Disordered mixed spin Ising system in a random*field

N. Benayad, A. Fathi and L. Khaya
Groupe de Mécanique Statistique
Laboratoire de Physique Théorique, Faculté des Sciences Aïn Chock,
B.P. 5366, Maarif, Casablanca, Morocco.

The diluted mixed spin Ising system consisting of spin-1/2 and spin-1 in a random field is studied by the use of finite cluster approximation the framework of a single-site cluster theory. The equations are derived using a probability distribution method based on the use of Van der Waerden identities. The complete phase diagrams are investigated in the case of the simple cubic lattice (z=6), where the random field is bimodally and trimodally distributed. In particular, the influence of the magnetic sites concentration on the tricritical behaviour is examined in detail.

I. INTRODUCTION

The random field Ising model (RFIM) on mono-atomic lattices has been a subject of much theoretical [1-4] and experimental [5,6] investigation in last years. This is because it helps to simulate many interesting but complicated problems. The best experimental realisation of a RFIM has been the diluted uniaxial-antiferromagnet in a uniform field (DAFF) ; such as the pots-typical system : $Mn_x Zn_{1-x} F_2$ in a magnetic field. It has been shown [7,8] that in the presence of uniform field the random exchange interactions give rise to local random staggered fields and that such a system should be isomorphic to the RFIM where the local random field H_i is assumed to have zero average $\langle H_i \rangle_r=0$ and is uncorrelated at different sites $\langle H_i H_j \rangle_r=H^2 \delta_{ij}$ Indeed, many experiments on DAFF's have confirmed some of the theoretical predictions derived for the RFIM [9]. We note that the trimodal distribution can be relevant for the study of diluted antiferromagnets [6].

One of the main points for which attention has been focused was the lower critical dimension d_l. The theoretical studies have concluded that d_l=2. Also, experiments support the existence of long range order in the three dimensional RFIM [10]. On the other hand, it is known that the critical properties on three dimensions are controlled by a zero temperature fixed point with modified scaling behaviour [11]. Some theories suggest that if a second order transition occurs at all it will be in an entirely new universality class [11]. However, the critical behaviour is still not fully understood since the experimental results [10,12] are difficult to interpret and numerical simulations suffer from equilibrium problems [13].

On the other hand, important questions about the RFIM have been the existence of a tricritical point and the order of low-temperature phase transitions in three dimensions. Mean field theories [14] predicted that the existence of a tricritical point depends on the form of The random field distribution. In particular the bimodal distribution (H) yields a tricritical point and the transition was found to be of first order for sufficiently strong random field, while the Gaussian one led to a second-order phase transition down to T=0. Using renormalisation group calculations [15], it has discussed that with an appropriate distribution function may led to a tricritical point. Houghton et al [16] using the high-temperature series expansions with bimodal and Gaussi distributions,confirmed the predictions of the mean field theory for $d \geq 4$. In dimension $d < 4$ however, the analysis suggests that, even for a Gaussian distribution, it has been observed fluctuation-driven first-order transitions at low temperatures.

Furthermore , Monte Carlo results of RFIM with a bimodal distribution have been either, inconclusive : some were interpreted in support of a first-order transition at finite low temperature [17], others favoured a continuous transition [18], or suggest an unusual behaviour [19] : jump in the order parameter but with an infinite correlation length at the transition. We have to point out here that the experiments [10,12] on diluted MnF_2 are difficult to clearly interpret but are suggestive of first-order transition.

On the other hand, some authors[20] have studied the case of spin S (greater than ½) Ising model in a random field in the mean-field approximation for a bimodal distribution. They have predicted a long-range order at T=0 up to S-dependent critical value of the field h, and the existence of tricritical point (T_t,H_t). Such model for any S in a random field with a trimodal distribution for the fields, within the mean-field theory, has also been studied [21]. Theobtained phase diagram (for any S) is qualitatively similar to that found earlier[22] for spin1/2 and it exhibits a rich multicritical behaviour.

Recently, attention has been directed to study of the magnetic properties of two-sublattice mixed spin Ising systems. They are of interest for the following main reasons.

