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Spin waves and local magnetizations on the Penrose tiling ATTILA SZALLAS, ANURADHA JAGANNATHAN, Laboratoire de Physique des Solides, CNRS-UMR 8502, Universite Paris-Sud, 91405 Orsay, France — The Penrose tiling is a perfectly ordered two dimensional structure with fivefold symmetry and scale invariance under site decimation. Quantum spin models on such a system can be expected to differ significantly from more conventional structures as a result of its special symmetries. We consider a Heisenberg antiferromagnet on the Penrose tiling, a quasiperiodic system having an inhomogeneous Neel-ordered ground state. Spin wave energies and wavefunctions are studied in the linear spin wave approximation. A linear dispersion law is found at low energies, as in other bipartite antiferromagnets, with an effective spin wave velocity lower than in the square lattice. Spatial properties of eigenmodes are characterized in several different ways. At low energies, eigenstates are relatively extended, and show multifractal scaling. At higher energies, states are more localized, and, depending on the energy, confined to sites of a specified coordination number. The ground state energy of this antiferromagnet, and local staggered magnetizations are calculated. Perpendicular space projections are shown, showing the underlying simplicity of this "complex" ground state. A simple analytical model, the two-tier Heisenberg star, is presented to explain the staggered magnetization distribution in this antiferromagnetic system.

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