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Unconventional localisation transition in high-dimensional semiconductors and Weyl semimetals SERGEY SYZRANOV, VICTOR GURARIE, LEO RADZIHOVSKY, Univ of Colorado - Boulder — We study a class of non-interacting electron systems with a power-law quasiparticle dispersion $\xi_{\mathbf{k}} \propto k^{\alpha}$ and a random short-correlated potential. We show that, unlike the case of lower dimensions, for $d > 2\alpha$ there exists a critical disorder strength (set by the band width), at which the system exhibits a disorder-driven quantum phase transition at the bottom of the band, that lies in a universality class distinct from the Anderson transition. In contrast to the conventional wisdom, it manifests itself in, e.g., the disorder-averaged density of states. For systems in symmetry classes that permit localisation, the striking signature is a non-analytic behaviour of the mobility edge, that is pinned to the bottom of the band for subcritical disorder and grows for disorder exceeding a critical strength. Focusing on the density of states, we calculate the critical behaviour (exponents and scaling functions) at this novel transition, using a renormalisation group, controlled by an $\varepsilon = d - 2\alpha$ expansion. We also apply our analysis to Dirac materials, e.g., Weyl semimetal, where this transition takes place in physically interesting three dimensions.

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