Convectons, anticonvectons, multiconvectons and drifting convectons in binary mixtures

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ABSTRACT

Recent years have seen rapid development in the theory of spatially localized structures in systems exhibiting bistability between a homogeneous or unstructured state and a periodic or structured state. The localized structures occupy a region of parameter space called the pinning region region and lie on a small number of solution branches that snake back and forth across this region. This structure and the stability properties of the associated localized states are now well understood, at least in the context of spatially reversible variational systems on the real line [1]. Many fluid systems exhibit spatially localized structures in both two and three dimensions. Of these the localized structures or convectons arising in binary fluid convection are perhaps the best studied [2]. A binary mixture with negative separation ratio heated from below develops a stabilizing concentration gradient via the (anomalous) Soret effect. The onset of convection takes place via a subcritical Hopf bifurcation that leads to a rich dynamical behaviour near the threshold. However, it is the presence of a strongly subcritical steady bifurcation of the conduction state beyond the Hopf bifurcation which favors the presence of convectons. Owing to horizontal midplane reflection symmetry, both even parity and odd parity convectons exist and are located in the pinning region. In this interval of Rayleigh numbers multiple convectons, of different lengths and either parity, are present.

In this work, we will present the properties of convectons in binary fluid convection in a two-dimensional laterally bounded domain [3], and we will discuss the effect of breaking the up/down reflection symmetry in a periodic domain. In this last case convectons coming from odd-parity convectons will necessarily drift. Results will be compared with the behaviour observed in a periodic domain with vertical boundary conditions preserving the up/down symmetry.

REFERENCES

[1] John Burke, Edgar Knobloch *Snakes and ladders: localized states in the SwiftHohenberg equation*, Phys. Lett. A **360**, 681688, 2007.

[2] Oriol Batiste, Edgar Knobloch, Arantxa Alonso, Isabel Mercader *Spatially localized binary-fluid convection*, J. Fluid Mech. **560**, 149-158, 2006.

[3] Isabel Mercader, Oriol Batiste, Arantxa Alonso, Edgar Knobloch *Convectons, anticonvectons and multiconvectons in binary fluid convection*, J. Fluid Mech. **667**, 586-606, 2011.