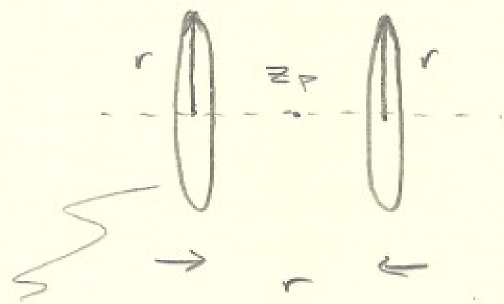
B constant ... then $F_{net} = 0$

B ≠ constant .... then $F_{net} \neq 0$

$$\vec{F} = -\vec{m} \times \frac{d\vec{B}}{dx} \qquad \left(\vec{B}(x_0 + \Delta x) \neq \vec{B}(x)\right)$$

note: Helmholtz configuration




located @ $z_s = {}^{-r}/_2$ : $\vec{B}_L = \dfrac{\mu_0 I r^2}{2(r^2 + (z_p + r/2)^2)^{3/2}}$

$$\vec{B}_R \text{ (located @ } z_s = r/2) = \frac{\mu_0 I r^2}{2(r^2 + (z_p - r/2)^2)^{3/2}}$$

$$\vec{B}_{NET} = \vec{B}_L + \vec{B}_R$$

currents in same direction
$$= \frac{\mu_0 I}{2r}\left[\frac{16}{5\sqrt{5}} - \frac{2304}{625\sqrt{5}}\left(\frac{z_p}{r}\right)^4 + \dots\right]$$

currents in different directions
$$= \frac{\mu_0 I}{2r}\left[\frac{96}{25\sqrt{5}} - \frac{z_p}{r} + \dots\right]$$

linear magnetic feild.

*