EFFECTS OF BROKEN SYMMETRY IN TURBULENT OR CHAOTIC SYSTEMS

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A number of authors (e.g Courvoisier et al. 2010, Zheligovsky 2011) have discussed the problem of long-wavelength instabilities of fully developed but homogeneous MHD states. This involves the construction of coupled mean-field momentum and induction equations whose coefficients depend on averaged properties of the undisturbed state. While in very simple cases there is a possiblility that the coefficients can be calculated, generally they have to be computed by applying a perturbation (for example a uniform magnetic field) to the basic state and measuring the response. Even though the dynamics is typically highly nonlinear and the response to even a very small perturbation typically finite in detail, one might hope that there are sensible mean responses, linear in the perturbation amplitude that can be captured by averaging. We have looked at a number of dynamical systems, both maps and ODEs as well as time dependent basic MHD states with an original average symmetry to see if this supposition is justified by adding small symmetry-breaking terms and investigating the average response. We find that it is not always possible to get a sensible answer and that what happens depends of the nature of the chaos in the basic state. This is compared with similar problems where the 'chaos' is not internal, but driven by random processes.

References

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