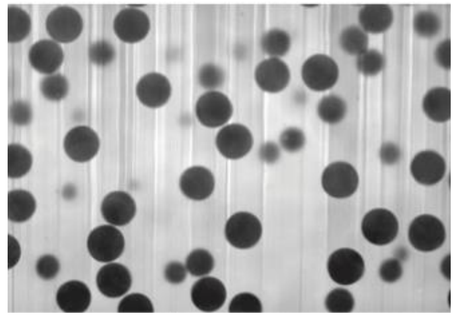
Effect of Particle Roughness on Shear-Induced Diffusion in Concentrated Suspensions

Phong Pham[1,2], Bloen Metzger[2], and Jason E. Butler[1]

[1]Department of Chemical Engineering, University of Florida, Gainesville, FL 32611; [2]IUSTI-CNRS UMR 7343, Aix-Marseille University, France

Goals

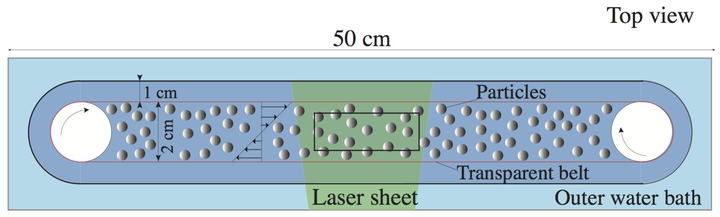
- **Developing accurate and rapid predictive capabilities for slurry dynamics.**



- For flows of concentrated suspensions (ϕ >30%), fluctuations in particle positions can not be predicted even qualitatively: *resolving this fundamental question will advance modeling capabilities.*
- Work focuses on the effect of particle roughness, ϵ ,on transverse hydrodynamic diffusion (D^*_{yy}) in concentrated suspensions composed of
  - large, rigid, and neutrally buoyant spheres
  - suspended in a viscous Newtonian fluid.

Experimental Methods

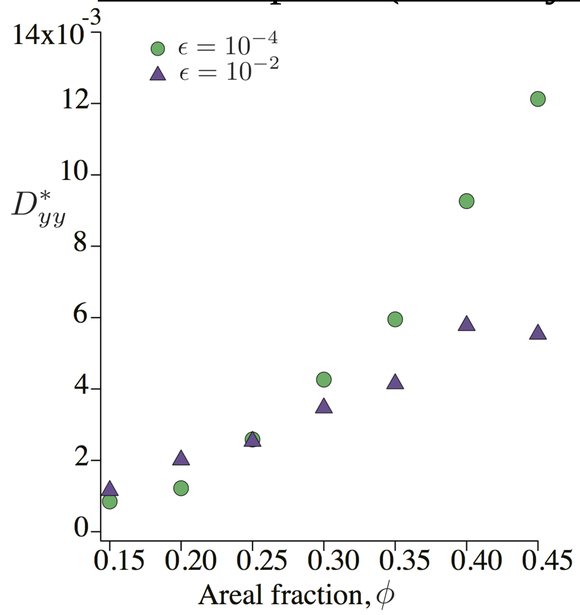
- Custom flow-cell with imaging capabilities to measure detailed dynamics.



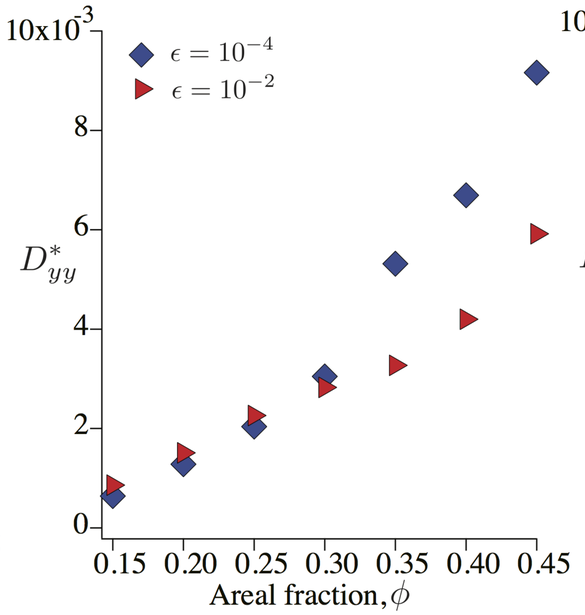
- Particles are non-colloidal (d = 2 mm).

