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Systematic manipulation of disorder for extraordinary functionality in materials

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Abstract:

Much of materials science deals with ordered crystalline or polycrystalline materials that are designed and delicately fabricated to have specific desired properties. However, disordered materials, such as glasses or granular media, have an untapped potential: they can exist in a multitude of metastable states that are distinguished by their microstructure. While the vast majority of these states have similar bulk properties, there are a few rare cases that have spectacular behavior. The challenge, of course, is to direct the material to such targeted useful states that would never be discovered by chance alone. Inspired by biology, we meet this challenge by introducing material training protocols that allow evolution toward those desired states. In these protocols, the possible modes of relaxation are augmented by introducing extra transient degrees of freedom, such as particle radii, that allow an easier pathway to the target. Once that desired state is reached, the additional degrees of freedom are removed. Using this conceptual framework, we create stable jammed packings that exist in exceptionally deep energy minima marked by the absence of low-frequency quasilocalized modes; this added stability persists in the thermodynamic limit.

Date:
12/05/2022

Time:
9:00 AM-10:15 AM (PT)

About the speaker:

Dr. Hagh is a postdoctoral scholar at the James Franck Institute in the University of Chicago and a member of the Simons collaboration on cracking the glass problem. Varda received her Ph.D from Arizona State University where she studied rigidity and mechanical stability of disordered materials. In her postdoctoral work, Varda has been interested in developing novel computational techniques for introducing new behavior into materials.

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