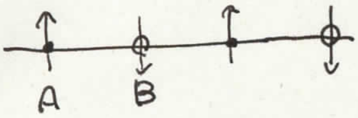
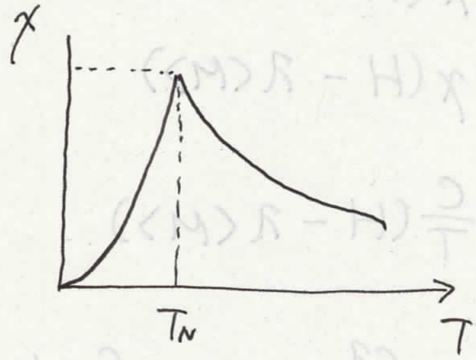
2.9 反強磁性





$\langle M_A \rangle = -\langle M_B \rangle = \langle M \rangle$

と定義する.

$$H = \sum_{\langle i,j \rangle} 2 J_{AF} S_i S_j$$

$$= \sum_j \frac{z J_{AF}}{(g\mu_B)^2} \langle M_i \rangle M_j$$

$$= \underbrace{- \sum_j \frac{z J_{AF}}{(g\mu_B)^2} \langle M \rangle}_{= H_{eff}} M_j$$

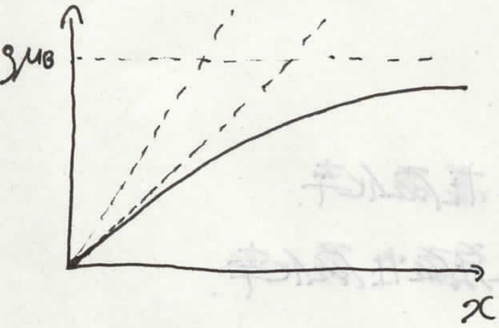
(平均場近似)
zは最近接の数

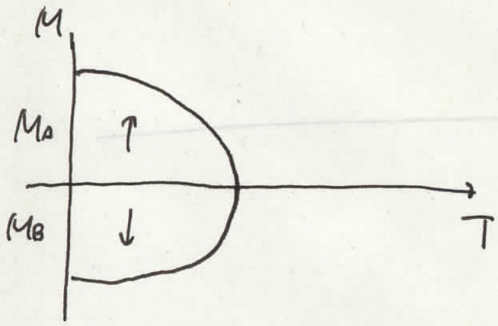
強磁性と等価. $\longrightarrow \langle M \rangle = g S \mu_B B_J(x)$.

$\left(x = \dfrac{g\mu_B S H_{eff}}{k_B T}\right)$.

$\langle M \rangle \neq 0$ の解を持つ $T_{N,m}$ を考えると.

$$k_B T_{N,m} = \frac{1}{3} J_{AF} z S(S+1).$$





$$\langle M \rangle = \chi (H + H_{\text{eff}})$$
$$= \chi (H - \lambda \langle M \rangle)$$
$$= \frac{C}{T} (H - \lambda \langle M \rangle)$$

$$\longrightarrow \quad \left(1 + \frac{C\lambda}{T}\right) \langle M \rangle = \frac{C}{T} H.$$

$$\langle M \rangle = \frac{C}{T + C\lambda} H.$$

$$\chi = \frac{C}{T + C\lambda}$$ キュリー・ワイス則.

ただし、 $C = \frac{g^2 \mu_B^2 S(S+1)}{3k_B}$, $\lambda = \frac{z J_{AF}}{g^2 \mu_B^2}$

$$C\lambda = \frac{z J_{AF} S(S+1)}{3k_B} = T_{N,m}$$

$$M_q = \frac{1}{N} \sum_j M_j e^{iqa_j}$$
$$H_q = H_{q,0} e^{iqa_j}$$

$$\chi = \frac{M_q}{H_q}$$

$q = 0$: 一様磁化率.
$q = \frac{\pi}{a}$: 反強磁性磁化率.

$$\chi\left(\frac{\pi}{a}\right) \longrightarrow \infty \quad \text{at } T_{N,m}.$$