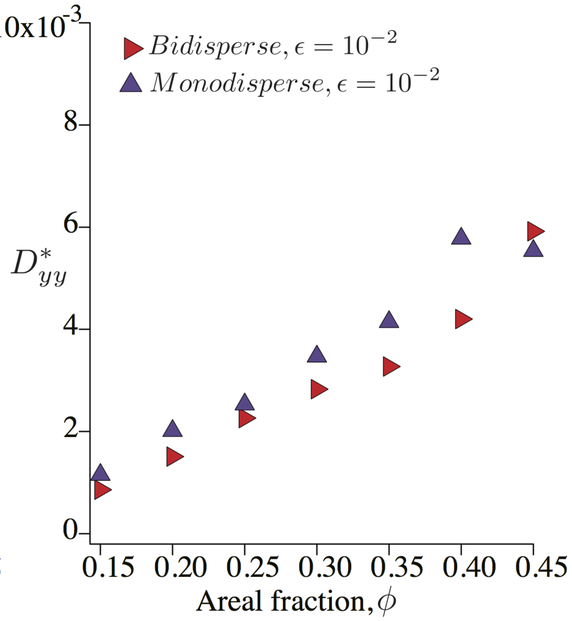
Results

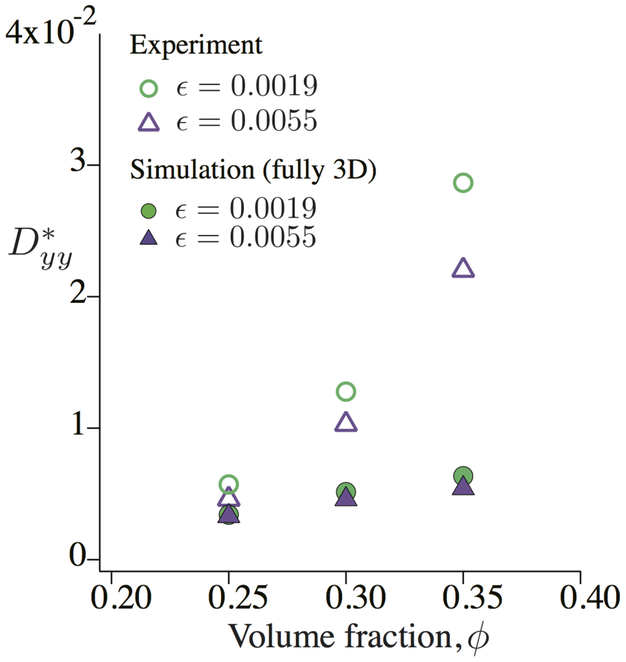
Monodisperse (monolayer)



Bidisperse (monolayer)







- Diffusion coefficient increases with particle roughness for small volume fractions, but ***decreases as particle roughness increases*** for high volume fractions.
- Identical trends are also seen for the case of bidisperse spheres.
- Experimental data confirms the simulation data.

Outcomes/Deliverables

- Solid-solid contacts control the dynamics and microstructure in viscous concentrated suspensions. This insight has exciting implications for modeling the dynamics of viscous slurries.
- Incorporating this insight into more general flows is resulting in enhanced accuracy and performance of calculations used to validate and predict suspension dynamics.

Acknowledgement: This material is based upon work supported by the National Science Foundation under Grant No.1362060 and by CPaSS industry members.