S3.C. The Critical Exponents for the Curie Point

Critical exponents α, β, γ & δ for a magnetic system are defined analogously to those for PVT systems.

(a) Degree of the critical isotherm δ.

$$\frac{H}{H_c^0} = A_\delta \left| \frac{M_H(T_c)}{M_0(0)} \right|^\delta$$

(3.110)

where A_δ is a proportionality constant,

$$M_0(0) = M_H(T)\Big|_{H=0,\,T=0} \qquad \text{and} \qquad H_c^0 = \frac{k_B T}{m_0}$$

Measurements give

$$4 \le \delta \le 6$$

(b) Magnetization exponent β.

$$\frac{M_0(T)}{M_0(0)} = A_\beta (-\epsilon)^\delta \qquad\qquad \epsilon = \frac{T - T_c}{T_c}$$

(3.111)

where A_β is a proportionality constant. Measurements give

$$\beta \approx \frac{1}{3}$$

(c) Exponents for the heat capacity α' & α.

$$C_H\Big|_{H=0} = \begin{cases} A_{\alpha'}(-\epsilon)^{-\alpha'} & T < T_c \\ A_\alpha \epsilon^{-\alpha} & T > T_c \end{cases}$$

(3.112)

where $A_{\alpha'}$ & A_α are proportionality constants. Measurements give

$$\alpha \sim \alpha' \sim 0$$

(dc) Exponents for the magnetic susceptibility γ' & γ.

$$\frac{\chi_T}{\chi_T^0}\Bigg|_{H=0} = \begin{cases} A_{\gamma'}(-\epsilon)^{-\gamma'} & T < T_c \\ A_\gamma \epsilon^{-\gamma} & T > T_c \end{cases}$$

(3.113)

where $A_{\gamma'}$ & A_γ are proportionality constants and

χ_T^0 = magnetic susceptibility of system if all spin-spin interactions are turned off.

Measurements give

$$\gamma \sim 1.3$$