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Scaling theory for the jamming transition[1]

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The existence of a critical jamming transition, which marks the onset of rigidity in athermal packings of spheres, suggests that universal physics underlies the origin and nature of rigidity in disordered solids ranging from glasses to foams and granular materials. The jamming transition was originally proposed as a zero-temperature critical point in a non-equilibrium phase diagram in packing density and shear stress. Many studies have documented critical phenomena near the jamming transition, including power-law scaling, diverging length scales and scaling collapse, and theories have been developed to understand these phenomena. However, a number of confusing features have precluded a unified critical scaling analysis of the transition. Here we resolve these issues to present a scaling ansatz for the jamming critical point in terms of density and shear stress. The theory predicts new exponents that we verify with numerical simulations.

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