# Quantum order by disorder: peculiar case of fcc antiferromagnet

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**Abstract**

Frustrated spin systems are highly sensitive to fluctuations due to their enlarged classical ground state manifold. In most cases, fluctuations stabilize one of the classically degenerate ordered ground states through the order by disorder effect. The classical degeneracy is lifted by either quantum zero-point motion or entropic selection. Using spin-wave theory, we study the ground state selected by quantum fluctuations in the face-centered-cubic Heisenberg antiferromagnet.
At the harmonic level, there is selection of a given state at zero temperature. However, the energy difference with the other ground state candidate is of particularly small value. To complement the study, we go to higher order in spin-wave theory and include the effects of magnon-magnon interactions self-consistently. We find a different ground state selection compared to what was found in the harmonic approximation, even at large spin. The failure of the harmonic approximation and perturbative expansion is argued to be due to the large number of accidental gapless modes in the harmonic spin-wave spectrum, reminiscent of the classical ground state degeneracy. The values for the energies of competing ground states in function of spin compare well to newly available numerical data, which confirms the efficiency of the self-consistent method.

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