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Thermodynamic glass transitions in three dimensional glasses

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The physics associated to the glass transition controls the dramatic evolution of transport coefficients in systems as diverse as dense liquids, polymers, colloids, but also granular particles and active matter. The experimental liquid-glass transition in equilibrium fluids is characterized by several phenomenological crossovers, but glasses can form without crossing any sharp singularity. I will present multiple evidences suggesting that the glass formation process is underlied by equilibrium phase transitions. Combining numerical tools developed to study ordinary phase transitions to recent theoretical analytical progress I will demonstrate that studies of the glass transition have entered a new phase, where the relevant order parameter, thermodynamic fluctuations and phase transformations can be directly analysed in finite dimensional model glasses.