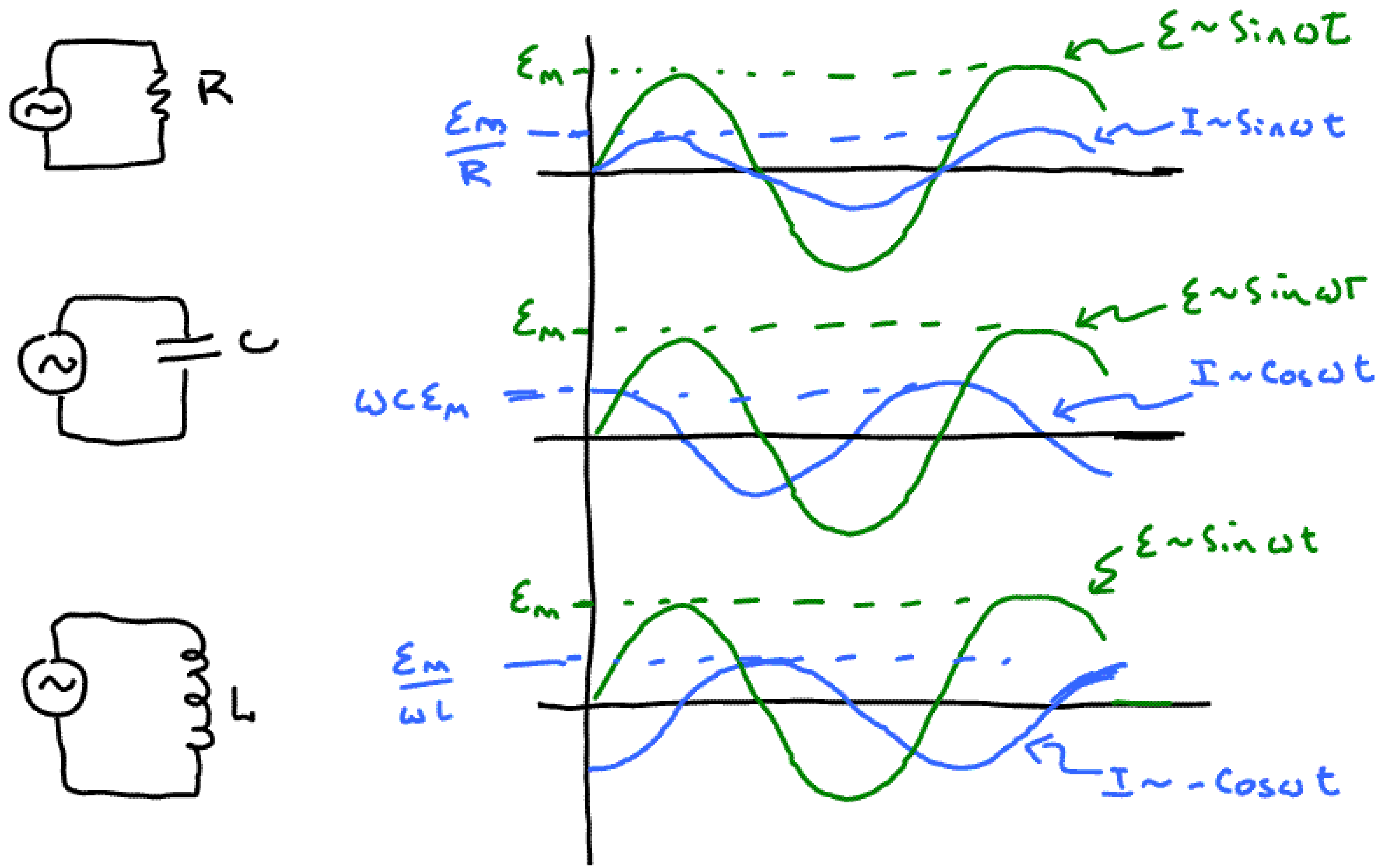
Physics 142 - November 3, 2005

magnetic fields in materials

Last Time -



R $$I = \frac{\mathcal{E}_M \sin\omega t}{R}$$

C $$I = \frac{\mathcal{E}_M \cos\omega t}{X_C}$$

$$X_C = \frac{1}{\omega C}$$

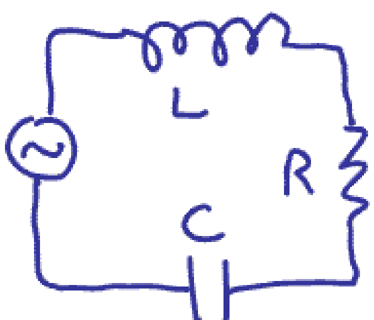
wrote as $= \omega C$ last time

which was a mistake

L $$I = -\frac{\mathcal{E}_M \cos\omega t}{X_L}$$

$$X_L = \omega L$$

LRC circuit



$$I_{max} = \frac{\mathcal{E}_{max}}{Z}$$

$$Z = \sqrt{R^2 + (X_L + X_C)^2}$$

Impedance

magnetic fields in Matter

$\mu \equiv$ magnetic Moment

