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Revealing the critical behavior of jamming: high precision simulations of large,exactly isostatic packings[1]

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Recently, an exact first-principle theory of jamming criticality in infinite dimensions has emerged. However, it is an understatement to say that $d = \infty$ is very far from the physically relevant dimensions of $d = 2$ and 3. In this work we probe how meaningful these infinite-dimensional predictions are in low dimensions by examining the scaling of the weak contact forces at jamming. We use a combination of 1) newly developed GPU techniques implementing quad-precision simulations and 2) an algorithm to calculate extremely accurate interparticle forces for isostatic packings to probe the behavior of systems of very-many particles in dimensions $d = 2 - 6$. We find that the weak forces arise from two populations, one associated with localized excitations and the other with extended excitations. We find that the fraction of localized excitations decreases with increasing dimension. Surprisingly, the infinite-dimensional predictions hold *exactly* all the way down to $d = 2$ for the extended excitations.

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