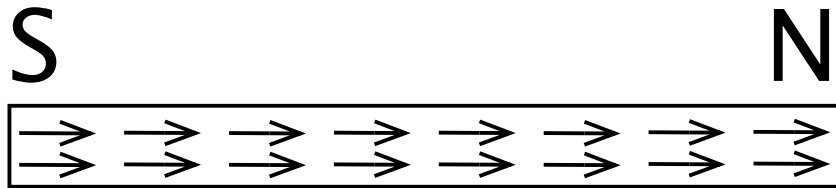


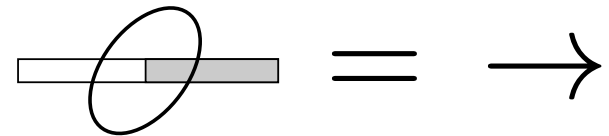
Lecture 20

Macro-micro correspondence



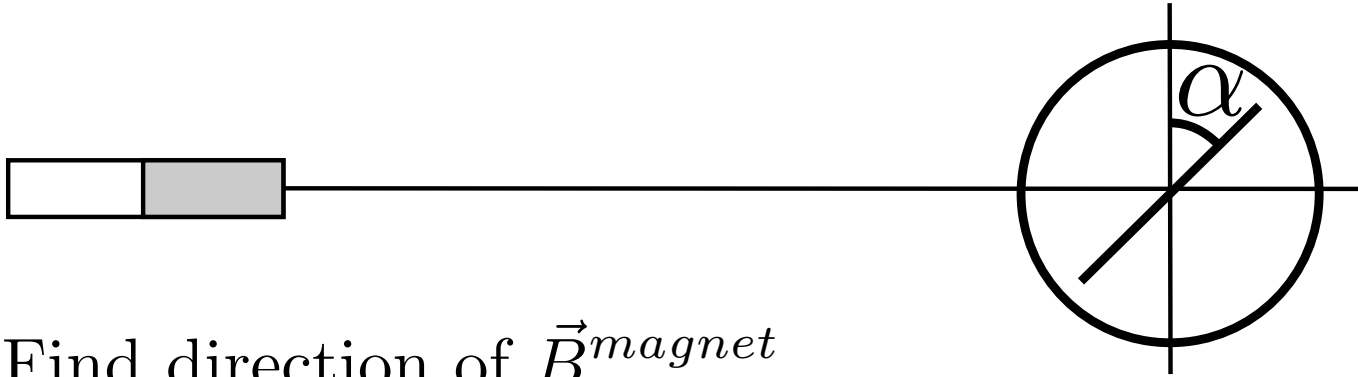
$$B_P^{magnet} = \left(\frac{\mu_0}{4\pi} \right) \frac{2\mu^{magnet}}{x^3}$$

