Disordered Topological Crystalline Phases

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Abstract

The myriad manifestations of topological crystalline phases (TCP), from anomalous higher-order boundary states to obstructed atomic limits, are well understood. A comprehensive understanding of their stability to disorder however remains an open question. We classify such disordered phases (with order-two symmetries) with disorder that breaks the crystalline symmetry, while preserving it on average. We uncover novel disordered phases; statistical higher-order phases whose hinge states are subject to disorder-induced backscattering but remain protected from Anderson localization at zero-energy and a novel superconducting phase which concurrently host the aforementioned critical zero-energy hinge state along with a disorder stable chiral Majorana hinge mode. We also discover that obstructed atomic limits are stable to disorder if and only if they have a filling anomaly: An observation that results, in contrast to clean TCPs, in disordered TCPs satisfying a complete bulk-boundary correspondence.