They have less translational symmetry than their single spin counterparts, and are well adapted to study a certain type offerrimagnetism [23]. Experimentally it has been shown that the MnNi(EDTA)-6H_2O complex is a example of a mixed spin system [24]. The mixed Ising

spin system consisting of spin-1/2 and spin-1 had been studied by renormalization group technique [25,26], by high-temperature series expansions [27], by free-fermion approximation [28] , by finite cluster approximation [29], and Monte-Carlo simulation [30]. The effect of dilution on the phase diagrams of these kind of system are also investigated by performing various techniques [26,29,31].

Since the monoatomic random field Ising model exhibits very interesting phase diagrams, it is worthy to investigate the two-sublattice mixed spin Ising system. This latter system can be described by the following Hamilton

$$H = -\sum_{\langle ij\rangle} J_{ij}\sigma_i S_j - \sum_i H_i\sigma_i - \sum_j H_j S_j, \qquad (1)$$

where σ_i and S_j are Ising spins of magnitude ½ and S at sites i and j, respectively. J_{ij} is the exchange interaction, H_i and H_j are the random fields, and the first summation is carried out only over nearest-neighbour pairs of spins. The fields H_i and H_j are assumed to be uncorrelated variables and obey a symmetric probability distribution Q(H)=Q(-H).

In this paper, we first investigate the phase diagram of the system described by the Hamiltonian (1) within the finite cluster approximation [32] within the framework of a single-site cluster for the trimodal distribution

$$Q(H_i) = p\delta(H_i) + \frac{(1-p)}{2}\left[\delta(H_i - H) + \delta(H_i + H)\right], \qquad (2)$$

where the parameter p measures the fraction of spins in the system not exposed to the field. We specially study the effect of the site dilution on the obtained phase diagram. This system can be describe by (1) in which we introduce the site occupancy number ξ_i which takes 0 or 1 depending on whether the site is occupied or not. Thus the Hamiltonian of such a system takes the form

$$H = -\sum_{\langle ij\rangle} J_{ij}\xi_i\xi_j\sigma_i S_j - \sum_i H_i\xi_i\sigma_i - \sum_j H_j\xi_j S_j, \qquad (3)$$

In present work, we limit ourselves to the case S=1 and J_{ij}=J. One notes that at p=1 or H=0, the system reduces to the simple diluted mixed spin-1/2 and spin-1 Ising model[26,29].

II. THEORETICAL FRAMEWORK

The theoretical framework we adopt in the study of the diluted random field mixed spin Ising model described by the Hamiltonian (3), is the finite cluster approximation (FCA) [32], based on a single-site cluster theory. In this method, we consider a particular spin σ_0 (S_0) and denote by $\langle\sigma_0\rangle_c$ ($\langle(S_0)^n\rangle_c$, n=1,2) the mean value of σ_0 $(S_0)^n$ for given configuration c of all other spins, i.e. where all other spins σ_i and S_j (i,j ≠ 0) are kept in a fixed state $\langle\sigma_0\rangle_c$ and $\langle(S_0)^n\rangle_c$ are then given by :

$$\langle\sigma_0\rangle_c = \left\langle \frac{\mathrm{Tr}_{\sigma_o}\,\sigma_o \exp(-\beta H_o^\sigma)}{\mathrm{Tr}_{\sigma_o} \exp(-\beta H_o^\sigma)} \right\rangle \qquad (4)$$

and :

$$\langle(S_0)^n\rangle_c = \left\langle \frac{\mathrm{Tr}_{S_o}(S_o)\, \exp(-\beta H_o^S)}{\mathrm{Tr}_{S_o} \exp(-\beta H_o^S)} \right\rangle, \qquad (5)$$

with

$$H_o^\sigma = -\left(J\sum_{j=1}^{z}\xi_0\xi_j S_j + \xi_0 H_0\right)\sigma_o, \qquad (6)$$

$$H_o^s = -\left(J\sum_{i=1}^{z}\xi_0\xi_i\sigma_i + \xi_0 H_0\right)S_o, \qquad (7)$$

where z is the nearest-neighbour coordination number of the lattice =1/T and Tr $_o$ (or Tr_{So}) means the partial trace with respect to the -Sublattice site o (or S-Sublattice site o). { S_1, S_2, ..., S_z } ({σ_1, σ_2, ..., σ_z }) are the nearest-neighbours spins of σ_0 (S_0) with which it directly interacts.

