Universal scaling and renormalization group flows of disordered elastic systems

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The transition to several classes of disordered solids is marked by diverse phenomena that have no counterpart in usual transitions to crystalline states. Many of these phenomena display an underlying signature akin of conserved universal behavior that is associated with continuous transitions. Incidentally, rigidity transitions induced by the formation of system-spanning disordered rigid clusters, like the jamming transition, can be well-described in most physically relevant dimensions by mean-field theories [1]. Here I will show results of a mean-field theory in arbitrary dimensions and extract universal scaling predictions showing logarithmic corrections that signal an upper critical dimension $d_u = 2$, below which the critical exponents are modified. We interpret this using normal form theory as a transcritical bifurcation in the renormalization group flows [2] and extract the universal nonlinear coefficients to make explicit predictions for the behavior near 2 dimensions. We derive universal scaling functions from this mean-field theory sufficient to predict all linear response in randomly diluted isotropic elastic systems in all dimensions [3].

References

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