$= I A$

$$\mu_e = \frac{e v r}{2}$$

Bohr $\rightarrow$ $L = mvr = 0, \hbar, 2\hbar \ldots$

$$\mu_e = n \frac{e\hbar}{2 m_e} \qquad n = 0, 1, 2 \ldots$$

Bohr magneton

We derived magnetic moment as if e^- moving in circle in a plane but we know it doesn't do that how come our analysis works?

n principle Quant. # $n = 1, 2 \cdots$

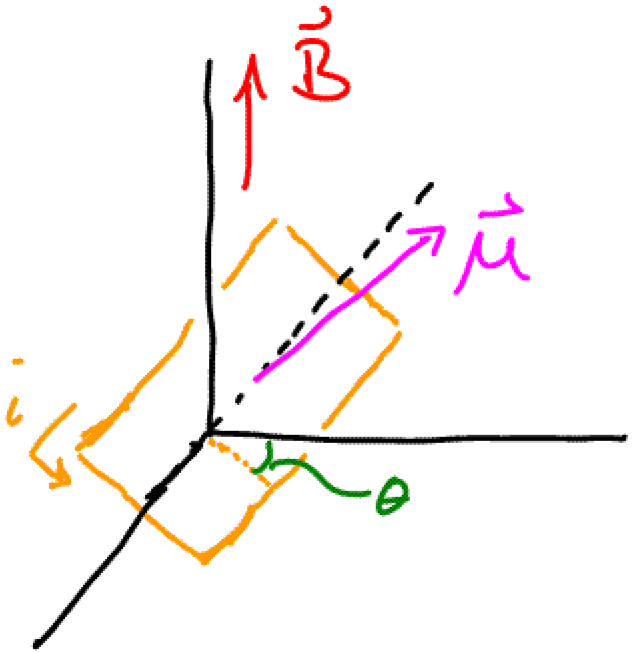
ℓ orbital quant. #

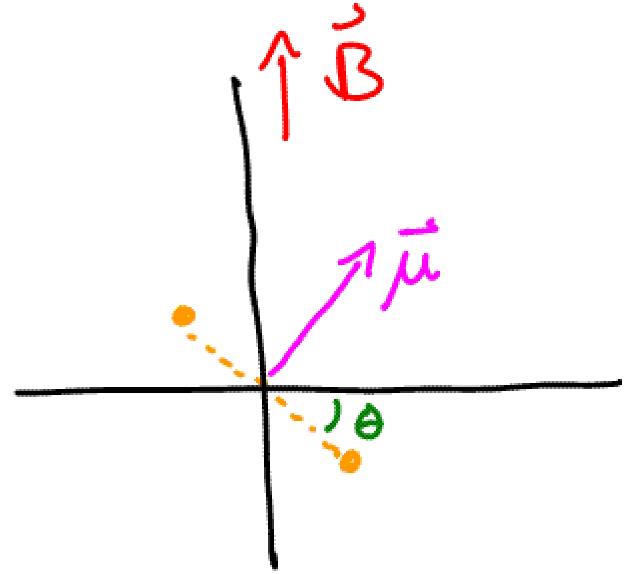
$$\ell = 0, 1, \cdots n-1$$

m_ℓ

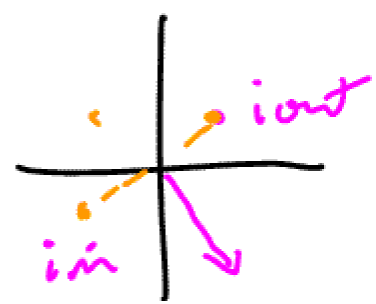
$$m = -\ell, (-\ell+1), \cdots 0, 1, 2 \cdots \ell-1, \ell$$

