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Avoided quantum criticality in disordered three-dimensional Dirac semi-metals JEDEDIAH PIXLEY, Condensed Matter Theory Center and Joint Quantum Institute, Department of Physics, University of Maryland, DAVID HUSE, Princeton University — We study the effects of short-range random potential disorder on three-dimensional Dirac semi-metals. We focus on the proposed quantum critical point (QCP) separating a semi-metal and diffusive metal phase driven by disorder. We will briefly review the existing evidence of such a QCP. We will then explore the non-perturbative effects of rare regions using Lanczos and the kernel polynomial method, from which we establish the existence of two distinct types of excitations in the weak disorder regime. The first are perturbatively renormalized dispersive Dirac states and the second are weakly dispersive quasi-localized "rare" eigenstates. We establish that these rare eigenstates contribute an exponentially small but non-zero density of states at zero energy, thus converting the semi-metal to diffusive metal transition into an avoided quantum critical point.

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