one atomic dipole moment



$$\mu^{magnet} = N\mu^{atom}$$

Compass needle next to a magnet

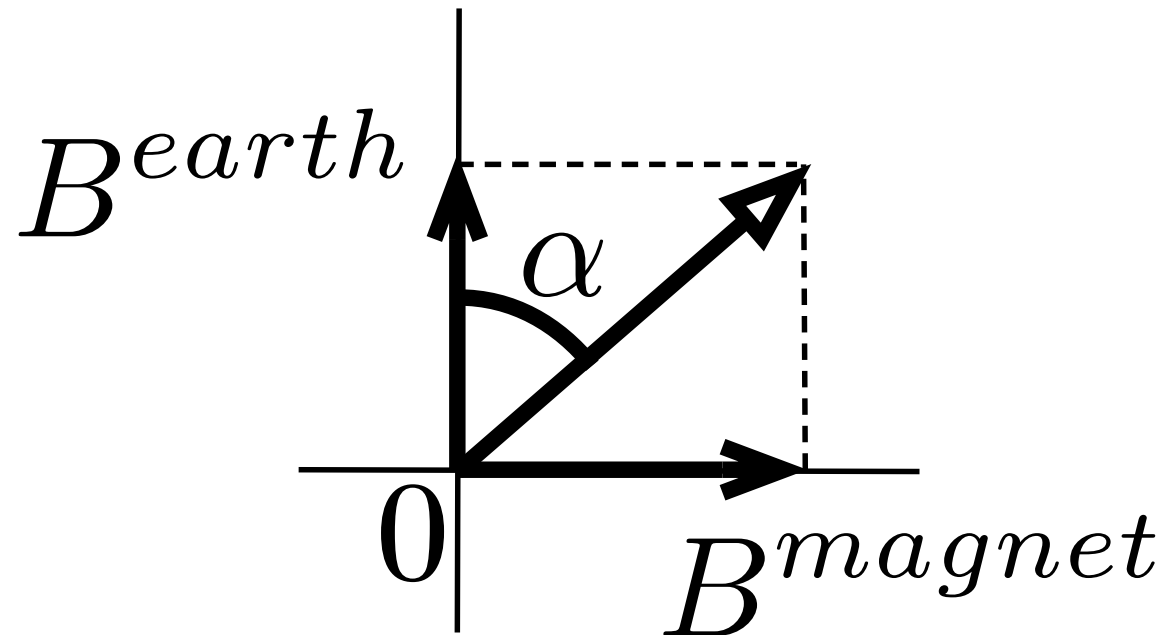


Find direction of $\vec{B}^{magnet}$

Choices:

- 1) Up
- 2) Right
- 3) Down
- 4) Left

Determine B^{magnet} at center of the compass.



$$\begin{aligned}
 \mu_{atom} &= IA = \frac{e}{T} \pi R^2, \quad T = \frac{2\pi R}{v} \\
 &= \frac{e}{\left(\frac{2\pi R}{v}\right)} \pi R^2 \\
 \mu_{atom} &= \frac{e}{2} v r
 \end{aligned}$$

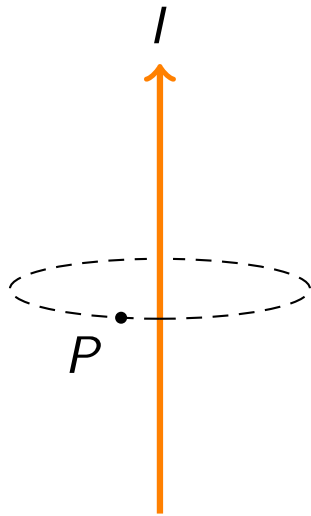
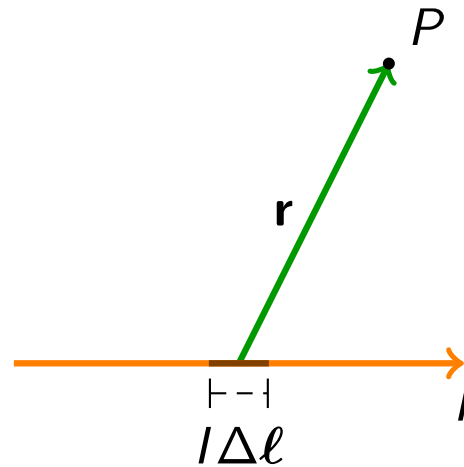
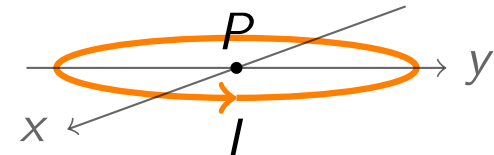
Angular momentum: $L \equiv m v R$

$$\therefore \mu_{atom} = \frac{e}{2} \cdot \frac{L}{m} \approx \frac{e}{2} \frac{\hbar}{m}$$

In general, $L = N\hbar$ where $n = 1, 2, 3\dots$

For the ground state $L \approx \hbar$

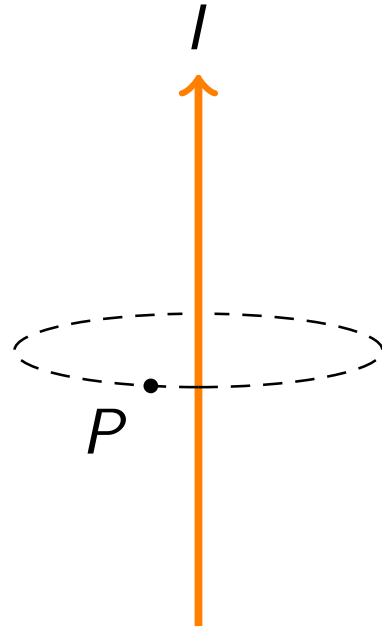
Review: The 3 Right Hand Rules



Choice	B at P (RHR1)	B at P (RHR2)	B at P (RHR3)
1	CW	Into	Up
2	CCW	Out	Down
3	Up	Left	$\hat{x}$
4	Down	Right	$\hat{y}$
5	0	0	0

CW = clockwise, CCW = counter-clockwise

Ampere's Law



Long wire

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B 2\pi r = \mu_0 I$$

Amperian Loop: $\oint_L \vec{B} \cdot d\vec{l} = \mu_0 I_L$

(simple example of Ampere's Law)