Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Connecting nanoscale motion and rheology of gel-forming colloidal suspensions HONGYU GUO, Physics, Johns Hopkins University, SUBRAMANIAN RAMAKRISHNAN, Chemical and Biomedical Engineering, Florida State University, JAMES HARDEN, Physics, University of Ottawa, ROBERT LEHENY, Physics, Johns Hopkins University — We report a combined x-ray photon correlation spectroscopy (XPCS) and rheometry study of the evolution of concentrated suspensions of nanometer-scale colloids undergoing gelation and aging. The suspensions are comprised of silica colloids, 45 nm in diameter, stabilized with octadecyl-hydrocarbon chains in decalin at colloidal volume fractions near 0.20. At low temperature, the solvent quality is poor for the octadecyl chains, leading to a weak, temperature-dependent, short-range attraction between the colloids that drives a reversible gel transition. Following a quench through this transition, the shear modulus grows rapidly as a function of time after an extended induction period. The intermediate scattering function measured with XPCS displays two features, a plateau value that provides information about constrained local dynamics in the gel and a terminal relaxation time that provides information about relaxation of residual stress. From the wave-vector dependence of the plateau value, a localization length can be extracted. Except at early times, the relationship between the localization length and the shear modulus agrees quantitatively with the prediction of Chen and Schweitzer based on a simplified mode coupling theory.

James Harden
Physics, Unversity of Ottawa

Date submitted: 20 Nov 2009 Electronic form version 1.4