

Finite Temperature RKKY Interaction

- 3D : $T_c \ll T_F$ Very weak thermal effects \longrightarrow T=0 RKKY interaction
 2D : $T_c \sim T_F$ Strong thermal effects \longrightarrow Finite Temp. RKKY interaction

- Carrier –mediated Mn –Mn coupling (RKKY interaction)

$$H = \sum_{ij} J_{ij}^{RKKY} \mathbf{S}_i \cdot \mathbf{S}_j$$

- Temperature dependent coupling

$$J_{ij}^{RKKY}(R, T) = \sum_q \chi(q, T) e^{i\mathbf{q} \cdot \mathbf{r}}$$

$\chi(q, T)$: Static spin susceptibility of free carriers

$$\chi(q, T=0) = N_F \sqrt{1 - \theta(q - 2k_F)} \left[1 - (2k_F/q)^2 \right]$$

N_F : Density of state at E_F

$$\chi(q, T; \mu) = \frac{1}{4k_B T} \int_0^\infty d\mu' \frac{\chi(q, 0; \mu')}{\cosh^2(\mu - \mu')/2k_B T}$$

$\mu(T)$: Finite Temperature chemical potential

$$\mu(T) = k_B T \ln \left[e^{n/N_F k_B T} - 1 \right]$$

