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Localisation and delocalising in the parabolic Anderson model

The parabolic Anderson problem is the Cauchy problem for the heat equation on the integer lattice with random potential. It describes the mean-field behaviour of a continuous-time branching random walk. It is well-known that, unlike the standard heat equation, the solution of the parabolic Anderson model exhibits strong localisation. In particular, for a wide class of iid potentials it is localised at just one point. However, in a partially symmetric parabolic Anderson model, the one-point localisation breaks down for heavy-tailed potentials and remains unchanged for light-tailed potentials, exhibiting a range of phase transitions.