Many-body localization edge in the random-field Heisenberg chain

DAVID J. LUITZ, NICOLAS LAFLORENCIE, FABIEN ALET, CNRS and Université Paul Sabatier de Toulouse — We present a large scale exact diagonalization study of the one dimensional spin 1/2 Heisenberg model in a random magnetic field. In order to access properties at varying energy densities across the entire spectrum for system sizes up to $L=22$ spins, we use a spectral transformation which can be applied in a massively parallel fashion. Our results allow for an energy-resolved interpretation of the many-body localization transition including the existence of a many-body mobility edge. The ergodic phase is well characterized by Gaussian orthogonal ensemble statistics, volume-law entanglement, and a full delocalization in the Hilbert space. Conversely, the localized (non-ergodic) regime displays Poisson statistics, area-law entanglement and signs of multifractality in the Hilbert space where a true localization never occurs. We perform finite size scaling to extract the critical edge and exponent of the localization length divergence.

David J. Luitz

CNRS and Université Paul Sabatier de Toulouse

Date submitted: 13 Nov 2014

Electronic form version 1.4