Extended symmetry in a 4-leg spin tube

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I show that a four leg antiferromagnetic spin-1/2 tube admits a low-energy description in terms of a $SU(2)_4$ Wess-Zumino-Novikov-Witten model combined with two Ising models and a super-conformal minimal model of central charge 1. The interchain interaction contains only $SU(2)_4$ primary operators that are also $SU(3)_1$ primaries, leading to an extended $SU(3)$ symmetry of the low-energy Hamiltonian, broken only by marginal terms. I discuss the consequences for the low-energy spectrum of the extended symmetry, and I identify operators whose correlation functions can reveal the extended symmetry.