

Department of Mathematics and Statistics. Texas Tech University.

Colloquium

On flows of implicitly constituted incompressible fluids

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Thursday, November 18, 2010

Room: CHEM 113, Time: 3:30pm

Refreshment is at 3:00pm, MA 238

ABSTRACT. We consider unsteady flows of incompressible fluids with a general implicit constitutive equation relating the deviatoric part of the Cauchy stress and the symmetric part of the velocity gradient in such a way that it leads to a maximal monotone (possibly multivalued) graph and the rate of dissipation is characterized by the sum of a Young function depending on the symmetric part of the velocity gradient and its conjugate being a function of the deviatoric part of the Cauchy stress. Such a framework is robust and includes, among others, classical power-law fluids, stress power-law fluids, fluids with activation criteria of Bingham or Herschel-Bulkley type, and shear-rate dependent fluids with discontinuous viscosities as special cases. The appearance of the symmetric part of the velocity gradient and the deviatoric part of the Cauchy stress in all the assumptions characterizing the considered class of implicit constitutive relationships is symmetric. We establish long-time and large-data existence of weak solution to such a system completed by the initial and Navier's slip boundary conditions in both subcritical and supercritical cases. We use tools such as Orlicz functions, properties of spatially dependent maximal monotone operators and Lipschitz approximations of Bochner functions taking values in Orlicz-Sobolev spaces. The lecture is based on joint works with M. Bulicek, P. Gwiazda, V. Prusa, K. R. Rajagopal and A. Swierczewska-Gwiazda.