Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad - 500107

Seminar

Insights into deformation and flow of glasses using colloidal suspensions

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Glasses are amorphous solids that have exceptional mechanical properties. Despite decades of research, our understanding of deformation of glasses is far from complete. This is primarily because the answers to several outstanding questions are hidden in the microscopic physics of the system, and experimental challenges make it inaccessible in atomic systems.

In recent years dense colloidal suspensions made of micron sized particles have been established as good model systems to study glasses. Due to crowding, dense colloidal suspensions exhibit many features similar to atomic glasses. For example, they display linear elastic behavior at small applied stresses, steady plastic flow at larger stresses, and also shearbanding transition with increasing shear rates. Besides these similarities, colloidal suspensions enable direct visualisation of particle trajectories in three dimensions. We have tracked trajectories of nearly a quarter million particles using confocal microscopy to obtain unprecedented amount of microscopic data on flow of colloidal glasses.

We have computed local strain from particle trajectories to construct spatial maps of deformation in sheared colloidal glasses. These maps reveal a very heterogeneous pattern; plastic deformation occurs in localized regions that we refer to as shear transformation zones. Further, the spatial correlations of particles strain reveal that shear transformation zones are associated with a long-range quadrupolar strain field. These results are reminiscent of strain field around an Eshelby's inclusion in isotropic elastic materials. Our experiments have also provided new insights into shearbanding instability, which is a generic instability in flows of many complex fluids. If time permits, I will also touch upon the mechanism of yielding in amorphous solids.

Thursday, Mar 28th 2019

11:30 AM (Tea/Coffee at 11:00 AM)

Seminar Hall, TIFR-H