Invited speaker

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On the structure of glasses at the nanoscale: implications for mechanical properties and thermal transport

It is well known that glasses lack long range translational order but that they do have short range order. Over several decades evidence has accumulated that points to the existence of coherent structures at the nm scale, i.e. medium range order, for many, if not all, glasses. The broad features of said structures do not depend on external parameters such as temperature, density, pressure, and chemical or thermal history. That is, they are “universal”.
A model is proposed to account for the behavior of these medium range structures. To take into account their universality, continuum mechanics is used as a theoretical framework, and a glass is described as a Debye solid endowed with many randomly oriented elastic strings or, more precisely, Volterra dislocations. The normal modes of these strings account, in general, for the excess of normal modes over the Debye density of states observed in glasses, as well as for the specific inelastic X-ray scattering data of glycerol and silica in the 2-14 meV range. The atomic motion associated with the string dynamics is consistent with the soft modes recently identified in large-scale numerical simulations of non-phonon modes in Lennard-Jones glass.
Speculations will be offered as to the role played by the elastic strings in the thermal transport, as well as other, properties of glasses.

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References

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