One notes that since H_o^σ and H_o^S depend on ξ_o (ξ_o =0 or 1), Eqs. (4) and (5) imply

$$\langle\xi_o\sigma_o\rangle_c = \xi_o\left\langle \frac{\mathrm{Tr}_{\sigma_o}\,\sigma_o \exp(-\beta \overline{H}_o^\sigma)}{\mathrm{Tr}_{\sigma_o} \exp(-\beta \overline{H}_o^\sigma)} \right\rangle, \qquad (8)$$

$$\langle\xi_o(S_o^\alpha)^n\rangle_c = \xi_o\left\langle \frac{\mathrm{Tr}_{S_o}(S_o)\, \exp(-\beta \overline{H}_o^S)}{\mathrm{Tr}_{S_o} \exp(-\beta \overline{H}_o^S)} \right\rangle, \qquad (9)$$

where

$$\overline{H}_o^\sigma = -\left(J\sum_{j=1}^{z}\xi_j S_j + H_0\right)\sigma_o$$

and

$$\overline{H}_o^S = -\left(J\sum_{i=1}^{z}\xi_i\sigma_i + H_0\right)S_o$$

Performing the traces in (8) and (9), we obtain the following exact relations

$$\left\langle \xi_o \sigma_o \right\rangle = \tfrac{1}{2}\xi_o \left\langle f\ \left(\{\xi_j S_j\}, H_0\right)\right\rangle \quad (10)$$

$$\left\langle \xi_o \left(S_o\right)^n \right\rangle = \xi_o \left\langle F_n\left(\{\xi_i \sigma_i\}, H_0\right)\right\rangle, \quad (11)$$

With

$$f\left(K\{\xi_j S_j\}, h_0\right) = \tanh\left[\frac{K}{2}\sum_{j=1}^{z}\xi_j S_j + \frac{h_0}{2}\right] \quad (12)$$

$$F_1\left(K\{\xi_i \sigma_i\}, h_0\right) = \frac{2\sinh\left[K\sum_{i=1}^{z}\xi_i\sigma_i + h_0\right]}{1 + 2\cosh\left[K\sum_{i=1}^{z}\xi_i\sigma_i + h_0\right]} \quad (13)$$

$$F_2\left(K\{\xi_i \sigma_i\}, h_0\right) = \frac{2\cosh\left[K\sum_{i=1}^{z}\xi_i\sigma_i + h_0\right]}{1 + 2\cosh\left[K\sum_{i=1}^{z}\xi_i\sigma_i + h_0\right]} \quad (14)$$

where, $K=\beta J$, $h_0=\beta H_0$, and $\langle \ldots \rangle$ denotes the canonical thermal average.

The next step is to carry out the configurational averaging over the site occupational numbers ξ_i, to be denoted by $\langle \cdots \rangle_r$.

In order to perform the thermal and configurational averaging on the right-hand side of Eqs (10) and (11), we expand the functions $f\left(\{\xi_i S_i\}, H_0\right)$ and $F_n\left(\{\xi_i \sigma_i\}, H_0\right)$ as finite polynomials of S_j^z and σ_i^z, respectively, that correctly account for the single-site kinematic relations. This can conveniently be done by employing Van der Waerden operators [33]. Then in order to carry out the thermal and site disorder configurational averaging, we have to deal with correlation functions. In this work, we consider the simplest approximation by neglecting correlations between quantities pertaining to different sites, but we include the correlation between the site disorder and the local configurational-dependent thermal averages of the spin. Denoting the average site concentration by $c = \langle \xi \rangle_r$, we obtain

$$\left\langle\left\langle f\ \left(K\{\xi_j S_j\}, h_0\right)\right\rangle\right\rangle_r = \prod_{j=1}^{z}\left[\sum_{S_j=-1}^{+1}\sum_{\xi_j=0}^{1} P\left(S_j, \xi_j\right)\right] f\left(K\{\xi_j S_j\}, h_0,\right) \quad (15)$$

