Static Length Scale in Glass Transition

Smarajit Karmakar

TIFR Centre for Interdisciplinary Sciences, Hyderabad

Email: smarajit@tifrh.res.in

Abstract:

Glasses are liquids whose viscosity has increased so much that they cannot flow. Accordingly there have been many attempts to define a static length-scale associated with the dramatic slowing down of supercooled liquid with decreasing temperature. In this talk, I will present a simple method to extract the desired length-scale which is highly accessible both for experiments and for numerical simulations. The fundamental new idea is that low lying vibrational frequencies come in two types, those related to elastic response and those determined by plastic instabilities. The minimal observed frequency is determined by one or the other, crossing at a typical length-scale which is growing with the approach of the glass transition. This length-scale characterizes the correlated disorder in the system: on longer length-scales the details of the disorder become irrelevant, dominated by the Debye model of elastic modes. After introducing the length-scale I will show how this scale completely determines the dynamics of the supercooled liquid under external constraints, thereby proving beyond doubt the static nature of the proposed length-scale. Then I will try to explain how this length scale can be used to explain all the finite size effects seen in simulations of glass forming liquids and its possible universal relation with the relaxation time. Finally I will try to establish the possible relation between this length scales and other proposed length scales like point to set length scale and patch length scale etc.