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Born melting of three dimensional crystals JORIS SPRAKEL, Wageningen University, ALESSIO ZACCONE, Technical University Munich, PETER SCHALL, University of Amsterdam, DAVID A. WEITZ, Harvard University —
While the microscopic nature of melting in 1 and 2 dimensions has been elucidated both theoretically and experimentally, this has proven elusive for three-dimensional crystalline solids. Max Born hypothesized that melting can be described as a rigidity catastrophe where the crystal's shear elastic constant vanishes at melting. Here we show experimental evidence, using three-dimensional imaging of soft colloidal crystals, for such a mechanical instability underlying melting. Our results reveal how non-affine fluctuations govern the mechanical instability which precipitates melting; modification of Born's theory to take non-affinity into account accurately describes our experimental data. Moreover, we show how the continuous weakening of the crystal's resistance to shear leads to the emergence of collective fluctuations who's size diverges at the melting point.

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