$$\left\langle\left\langle F_n\left(K\{\xi_i \sigma_i\}, h_0\right)\right\rangle\right\rangle_r = \prod_{i=1}^{z}\left[\sum_{\sigma_i=-1/2}^{+1/2}\sum_{\xi_i=0}^{1} R\left(\sigma_i, \xi_i\right)\right] F_n\left(K\{\xi_i \sigma_i\}, h_0\right) \quad (16)$$

with

$$P\left(S_j, \xi_j\right) = \sum_{I_1=-1}^{+1}\sum_{I_2=0}^{1} a\left(I_1, I_2\right)\ \delta_{S_j, I_1}\ \delta_{\xi_j, I_2}, \quad (17)$$

$$R\left(\sigma_i, \xi_i\right) = \sum_{k_1=-1/2}^{+1/2}\sum_{k_2=0}^{1} b\left(k_1, k_2\right)\ \delta_{\sigma_i, k_1}\ \delta_{\xi_i, k_2}, \quad (18)$$

where

$$a(\pm 1, 1) = \frac{1}{2}\left(\pm m_{j1} + m_{j2}\right), \quad a(0,1) = \left(c - m_{j2}\right),$$

$$a(I_1, 0) = \frac{1}{3}(1-c), \quad (19)$$

$$b\left(\frac{\pm 1}{2}, 1\right) = \left(\frac{c}{2} \pm \mu_i\right), \quad b\left(\frac{\pm 1}{2}, 0\right) = \frac{1}{2}(1-c)$$

where,

$$\mu_i = \left\langle\left\langle \xi_i \sigma_i \right\rangle\right\rangle_r, \quad m_{jn} = \left\langle\left\langle \xi_j \left(S_j\right)^n \right\rangle\right\rangle_r. \quad (20)$$

Since the field is randomly distributed, we have to perform the random average of H_i according to Eq.(2). The ordering parameters de μ and m_n are then defined as $\mu=\overline{\mu_i}$, $m_n=\overline{m_{nj}}$, where the bar denotes the longitudinal random field average Thus, using Eqs. (10), (11), and (15) - (18), we obtain the following set of coupled equations for μ^α and m_n

$$\mu = c\sum_{I_1=-1}^{+1}\cdots\sum_{I_z=-1}^{+1}\sum_{\xi_1=0}^{1}\cdots\sum_{\xi_z=0}^{1}\left[\prod_{j=1}^{z} a\left(I_j, \xi_j\right)\right]\times \overline{f}\left(K[\xi_1 S_1(I_1), \ldots, \xi_z S_z(I_z)]; p; h\right) \quad (21)$$

$$m_n = c\sum_{k_1=-1/2}^{+1/2}\cdots\sum_{k_z=-1/2}^{+1/2}\sum_{\xi_1=0}^{1}\cdots\sum_{\xi_z=0}^{1}\left[\prod_{i=1}^{z} b\left(K_i, \xi_i\right)\right]\times \overline{F_n}\left(K[\xi_1\sigma_1(k_1), \ldots, \xi_z\sigma_z(k_z)]; p; h\right) \quad (22)$$

where μ_i and m_{nj} in Eqs.(27) and (28) are replaced by μ and m_n respectively, and

$$\overline{f}(x, p, h) = \int Q\left(H_o\right) f\left(x, \beta H_0\right) dH_o,$$

$$\overline{F_n}(x, p, h) = \int Q\left(H_o\right) F_n\left(x, \beta H_o\right) dH_o,$$

with $h=\beta H$ $S_j(I) = I$ and $\sigma_i(k) = k$. It is advantageous to carry out further algebraic manipulations on Eqs (21) and (22) in order to transform their right-hand sides to an expansion with respect to m_n (or μ) which is suitable for the study of the present system even in the vicinity of the critical temperature. To this end, we follow the procedure used by two of us (N. B and A. F) in the case of a mixed spin Ising model [34]. Doing this, we obtain

$$\mu = c\sum_{n_1=0}^{z}\sum_{n_2=0}^{z-n_1}\sum_{i_1=0}^{n_1}\sum_{i_2=0}^{n_2} 2^{-n_1-n_2} C_z^{n_1} C_{z-n_1}^{n_2} C_{n_1}^{i_1} C_{n_2}^{i_2} (-1)^{i_2} \times$$

