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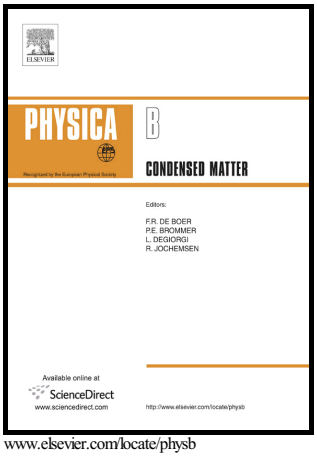

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Cubic Ideal Ferromagnets at Low Temperature and Weak Magnetic Field

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Abstract

The low-temperature series for the free energy density, pressure, magnetization and susceptibility of cubic ideal ferromagnets in weak external magnetic fields are discussed within the effective Lagrangian framework up to three loops. The structure of the simple, body-centered, and face-centered cubic lattice is taken into account explicitly. The expansion involves integer and half-integer powers of the temperature. The corresponding coefficients depend on the magnetic field and on low-energy effective constants that can be expressed in terms of microscopic quantities. Our formulas may also serve as efficiency or consistency check for other techniques like Green's function methods, where spurious terms in the low-temperature expansion have appeared. We explore the sign and magnitude of the spin-wave interaction in the pressure, magnetization and susceptibility, and emphasize that our effective field theory approach is fully systematic and rigorous.

1 Introduction

The low-temperature expansion of the partition function for the three-dimensional ideal ferromagnet in a weak magnetic field has been derived in Ref. [1] up to three-loop order within the systematic effective Lagrangian framework. The main intention of that article was to go beyond Dyson's analysis, Refs. [2, 3], by evaluating the next-to-leading term in the spontaneous magnetization caused by the spin-wave interaction. It