the new model becomes more flexible than the previous (first) model. In other words, the model is composed of hopping processes among (N+1)-states with the binomial distribution in equilibrium. Namely, the distribution of the n-th state in equilibrium is given by

$$p(n)={}_{N}C_{n}x^{N-n}(1-x)^{n}, \qquad (0\leq x\leq 1).$$

This model is applied to various problems; the random frequency modulation, the stationary light scattering and the transient light scattering. The spectrum of this model is quite analogous to the one due to the phonon side bands, though the direct comparison must be done carefully.

Our second model may be powerful in treating various systems except the ordinary light scattering, for instance, γ-ray or X-ray scattering in solids. Moreover the formulation developed here may have wide range of applicability to various other phenomena. These remain to be solved in future.

3. Phase Transition Phenomena of Diluted Antiferromagnets in a Magnetic Field and Random-Field Effects

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Abstract

Our present work gives an unified interpretation for the phase transition behaviors in three-dimentional dilute Ising antiferromagnets under a uniform

magnetic field. Until now, theoretical and experimental studies of phase transition in random magnetic fields have been extensively performed. The issue of the lower critical dimention d_l of Ising system in random fields has attracted much theoretical and experimental interest. While Imry and Ma originally suggested that $d_l=2$ by a simple domain-wall argument, and calculations valid for dimensions $d>4$ suggest $d_l=3$, there has been still a controversy.

Fishman and Aharony first pointed out that random fields can be generated in uniaxial random antiferromagnets by applying an external field. Using a random bond model, they showed that a Hamiltonian of a two-sublattice antiferromagnet in a uniform field is equivalent to that of a ferromagnet in random fields. Random fields are generated indirectly by the random molecular fields and their magnetude is linearly proportional to the local magnetization. Thereafter, modification of random fields is carried out by using a random site model, and they are also generated directly by the applied field.

It has been demonstrated by various experimental results that in a two-dimensional system, random magnetic fields destroy the long-range-order at low temperature and the phase transition. On the other hand, in three-dimensional systems, an interpretation for various experimental results on neutron scattering, specific-heat and magnetization measurements has been still controversial; some suggest that the phase transition is a first order, some assert that $d_l=2$, and others suggest that $d_l\geqq 3$.

Accordingly, we have performed comprehensive studies of magnetic susceptibility and specific-heat of a three-dimensional dilute antiferromagnet

$Mn_{0.82}Zn_{0.18}F_2$ in a uniform field.

We get a new concept from the present experiment that two kinds of magnetic fields are generated in a dilute antiferromagnet in a uniform field. One is, of course, a random field and the other is a staggered field. A staggered field destroys the phase transition and a random field does not. A divergent magnetic susceptibility at extremely-weak field and a rounding of the peak at higher fields directly suggests that a staggered magnetic field is induced by a uniform field. Our observation of the field dependence of the specific-heat is as follows; in smaller fields specific-heat reveals a symmetric divergence with peak height larger than in zero field and upon further increasing a field a peak rounds. The phenomenon in small field is attributed to the effect of a random field. But the behaviors that the peaks fall and round with increasing fields are attributed to that of a staggered field.

From these considerations, we can say that in the real magnetic systems two compeating fields in dilute antiferromagnets in a uniform field have made an interpretation for the experimental results to be difficult and that random magnetic field dose not destroy the phase transition in three-dimentional Ising systems.