Correlated Disorder and Viscoelasticity of Soft Colloidal Gels

Jorge M. Escobar-Agudelo[1], Danilo B. Liarte[1,2], Rui Aquino[1]

[1] Institute of Theoretical Physics, UNESP–São Paulo State University, São Paulo, SP, Brazil
[2] ICTP South American Institute for Fundamental Research, São Paulo, SP, Brazil

Within solid-state physics it is known that periodic networks can be used to describe crystalline solids. However, in nature, there are disordered structures that lack this periodicity, known as amorphous solids, which can be studied using topological and statistical tools [1]. Since these materials and the particularities in their structures are diverse, there is not yet a generalized theory that can describe them all, which represents an exciting challenge. In our case we will focus on colloidal gels [1]. The property we are most interested in is their subisosticity, which means they exhibit a rigid structure even when their average coordination number is below its critical value [2]. In other words, they are rigid even when the number of links between colloids is insufficient to counteract the non-trivial degrees of freedom of the system [3]. This has been attributed to internal stresses in the system [1] as well as the existence of spatial correlations in the gels [3], where the presence of a bond between two colloids affects the probability of bonds in the surroundings. Our objective is to design a theoretical model to predict this subisostaticity and study other universal properties of our system. We propose to generalize a mean-field theory, such as the coherent potential approximation, by introducing an appropriate description of the correlations.

References

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