Localization for non-monotone Anderson-type models

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We consider random Hamiltonians on the lattice given by

$$H_\omega = -\Delta + V_\omega, \quad V_\omega(x) = \sum_{k \in \mathbb{Z}^d} \omega_k u(x-k), \tag{1}$$

on $\ell^2(\mathbb{Z}^d)$, whose randomness is generated by a sign-indefinite single-site potential $u \in \ell^1(\mathbb{Z}^d;\mathbb{R})$ with i.i.d. random variables ω_k, $k \in \mathbb{Z}^d$. The main challenge of models of the type (1) is that u may change its sign. As a consequence, certain properties of H_ω depend in an non-monotone way on the random parameters ω_k, $k \in \mathbb{Z}^d$. For this reason many established tools for the spectral analysis of random Schrödinger operators are not directly applicable in this model.

In this talk we discuss recent results on localization in the large disorder regime for via the fractional moment method. The specific assumption on the single-site potential u is that $\operatorname{supp} u$ is finite and has fixed sign on the boundary of its support.

Moreover, we present a Wegner estimate for exponentially decaying single-site potentials, i.e. $|u(k)| \leq C\mathrm{e}^{-\alpha\|x\|_1}$ but not necessarily of bounded support, which is valid on the whole energy axis. A Wegner estimate is an upper bound on the expected number of eigenvalues in some energy interval $[a,b]$ of a finite volume restriction H_Λ of H_ω, $\Lambda \subset \mathbb{Z}^d$. Since our Wegner bound is valid on the whole energy axis, it can be used for a localization proof via multiscale analysis in any energy region where the initial length scale estimate holds.

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