Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

X-ray photon correlation spectroscopy studies of structural irreversibility in a colloidal gel subjected to oscillatory shear flow MU SUNG KWEON, WESLEY BURGHARDT, Northwestern University, SUBRAMANIAN RAMAKRISHNAN, GOLDA LOUIS, DANICA THOMAS, Florida State University, SURESH NARAYANAN, Argonne National Laboratory — X-ray photon correlation spectroscopy (XPCS) is used to probe the microscopic structural reversibility in a colloidal gel subjected to oscillatory shear flow. Silicon dioxide particles in decalin aggregate into a gel structure as a result of depletion interactions associated with dissolved polystyrene molecules. XPCS studies on aged quiescent gels show negligible structural dynamics on time scales of tens of seconds. Such samples were subjected to oscillatory shear with varying stain amplitude using a rheometer installed in the XPCS beam line and x-ray capable polycarbonate fixtures; this enable simultaneous rheological measurements during the XPCS experiment. In the presence of unidirectional shear flow, the decay of the XPCS autocorrelation function is dominated by the convective motion induced by the applied deformation. In oscillatory shearing of samples in the absence of significant structural relaxation, the autocorrelation function becomes periodic, returning to its initial value once every oscillation period. At higher strains, irreversible motions at the microscopic level lead to decay in the 'echos' of the autocorrelation function. Interestingly, structural irreversibility is detected by XPCS only at strains that are significantly higher than those at which nonlinearity

Wesley Burghardt
Northwestern University

Date submitted: 14 Nov 2014 Electronic form version 1.4