

Real space decay of flat band projectors from compact localized states

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Flatbands (FB) with compact localized eigenstates (CLS) fall into three main categories, controlled by the algebraic properties of the CLS set: orthogonal, linearly independent, linearly dependent (singular). A CLS parametrization allows us to continuously tune a linearly independent FB into a limiting orthogonal or a linearly dependent (singular) one. We derive the asymptotic real space decay of the flat band projectors for each category. The linearly independent FB is characterized by an exponentially decaying projector and a corresponding localization length, all dressed by an algebraic prefactor. In the orthogonal limit, the localization length is, and the projector is compact. The singular FB limit corresponds to with an emerging power law decay of the projector. We obtain analytical estimates for the localization length and the algebraic power law exponents depending on the dimension of the lattice and the number of bands involved. Numerical results are in excellent agreement with the analytics. Our results are of relevance for the understanding of the details of the FB quantum metric discussed in the context of FB superconductivity, the impact of disorder, and the response to local driving.