convectons

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ABSTRACT

Convectons are spatially localized regions of convection embedded in a quiescent back-ground. States of this type were found in numerical studies of magnetoconvection in both two and three spatial dimensions [1,2]. But despite its important role in identifying convectons numerical continuation has not been applied to the equations of magnetoconvection. Existing attempts to explain the existence of convectons in these equations use matched asymptotic equations valid in the limit of small diffusivity ratio or model equations in the spirit of the Swift-Hohenberg equation [3,4].

The magnetoconvection problem differs from other systems exhibiting convectons because of the presence of a conserved quantity, the magnetic flux associated with an imposed vertical magnetic field [5]. This fact is responsible for special features of the bifurcation diagram such as the existence of localized states outside the bistability region and a snaking diagram which is slanted [6].

We use numerical continuation on the magnetoconvection equations to characterize the properties of magnetohydrodynamic convectons and examine their stability properties as a function of imposed spatial period L. We show that the slanted snaking observed in [6] is a finite domain effect and describe in detail the transformation of slanted snaking into standard snaking with increasing L.

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