1125-65-1653 **Zhu Wang** (wangzhu@math.sc.edu), Department of Mathematics, University of South Carolina, Columbia, SC 29208, and **Lili Ju*** (ju@math.sc.edu), Department of Mathematics, University of South Carolina, Columbia, SC 29208. *Exponential Time Differencing Gauge Method for Incompressible Viscous Flows.*

To design efficient and accurate time integration schemes for numerically simulating incompressible viscous flows, such as those governed by Stokes or Navier-Stokes equations, the discretization and coupling of velocity and pressure need to be treated carefully for stability and consistency. The gauge formulation introduces a gauge variable and an auxiliary field for the fluids equations, and the resulting system contains a coupled momentum equation and a kinematic equation with certain consistent boundary conditions. In this talk, we present an exponential time differencing multistep method for solving the gauge system with high-order temporal accuracy. In particular, the momentum equation is completely decoupled from the kinematic equation in the discrete level at each time step and is solved by explicit exponential time stepping schemes. We rigorously prove that the first order exponential time differencing scheme is unconditionally stable for the Stokes flow. A compact representation of the method for problems on rectangular domains is also proposed, which makes FFT-based fast solvers available for the resulting fully discrete problems. Various numerical experiments are carried out to demonstrate the accuracy and stability of the method. (Received September 18, 2016)