Colloquium. Department of Mathematics and Statistics, Texas Tech University

Analysis of the Navier-Stokes systems and generalized Forchheimer flows

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ABSTRACT. In Part I of the talk, we first review the asymptotic expansions of Foias-Saut-type for all Leray-Hopf weak solutions of the three-dimensional Navier-Stokes equations of viscous, incompressible fluids with periodic boundary conditions, when the body forces decay in time either exponentially or algebraically. We then introduce appropriate systems of decaying functions and corresponding asymptotic expansions in those systems. We prove that if the force has a large-time asymptotic expansion in Gevrey-Sobolev spaces in such a general system, then any Leray-Hopf weak solution admits an asymptotic expansion of the same type. In Part II, we present recent studies of the generalized Forchheimer isentropic gas flows in porous media, and complex flows of mixed regimes, namely, pre-Darcy, Darcy and post-Darcy in the same domain. Rigorous estimates, continuous dependence and structural stability results are established.