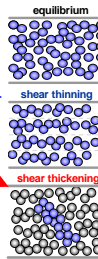
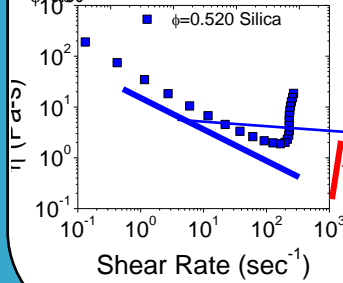
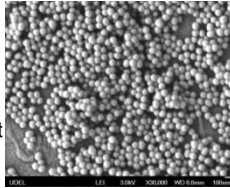


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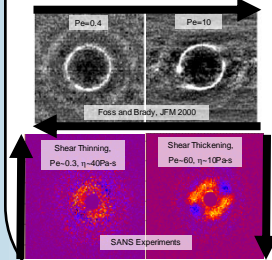
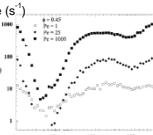
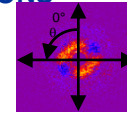
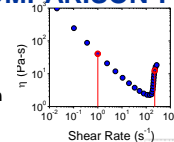
## SUSPENSION PROPERTIES

Commercial Spherical Silica Particles  
Near Hard-Sphere, surface stabilized  
~120nm diameter (SEM, SANS)  
Suspended in Newtonian, partly  
deuterated PEG/EG mixture  
Strongly, continuously shear thickening at  
 $\phi=0.50$



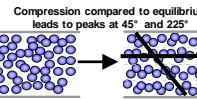
## SANS GIVES STRUCTURE COMPARISON TO SIMULATIONS

Simulation  $g(r)$  shows high and low particle concentrations in same location as scattering measurement.



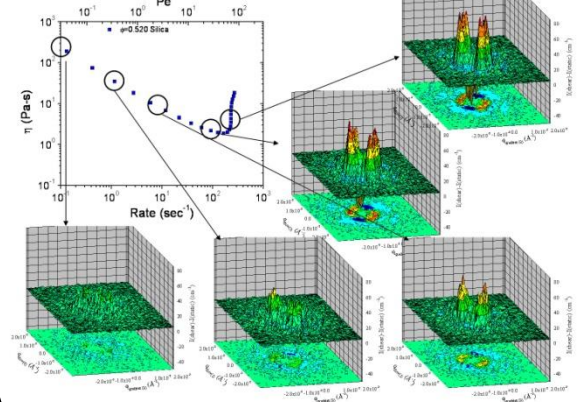
Morris and Katyal, Physics of Fluids, 2002

1-2 Plane SANS measurements

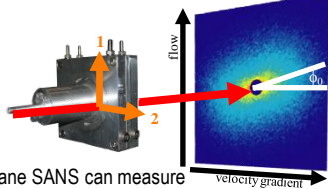


## GROWTH OF STRUCTURE BY SANS

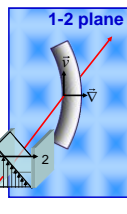
3-D PLOTS SHOW SANS UNDER SHEAR WITH STATIC SANS SUBTRACTED - REVEAL STRUCTURAL CHANGES



## FLOW-SANS

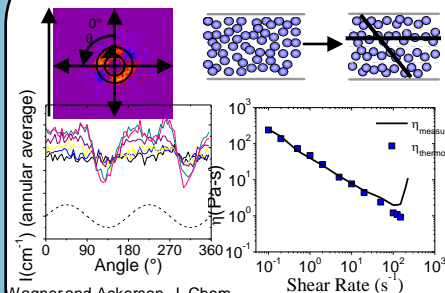


1-2 Plane SANS can measure structure directly in shear plane. Now can measure in all 3 planes of shear to match microstructural changes to rheological changes.



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## SANS THERMODYNAMIC VISCOSITY



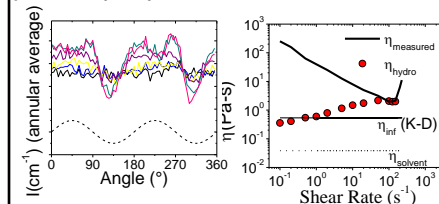
Wagner and Ackerson, J. Chem. Phys., 1992

$$P_{21} = \int_0^{2\pi} \frac{I(q, \theta, \dot{\gamma})}{I(q, \theta, \dot{\gamma} = 0)} \cos \theta \sin \theta d\theta$$

Note: First microstructural measurements of thermodynamic stress that drives shear thinning.

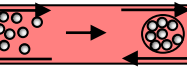
## SANS HYDRODYNAMIC VISCOSITY

Total increased scattering at peak from hydrodynamics



Maranzano and Wagner, J. Chem Phys., 2002

$$P_1 = \int_0^{2\pi} \left( \frac{I(q, \theta, \dot{\gamma})}{I(q, \theta, \dot{\gamma} = 0)} - 1 \right) d\theta$$



$$\eta_{hydro} \approx 2.4 \zeta P_1(\dot{\gamma})$$

Challenge: Need data at high stresses in strongly shear-thickened state.

## CONCLUSIONS

- First structural measurements on suspensions performed in shear plane
- Structure anisotropy in shear plane agrees with simulations and theory at low and moderate Pe
- Structure-property relations work to compare SANS measurements to rheology

## ACKNOWLEDGEMENTS

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