Dynamics of Melting within Bulk Colloidal Crystals

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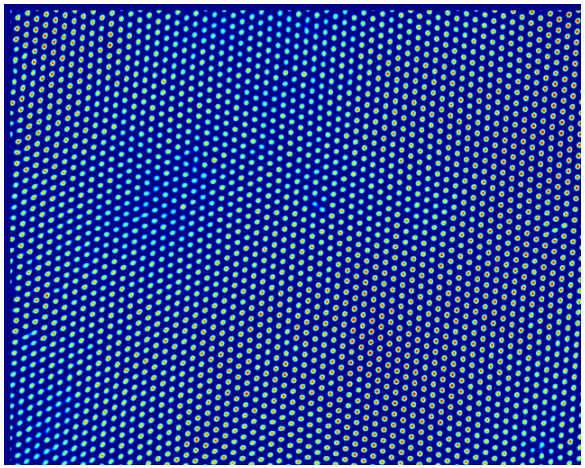
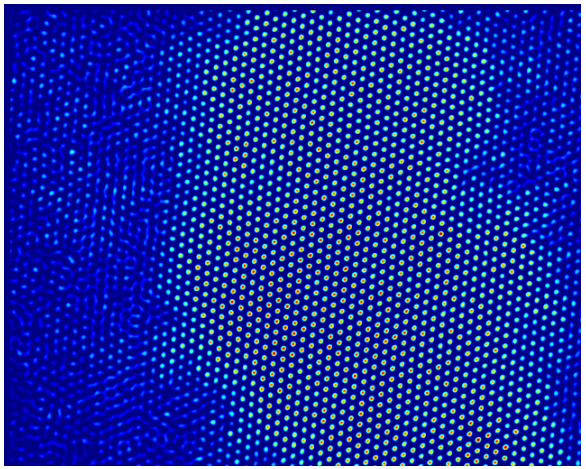
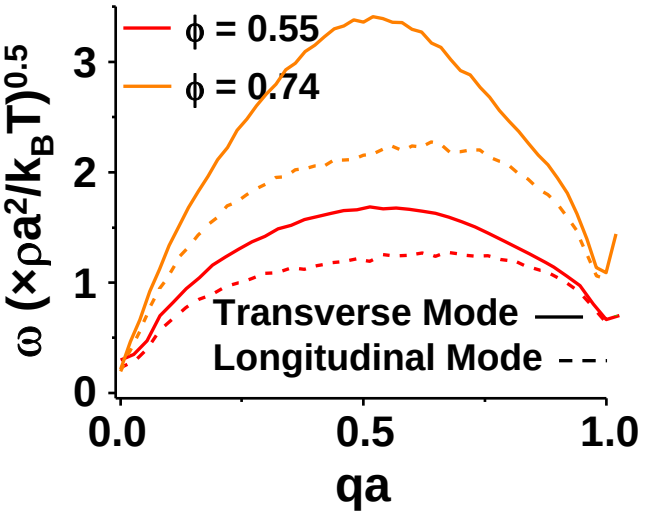
We synthesize temperature sensitive colloids and determine whether vibrational instability (the Lindemann criterion) and/or shear instability (the Born criterion) provide a comprehensive microscopic definition of melting by measuring particle motions using video light microscopy.



$\phi = 0.74$



$\phi = 0.55$



The longitudinal and transverse modes, calculated from the particle displacement field, decreased with a decrease in the volume fraction. The spring constants in the colloidal crystal decreased with a decrease in the volume fraction, eventually becoming very similar to each other near the melting point. Furthermore, the bulk modulus of the crystal became almost equal to the shear modulus near the melting point.

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