$$\left(m_1\right)^{i_1+i_2}\left(m_2\right)^{n_1+n_2-i_1-i_2} \times$$

$$\left(1-m_2\right)^{z-n_1-n_2}\ \overline{f}\left(K(n_1-n_2),p,h\right), \tag{23}$$

and

$$m_n = c\sum_{n_1=0}^{z}\sum_{n_2=0}^{z-n_1}\sum_{i_1=0}^{n_1}\sum_{i_2=0}^{n_2} 2^{-n_1-n_2+i_1+i_2} C_z^{n_1} C_{z-n_1}^{n_2} C_{n_1}^{i_1} C_{n_2}^{i_2} (-1)^{i_2} \times$$

$$(c)^{n_1+n_2-i_1-i_2}\left(\mu\right)^{i_1+i_2} \times$$

$$(1-c)^{z-n_1-n_2}\ \overline{F_n}\left(\frac{K}{2}(n_1-n_2),p,h\right). \tag{24}$$

where C_n^p are the binomial coefficients n!/[p!(n-p)!].

III. PHASE DIAGRAMS

We are first interested in investigating the phase diagram of the system described by the Hamiltonian (3). Let us first write (23) and (24) for m_1 in the following form

$$\mu = A_1\left(K,p,c,h,m_2\right)\ m_1 + B_1\left(K,p,c,h,m_2\right)\left(m_1\right)^3 + \ldots \tag{25}$$

$$m_1 = A_2\left(K,p,c,h\right)\ \mu + B_2\left(K,p,c,h\right)\left(\mu\right)^3 + \ldots \tag{26}$$

where A_i, B_i ,... (i=1,2) are obtained from Eqs (23) and (24) by choosing the appropriate corresponding combinations of indices i_j (j=1,2). Substituting m_1 and m_2 in (23) with their expression taken form (24) we obtain an equation for μ_z of the form

$$\mu = a\mu + b\mu^3 \ldots, \tag{27}$$

where $a=A_1A_2$ (28)

and $b=A_1B_2+B_1A_2$ (29)

The second-order transition is then determined by the equation.

$$1=A_1(K,p,c,h,m_2^c).A_2(K,p,c,h,m_2^c) \tag{30}$$

where m_2^c is the solution of the equation (26) for $p\to 0$, manely

$$m_2^c = c\sum_{n_1=0}^{z}\sum_{n_2=0}^{z-n_1} C_z^{n_1} C_{z-n_1}^{n_2}\, 2^{-n_1-n_2}\,(c)^{n_1+n_2}(1-c)^{z-n_1-n_2}$$

$$\times\overline{F_2}\left(\frac{K}{2}(n_1-n_2),p,h\right) \tag{31}$$

The magnetization μ in the vicinity of the second-order transition line is given by

$$\mu^2 = \frac{1-a}{b}. \tag{32}$$

The right-hand side of (32) must be positive. If this is not the case, the transition is of the first order . In the (T,H) plane and for a given concentration of the magnetic sites, the point at which a=1 and b=0 characterises the tricritical point.

A. THE UNDILUTED SYSTEM

First, Let us investigate the phase diagram of the undiluted case (c=1)for the simple cubic lattice (z = 6).

