

**5R 5**      Finite-Time Vortex Singularity and the Kolmogorov Spectrum in a 3D Spiral Model.\* CHUNG-SANG NG, XIAOGANG WANG, and A. BHATTACHARJEE, U. of Iowa. --- A recent analytic model of highly symmetric three-dimensional Euler flows<sup>1</sup> which exhibits a finite-time vortex singularity is developed further. It was shown in Ref. 1 by asymptotic analysis of the Euler equation that the vorticity blows up at a velocity stagnation point as inverse time in a locally self-similar manner. By considering the Euler equation as an integro-differential system, with the pressure calculated by the Poisson equation, we can construct a flow with bounded energy. It is found that the singularity has to be supported by the self-consistent pressure generated by the local flow itself and that the locally self-similar model can provide such self-consistency. It is also shown that this locally self-similar model does not contradict a recent theorem which states that the direction of the vorticity in the initial state of the present model of the singular flow has to diverge sufficiently.<sup>2</sup> The presence of spiral structure leads to the model developed by Lundgren<sup>3</sup> in which the gradual tightening of spirals by differential rotation provides a mechanism for transfer of energy to small spatial scales. It is shown, by asymptotic analysis of the Navier-Stokes equation, that a time-average over the lifetime of the spiral vortex in the present model yields the Kolmogorov spectrum.

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<sup>1</sup>A. Bhattacharjee and Xiaogang Wang, Phys. Rev. Lett. 69, 2196 (1992).

<sup>2</sup>P. Constantin and C. Fefferman, Indiana Univ. Math. J., 42, 775 (1993).

<sup>3</sup>T. S. Lundgren, Phys. Fluids 25, 2193 (1982).