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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.

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