$$\mu = \mu_b \sqrt{\ell(\ell+1)}$$



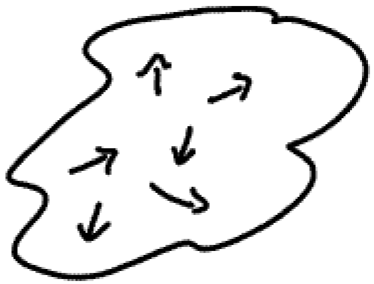


Torque on Dipole $= \vec{\mu} \times \vec{B}$

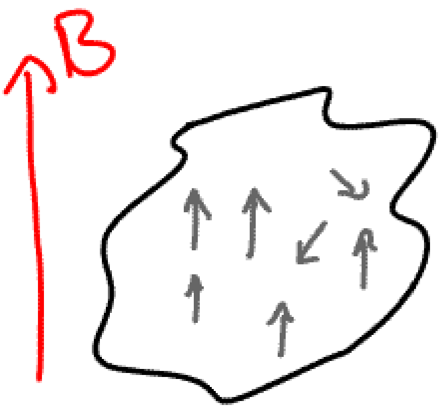


magnetic fields in matter

Paramagnetism

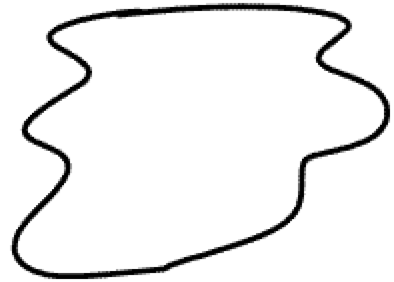


Have magnetic moments in RANDOM orientations

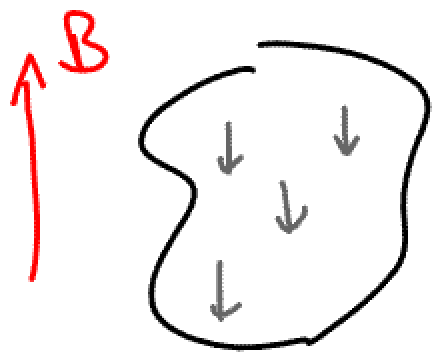


Partial Alignment enhances field

Diamagnetism



No Dipoles



Weakens B

Fe Ferromagnetism

Domains Mostly align w/ field

Field saturates at 2 Tesla

$$B = \mu_0(1+\chi_M)\, B_{free}$$

external Field

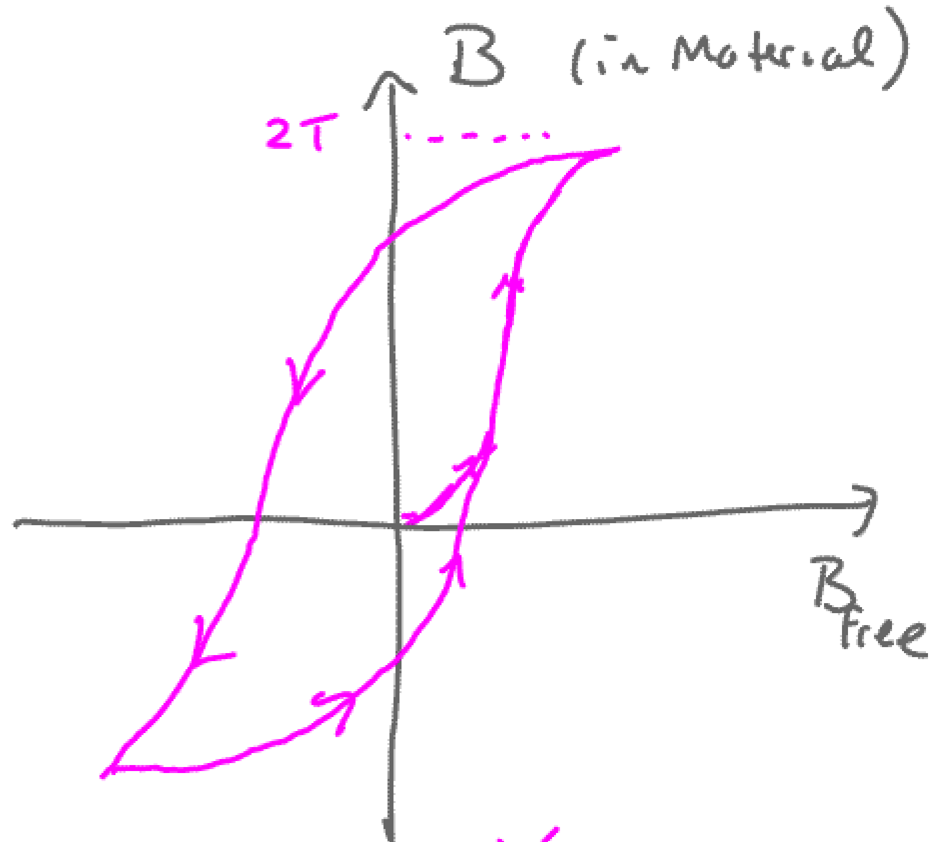
magnetic Susceptability

magnetic permeability

μ

$$B = K_M\, B_{free}$$

const. of relative permeability



Hysteresis Loop