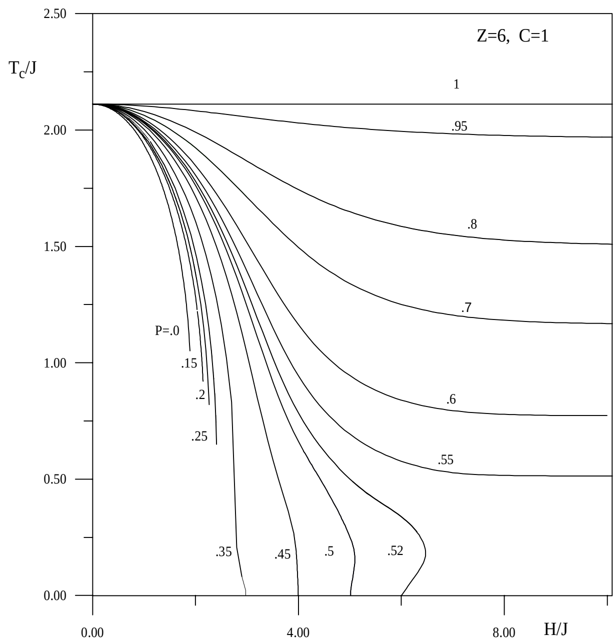

FIG.1:The phase diagram in T-H plane of the mixed spin-1/2 and spin-1 Ising system in a random field on simple cubic lattice (z=6). The number accompanying each curve denotes the value of p. Black dots indicate the tricritical points.

In figure 1, we represent the phase diagram in the (T,H) plane for various values of p. When the random field is bimodally distributed (p=0), the critical temperature decreases gradually from its value Tc(H=0) in the mixed spin system, to end in a tricritical point. As shown in the figure, when we consider a trimodal random field distribution (i.e. p≠0), the system keeps a tricritical behaviour for relatively small range of p (0 ≤ p ≤ 0.2899).

The T-component of the tricritical point decreases with increasing values of p. When p belongs to the range $0.2899 < p \leq 1$, the tricritical behaviour disappears and all transitions are always of second order for any value of the field H. Moreover, we note the existence of a critical values $p^*=0.5259$, indicating two qualitatively different behaviours of the system which depend on the range of p. Thus for $p<p^*$, the system exhibits at the ground state a phase transition at a finite critical value H_c of H. But for $p^* < p < 1$, there is no critical field, and therefore, at very low temperature, the ordered state is stable for any value of the field strength. This latter behaviour is qualitatively similar to that obtained in random field spin1/2 Ising model [22]. It is also worthy of notice here that such critical value p* has been found [34] by two of us (N. B And A. F) in the study of a mixed spin Ising model in a transverse random field. As expected, we can see in Fig.1 that for a fixed value of H, the critical temperature is an increasing function of p. As clearly shown from Fig.1, the system exhibits a reentrant behaviour in narrow ranges of H and p. This phenomena is due to the competition between the exchange interaction and frustration induced by quenched local fields. It is interesting to note here that such reentrance does not exist in the monoatomic (spin-1/2) random field Ising model distribution [21,22].

B. THE SITE DILUTED SYSTEM

First, we study the system described by the Hamiltonian (2), when the longitudinal field is bimodally distributed (p=0).

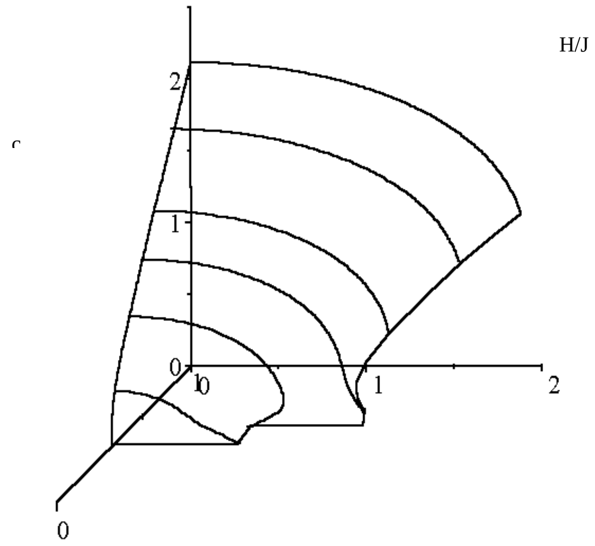

FIG.2: Phase diagram in T-H-c space of the diluted mixed spin-1/2 and spin-1 Ising system in bimodal field (p=0).

TCL is the tricritical line. The number accompanying each curve denotes the value of c.

