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Non-Abelian Fracton Topological Order and New Constructions of Fracton Phases S. VIJAY, LIANG FU, MIT — We present recent progress in the study of fracton topological phases, 3D topologically-ordered states of matter with gapped, fractionalized excitations that are immobile (termed fractons), and cannot be moved by acting with any local operator without creating other gapped excitations. We present an isotropic construction of a fracton topological phase, starting from inter-penetrating layers of a 2D topological phase. Condensation of excitations that are created in adjacent layers can lead to a fracton topological phase or a more conventional 3D topological order. This construction leads to a new perspective on the emergence of the immobile fracton excitations, as well as an understanding of the wavefunction for certain fracton phases. We then introduce a model that realizes a new "non-Abelian fracton topological phase, where the fracton excitations have quantum dimension $d > 1$. Bound-states of the fractons can behave as mobile, non-Abelian anyons with well-defined statistics and fusion rules. This provides an example of a truly 3D phase of matter with non-Abelian anyons. Finally, we describe a lattice model of interacting bosons with a local $U(1)$ symmetry that realizes a stable, gapless phase with emergent fracton excitations.

Sagar Vijay
MIT

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