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Multipartite Entanglement and Few-Body Hamiltonians

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We investigate the possibility to obtain highly multipartite-entangled states as nondegenerate eigenstates of Hamiltonians that involve only short-range and few-body interactions. We study small-size systems (with a number of qubits ranging from three to five) and search for Hamiltonians with a Maximally Multipartite Entangled (MMES) eigenstate. We then find conditions, including bounds on the number of coupled qubits, to build a Hamiltonian with a Greenberger-Horne-Zeilinger (GHZ) nondegenerate eigenstate. We finally comment on the entangling power of these Hamiltonians and on possible applications.