P. Belik: Fractal Powers in Serrin's Swirling Vortex Solutions

We consider a modification of the fluid flow model for a tornado-like swirling vortex developed by J. Serrin in 1972 where velocity decreases as the reciprocal of the distance from the vortex axis. Recent studies, based on radar data of selected severe weather events, indicate that the angular momentum in a tornado may not be constant with the radius, and thus suggest a different scaling of the velocity/radial distance dependence.

Motivated by this suggestion, we consider Serrin's approach with the assumption that the velocity decreases as the reciprocal of the distance from the vortex axis to the power b with a general $b > 0$. This leads to a boundary-value problem for a system of nonlinear differential equations. We analyze this problem for particular cases, both with nonzero and zero viscosity, discuss the question of existence of solutions, and use numerical techniques to describe those solutions that we cannot obtain analytically.

This is joint work with D. Dokken, K. Scholz and M. Shvartsman.