

# Magnetic Energy Scales

We already saw Asymmetry/Pauli  $\rightarrow$  KE of  $e^-$

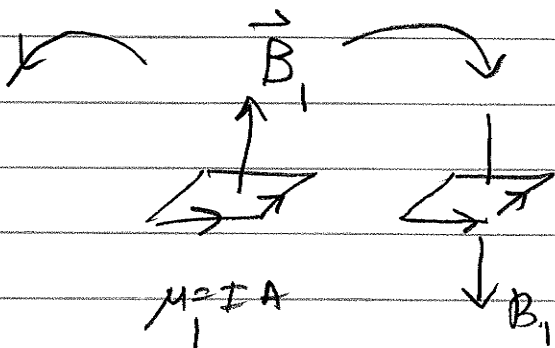
in solid  $\sim 10^2 \times$  what we expect classically

Symmetry of wave function also affects interactions

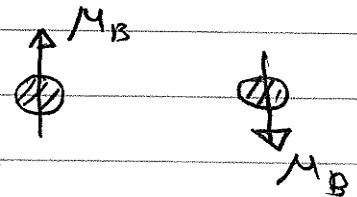
between electrons and is an important determining factor

in magnetism.

Consider whether magnetism could arise from dipole-dipole



$$E = -\frac{\mu \cdot B}{2}$$



~~By E  $\mu_B$~~

$$U = \frac{\mu_0}{4\pi r^3} \left[ 3(\hat{m}_1 \cdot \hat{e})(\hat{m}_2 \cdot \hat{e}) - \hat{m}_1 \cdot \hat{m}_2 \right]$$

$\hat{e}$  connects dipole centers

$$\frac{\mu_0}{4\pi r^3} \text{ m}^2$$

$$\frac{4\pi \cdot 10^{-7}}{4\pi} \frac{(9.3 \cdot 10^{-24})^2}{(10^{-10})^3} \frac{10^{-7} \cdot 10^{-48}}{10^{-30}}$$

$$\sim 10^{-23} \text{ J} \sim 10^{-4} \text{ K}$$

$$\rightarrow k_B \sim 10^{-23}$$