Department of Applied and Computational Mathematics and Statistics Colloquium

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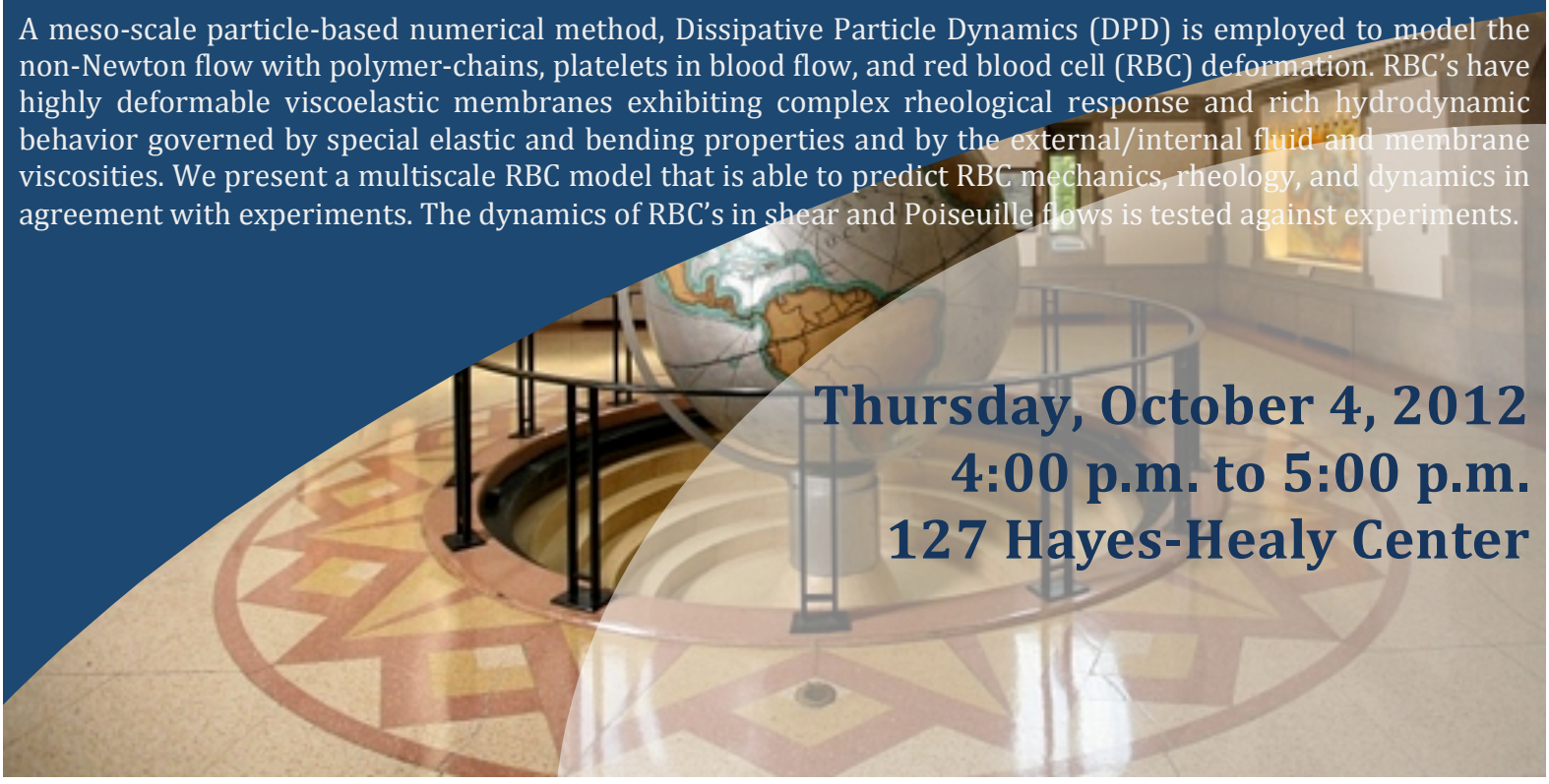
will give a lecture entitled:

Uncertainty Quantification of Complex Stochastic Systems and Multiscale Modeling of Blood Flows

Abstract

Experience suggests that uncertainties often play an important role in quantifying the performance of complex systems. Therefore, uncertainty needs to be treated as a core element in modeling, simulation and optimization of complex systems. In this talk, a new formulation for quantifying uncertainty will be discussed. An integrated simulation framework will be presented that quantifies both numerical and modeling errors in an effort to establish "error bars" in CFD. In particular, stochastic formulations based on Galerkin and collacation versions of the generalized Polynomial Chaos (gPC) will be discussed. Additionally, we will present some effective new ways of dealing with this "curse-of–dimensionality". Particularly, adaptive ANOVA decomposition, and some stochastic sensitivity analysis techniques will be discussed in some detail. Several specific examples on flow and transport in randomly heterogeneous porous media, random roughness problem, uncertainty quantification in carbon sequestration and parameter estimation in climate models will be presented to illustrate the main idea of our approach.

A meso-scale particle-based numerical method, Dissipative Particle Dynamics (DPD) is employed to model the non-Newton flow with polymer-chains, platelets in blood flow, and red blood cell (RBC) deformation. RBC's have highly deformable viscoelastic membranes exhibiting complex rheological response and rich hydrodynamic behavior governed by special elastic and bending properties and by the external/internal fluid and membrane viscosities. We present a multiscale RBC model that is able to predict RBC mechanics, rheology, and dynamics in agreement with experiments. The dynamics of RBC's in shear and Poiseuille flows is tested against experiments.



Thursday, October 4, 2012
4:00 p.m. to 5:00 p.m.
127 Hayes-Healy Center