Abstract Submitted
for the NEF10 Meeting of
The American Physical Society

Statistical Equilibria of Turbulence on Surfaces of Different Symmetry

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of statistical descriptions of freely decaying two-dimensional turbulence by perform-
ing direct numerical simulations (DNS) of the Euler equation with hyperviscosity
on two surfaces of different symmetry, namely, the square torus and the sphere.
DNS shows, at long times, a dipolar coherent structure in the vorticity field on the
torus but a quadrupole on the sphere [1]. We look for a theoretical explanation in
the truncated Miller-Robert-Sommeria theory that conserves the fine-grained enstro-
phy, while also respecting conservation laws that reflect the symmetry of the domain.
This theory is shown to be equivalent to the phenomenological minimum-enstrophy
principle [2]. Finally, the theoretical results agree with DNS, and the calculation
reveals how the conservation of zero angular momentum forces the sphere to have
one more dipole pair than on the torus.


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Date submitted: 01 Oct 2010            Electronic form version 1.4