Title: Potentially singular behavior of 3D incompressible Navier-Stokes equations

Abstract: *Whether the 3D incompressible Navier-Stokes equations can develop a finite time singularity from smooth initial data is one of the Seven Clay Millennium Problems. In this talk, We study the nearly self-similar blowup of a variant of the axisymmetric Navier--Stokes equations with two different viscosity coefficients with smooth initial data. This variant can be viewed as a viscous axisymmetric Boussinesq system and preserves almost all the known properties of the Navier--Stokes equations except for the conservation of angular momentum. We use a small viscosity coefficient for the total circulation to generate a shock like traveling wave. We then apply a relatively large viscosity for the angular vorticity to stabilize the strong shearing instability induced by the sharp front of the total circulation. We present convincing numerical evidence that this variant of the axisymmetric Navier--Stokes equations produce a stable nearly self-similar blowup solution with maximum vorticity increased by a factor of 10^{21}. We also study the axisymmetric Euler equations with a solution dependent vanishing viscosity. We show that the solution develops a nearly self-similar blowup whose self-similar profile satisfies the axisymmetric Navier--Stokes equations with constant viscosity. Various blowup criteria are applied to confirm the potential finite time blowup of the Navier--Stokes equations.*