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Equilibrium study of a liquid-glass transition

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The liquid-glass transition in dense fluids is characterized by several crossover temperatures, but glasses are obtained without crossing any sharp singularity. The existence of an underlying phase transition, predicted theoretically in some limiting cases, is therefore only supported by uncontrolled extrapolations of macroscopic observables. Here we use a specific random pinning field to induce a liquid-glass transition in a simulated fluid. We discover a range of control parameters for which the transition can be crossed at thermal equilibrium, which allows us to probe for the first time the microscopic nature of an equilibrium glass. Our results, obtained for a range of modest system sizes, suggest that the glass transition is of the random first order type.