Dynamics of Melting within Bulk Colloidal Crystals

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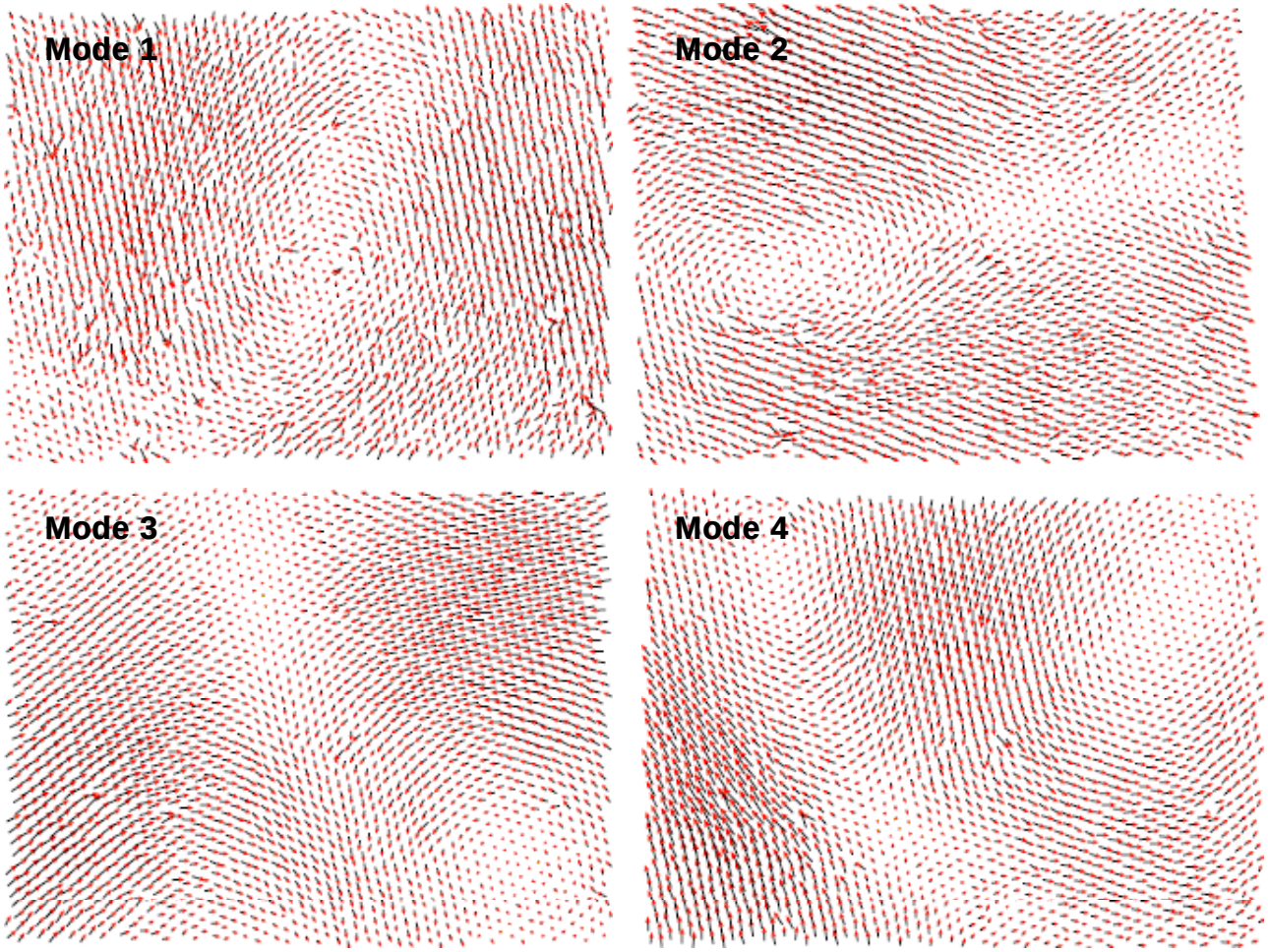
Spatial disorder can cause strong modification of physical properties of materials. For example, disorder in the geometric structure alone in structural glasses and amorphous systems are being speculated to cause excess low energy vibrational modes and inhomogeneity in force propagation.

We synthesized colloidal crystals made of spherical microgel particles that can exhibit tremendous variations in local bond length fluctuations despite a remarkably high degree of crystalline order in the equilibrium positions of the particles. We use real-time video microscopy, individual particle tracking and novel analysis technique to determine the low-energy vibrational modes and the density of vibrational modes in the presence of the strong heterogeneity.



We find that the lowest energy vibrational modes are dominated by a few long-wavelength plane-waves, and the density of vibrational modes shows Debye-like behavior at low energy despite the strong disorder.

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