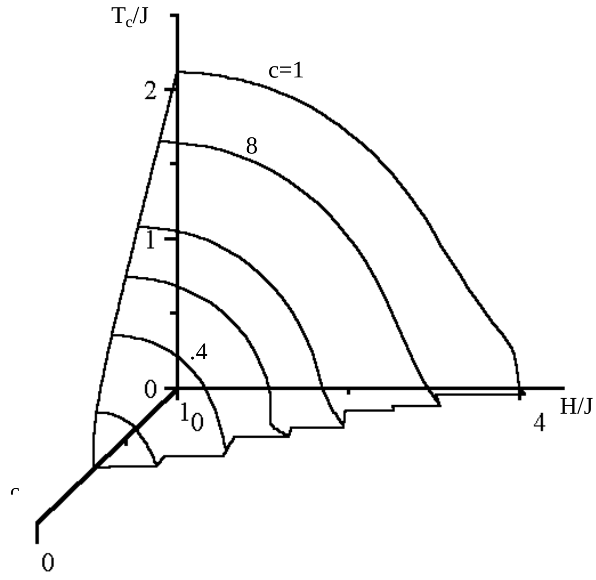

FIG.3: Phase diagram in T-H-c space the diluted mixed spin-1/2 and spin-1 Ising system in a trimodal distribution (p=.45). The number accompanying each curve denotes the value of c.

In Fig.2, we represent the phase diagram in the T-H-c space for a coordination number appropriate to the simple cubic lattice (z=6). Let us first indicate that in the T-c plane (H=0 or p=1) the phase diagram expresses the known result of a diluted magnetic system [28,34]. The critical temperature T_c decreases linearly from its value in the mixed Ising system $T_c(c=1)$, to vanish rapidly at the percolation threshold $c^* = 0.2824$ which is quite good compared with the best value of 0.31 calculated Sykes and Essam [35]. The remaining part ($H\neq0$) of the phase diagram shows the influence of the dilution parameter c on the critical line of the random field mixed spin Ising model. In the figure, we plot various transition lines when c takes values large than c*. It is seen that the system keeps a tricritical behaviour only when at least half of the sites of the system are magnetic $0.508 < c \leq 1$. The H-component of the tricritical point decreases with decreasing value of c and there exists a tricritical line (TCL) which vanishes at c=0.508. When c belong to the range $c^* < c < 0.508$, the tricritical behaviour disappears and all transitions are always of second-order for any value of the field. We also note that the phase diagram shows a reentrance in narrow ranges of H and c. On the other hand, we plot in the figure the zero-temperature phase diagram which shows different thresholds as solutions of the equation $T_c(c,H,p=0)=0$.

Next, we investigate the phase diagrams of the system when the form of the random field is chosen to be a trimodal distribution ($p \neq 0$). In Fig.3, we represent the influence of the dilution on the phase diagram of the pure system when the transition is of second order for any value of H (for instance p=0.45). In fig.3, we plot the sections of the critical surface $T_c(c,H)$, with planes of fixed value of c. As shown in the figure, some curves present a reentrant behaviour in appropriate ranges of H and c. As it was observed in bimodal distribution, we also

note the existence of different thresholds as solution of the equation $T_c(c, H, p=0.45) = 0$. It indicates that these

thresholds depend strongly with H. As clearly expressed in the figure, the zero-temperature critical concentration varies in a stepwise way.

Since the pure version of the system under study exhibits a reentrant behaviour when the fraction p of spins not exposed to the field H is near p*, it is worthy to investigate the effects of the dilution parameter on such reentrant.

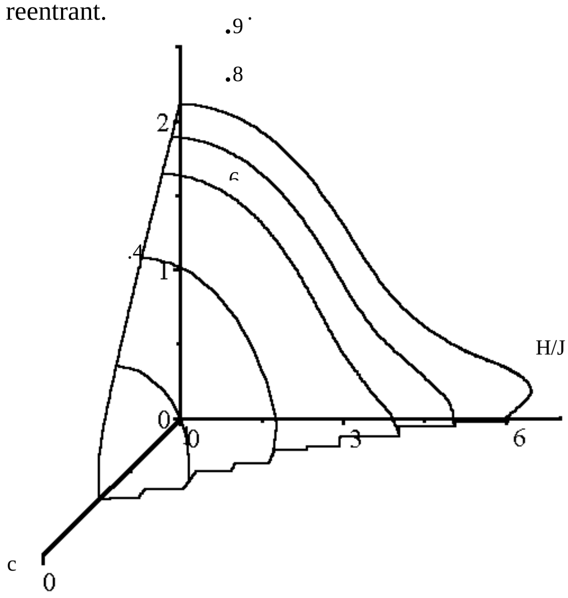

FIG.4: Phase diagram in T-H-c space of the diluted mixed spin-1/2 and spin-1 Ising system in a trimodal distribution (p=.52). The number accompanying each curve denotes the value of c.

