Colloidal Glasses and Supercooled Liquids

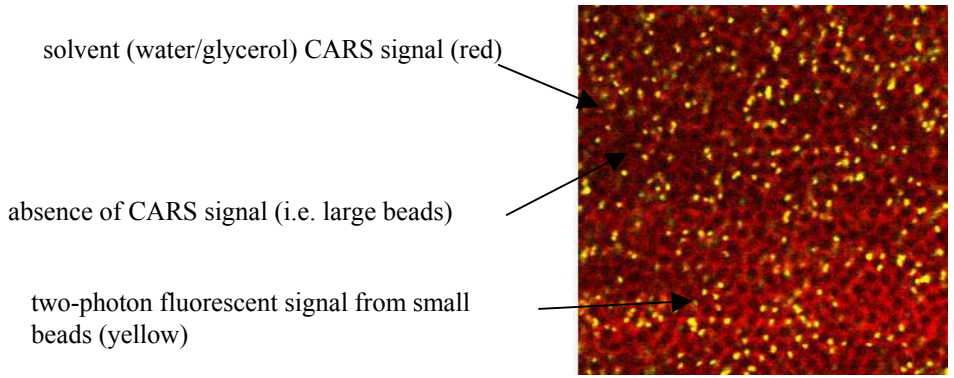
Colloidal systems (comprised of small particles [10 nm – 10 μm] dispersed in a solvent) demonstrate many of the properties of atomic systems. Though much of the behavior of these systems resembles that of atomic systems, the colloidal behavior occurs on length and time scales orders of magnitude longer, making their behavior accessible to a wide variety of experimental techniques, including microscopies.

CARS microscopy is a nonlinear microscopy using two picosecond lasers to induce coherent Raman scattering from samples containing a particular species with a vibrational energy level equal to the difference of the frequencies between the two lasers. It is a non-perturbative and species selective microscopy and is an ideal probe for colloidal systems:

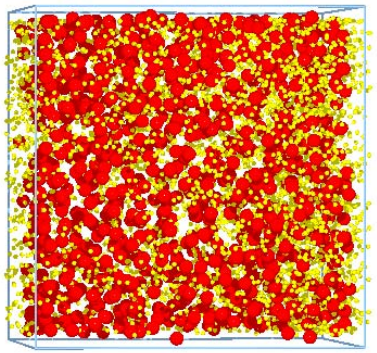
Local information available--correct time and length resolution for studying colloids
Good resolution (~ 300nm lateral, ~ 800nm axial) -- intrinsic 3D resolution
No labeling necessary -- no perturbations to the system (swelling, charging), no long time bleaching

Dual CARS/two photon fluorescent image of a dense binary colloidal mixture.
CARS image of r = 1μm silica beads. Contrast comes from tuning into a vibrational band of the solvent
Simultaneous two photon fluorescent image of r = 200 nm labeled polystyrene beads.

Two dimensional image in time



Three dimensional reconstruction



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