HETEROCLINIC CYCLE IN THE SPHERICALLY INVARIANT RAYLEIGH-BÉNARD PROBLEM: THE (3,4) MODE INTERACTION

Abstract. It is already known that structurally stable heteroclinic cycles between group orbits of equilibria can arise due to the symmetry of the problem [1]. For the spherical Rayleigh-Bénard problem with $O(3)$-symmetry, Chossat and Guyard [2] prove the existence of "simple" heteroclinic cycles connecting opposite axisymmetric solutions of the even mode in the $(\ell, \ell+1)$ interaction of two consecutive spherical modes. This last study was undertaken in the so-called *self-adjoint* degeneracy framework which naturally appears for large scale convective motions in astrophysics. The interest of the $(3,4)$ interaction study is double: i) it constitutes an exception not mentioned in [2]: the heteroclinic cycles connect solutions with the cube symmetry , ii) it can occur in the geophysical GEOFLOW-experiment planned to run on the International Space Station. For this second case, the numerical results show another kind of degeneracy. The resulting dynamics lead to complex heteroclinic and homoclinic cycles which are quite different from the self-adjoint case. We will describe heteroclinic cycles in both cases (self-adjoint degeneracy and GEOFLOW-experiment) pointing out the main differences.

References

[1] D. Armbruster, J. Guckenheimer, and P. Holmes. Heteroclinic cycles and modulated waves in systems with $o(2)$-symmetry. *Physica D*, 29:257–282, 1988.

[2] P. Chossat and F. Guyard. Heteroclinic cycles in bifurcation problems with $o(3)$ symmetry and in the spherical bénard problem. *J. Nonlinear Sci.*, 6:201–238, 1996.