Dynamic quadrupolar susceptibility for the spin-1 Blume-Emery-Griffiths model

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Abstract

The spin-1 Blume-Emery-Griffiths (BEG) model [1] is a spin system which contains biquadratic exchange interactions (K) and the crystal field (D) (or quadrupolar field) in addition to bilinear exchange interactions (J). Recently, the linear response of the quadrupolar order parameter to the crystal field which is also known as the static quadrupolar susceptibility for the BEG model has been studied within mean-field approximation by us [2]. In this work, the dynamic response of the same spin system in the presence of a periodically varying time-dependent crystal field is formulated on the basis of Onsager theory of irreversible thermodynamics. An expression for the dynamic (or complex) quadrupolar susceptibility is calculated. From the real and imaginary parts of this expression, dispersion relation and absorption factor for the quadrupolar field are derived. The temperature and crystal field variations of these quantities for both low- and high-frequency regimes are analyzed using two different phase diagram topologies which take place for K/J=3.0 and K/J=5.0. In particular, their behaviours for temperatures and crystal field values less than, equal to, and greater than the second-order phase transition are investigated. From this investigation frequency dependent peaks (or maxima) are observed in the ordered and disordered phases. We also show that by definition the quadrupolar dispersion converges to the corresponding static quadrupolar susceptibility in the zero frequency limit [2].

References

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