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Entanglement spectroscopy of SU(2)-broken phases in two dimensions VINCENZO ALBA, FABIAN KOLLEY, Ludwig Maximilians University Munich, STEFAN DEPENBROCK, University of California Irvine, IAN MCCULLOCH, University of Queensland, ULRICH SCHOLLWOECK, Ludwig Maximilians University Munich — In magnetically ordered systems the breaking of SU(2) symmetry in the thermodynamic limit is associated with the appearance of a special type of low-lying excitations in finite size energy spectra, the so called tower of states (TOS). In the present work we numerically demonstrate that there is a correspondence between the SU(2) tower of states and the lower part of the ground state entanglement spectrum (ES). Using state-of-the-art DMRG calculations, we examine the ES of the 2D antiferromagnetic J_1-J_2 Heisenberg model on both the triangular and kagomé lattice. At large ferromagnetic J_2 the model exhibits a magnetically ordered ground state. Correspondingly, its ES contains a family of low-lying levels that are reminiscent of the energy tower of states. Their behavior (level counting, finite size scaling in the thermodynamic limit) sharply reflects tower of states features, and is characterized in terms of an effective entanglement Hamiltonian that we provide. At large system sizes TOS levels are divided from the rest by an entanglement gap. Our analysis suggests that (TOS) entanglement spectroscopy provides an alternative tool for detecting and characterizing SU(2)-broken phases using DMRG.

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