In figure 4, we represent the variation of the critical temperature with the field H/J, keeping p fixed (p=0.52) for various values of c. Our results indicate that the reentrant behaviour appears only for small range of the dilution parameter c (0.959 < c < 1) and therefore the system does not exhibit a reentrance when c is very small. Thus, the critical temperature decreases gradually from its value $T_c/J(H=0)$ to vanish at some c-dependent critical value H_c of the field.

Furthermore, it is interesting to investigate, for a given value of c, the phase diagram of the system when p is greater than p*(c=1) = 0.5259. For such value of p and as noted in section 3.1, the pure system at low temperature, which keeps the ferromagnetic order for any value of the magnetic field. As expected, such behaviour appears in the diluted case, but the location of p* depends on the concentration c of magnetic sites.

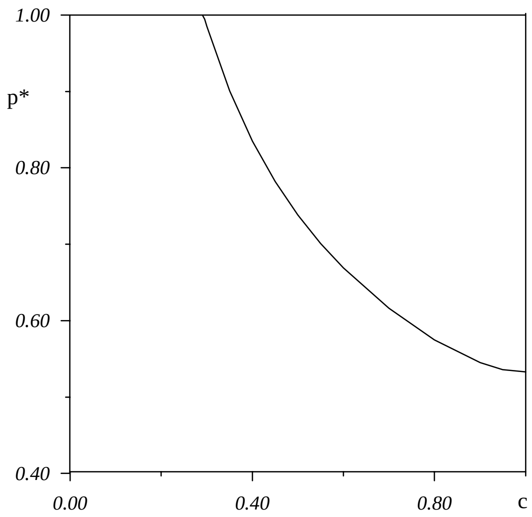

FIG.5: The dependence of the critical value p* as a function of the dilution parameter c.

As shown in Fig.5, p* increases with decreasing values of c. In figure 6, we plot the phase diagram of the system in T-H-c space when p=0.6 (p > p*(c=1)).

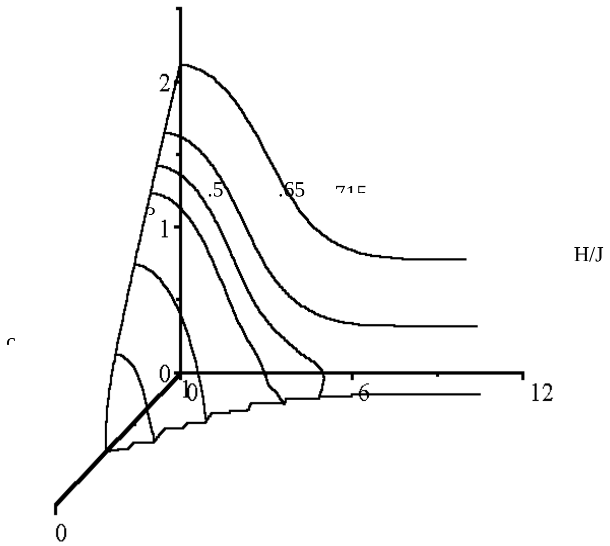

FIG.6: Phase diagram in T-H-c space of the diluted mixed spin-1/2 and spin-1 Ising system in a trimodal distribution (p=.6). The number accompanying each curve denotes the value of c.

It appears two qualitatively different behaviours of the system which depend on the range of c. For the chosen value of p, when c* ≤ c ≤ 0.718, the system exhibits at the ground state a phase transition at a finite critical value Hc of H. But for 0.718 < c ≤ 1, there is no critical magnetic

field, and therefore, at very low temperature, the ordered state is stable for any value of the field strength. Thus, the dilution parameter may distroy the ordered state for any h at low temperature when it exists in the pure system.

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