Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Geometric Diagnostics of Complex Patterns: Spiral Defect Chaos in Convection[1] HERMANN RIECKE, Northwestern University, SANTIAGO MADRUGA, Max-Planck-Institute for Physics of Complex Systems — Motivated by the observation of spiral patterns in a wide range of physical, chemical, and biological systems we present an approach that aims at characterizing quantitatively spiral-like elements in complex stripe-like patterns. The approach provides the location of the spiral tip and the size of the spiral arms in terms of their arclength and their winding number. In addition, it yields as topological information the number of pattern components (Betti number of order 1), as well as their size and certain aspects of their shape. We apply the method to spiral defect chaos in thermally driven Rayleigh-Bénard convection and find that the winding number of the spirals, but not their arclength, is non-monotonic in the heating. The distribution function for the number of spirals is significantly narrower than a Poisson distribution. The distribution function for the winding number decays approximately exponentially. For small Prandtl numbers the analysis reveals a large number of small compact pattern components. Including non-Boussinesq effects, we find that they not only break the up-down symmetry but also strongly increase the number of small, compact convection cells.

[1]Supported by NSF DMS-9804673 and DOE DE-FG02-92ER14303

Hermann Riecke
Northwestern University

Date submitted: 20 Nov 2006 Electronic form version 1.4