# Navier–Stokes–Fokker–Planck Systems: Analysis, Approximation, Computation

Plenary lecture

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The lecture will survey recent developments concerning the existence of global-in-time weak solutions to a general class of coupled microscopic-macroscopic bead-spring chain models that arise in the kinetic theory of dilute solutions of polymeric liquids with noninteracting polymer chains, and their numerical approximation. The class of models involves the unsteady incompressible Navier–Stokes equations in a bounded domain for the velocity and the pressure of the fluid, with an elastic extra-stress tensor appearing on the right-hand side of the momentum equation. The extra-stress tensor stems from the random movement of the polymer chains and is defined by the Kramers expression through the associated probability density function that satisfies a Fokker–Planck type parabolic equation, a crucial feature of which is the presence of a center-of-mass diffusion term.

We also discuss computational challenges associated with the numerical approximation of the high-dimensional Fokker–Planck equation with unbounded drift in the model, by means of operator splitting techniques and greedy approximation of the high-dimensional Ornstein–Uhlenbeck operator featuring in Fokker–Planck equation.

The lecture is based on a series of recent papers with John W. Barrett (Imperial College London), David Knežević (Harvard University) and Leonardo Figueroa (Universidad de Concepción, Chile).

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