Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Statistical Equilibria of Turbulence on Surfaces of Different Symmetry[1] WANMING QI, BRAD MARSTON, Brown University — We test the validity of statistical descriptions of freely decaying 2D turbulence by performing direct numerical simulations (DNS) of the Euler equation with hyperviscosity on a square torus and on a sphere. DNS shows, at long times, a dipolar coherent structure in the vorticity field on the torus but a quadrapole on the sphere[2]. A truncated Miller-Robert-Sommeria theory[3] can explain the difference. The theory conserves up to the second-order Casimir, while also respecting conservation laws that reflect the symmetry of the domain. We further show that it is equivalent to the phenomenological minimum-enstrophy principle by generalizing the work by Naso et al.[4] to the sphere. To explain finer structures of the coherent states seen in DNS, especially the phenomenon of confinement, we investigate the perturbative inclusion of the higher Casimir constraints.

[1]Supported in part by NSF DMR-0605619.
[2]J. Y-K. Cho and L. Polvani, Phys. Fluids **8**, 1531 (1996).
[3]A. J. Majda and X. Wang, *Nonlinear Dynamics and Statistical Theories for Basic Geophysical Flows* (Cambridge University Press, 2006).
[4]A. Naso, P. H. Chavanis, and B. Dubrulle, Eur. Phys. J. B **77**, 284 (2010).

Wanming Qi
Brown University

Date submitted: 10 Nov 2011 Electronic form version 1.4