Questions From Monday's Class

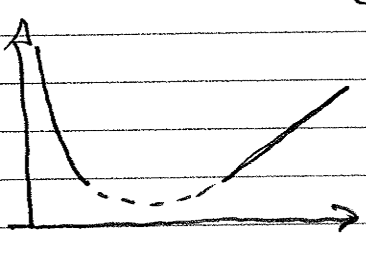
Q: Are weak and strong forces central?

Yes, in certain situations you can describe interaction between two quarks due to strong force as $V(r)$

$$V_s(r) = \begin{cases} \alpha_s / r & r \ll 1 \text{ Fermi} \leftarrow 10^{-15} m \\ \sigma_s r & r \gg 1 \text{ Fermi} \end{cases}$$

$\sigma_s \approx \frac{1 \text{ GeV}}{\text{Fermi}}$

quark mass $\approx$
- u 1.7 – 3.3 MeV
- d 4.1 – 5.8 MeV
- c 1270 MeV
- s 101 MeV
- t 172000
- b 4190



$V_s \sim \sigma_s r \Rightarrow$ confinement!

Weak force

$$V_w(r) = \alpha_w \frac{e^{-r/L_w}}{r}$$

Yukawa

$L_w = 10^{-18}$ m

$M_w = 100$ GeV

$L_w = \frac{\hbar}{mc}$

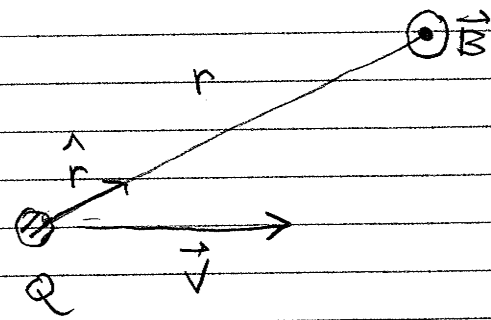
Compton wavelength

eg $L_w = \frac{10^{-34}}{\frac{10^{11} 10^{-19}}{(3 \cdot 10^8)^2} 3 \cdot 10^8} \sim 10^{-18}$

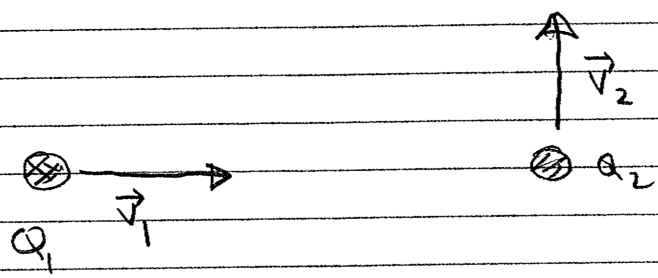
E2

Bigger issue of angular momentum conservation:

Field carries Momentum and Angular Momentum



$$\vec{B} = \frac{\mu_0}{4\pi} \frac{Q\, \vec{v} \times \hat{r}}{r^2}$$



Q_2 feels no magnetic force since $\hat{r} \parallel \vec{v}_1$ so $\vec{B}_1 = 0$

Q_1 does feel a force however since $\hat{r} \perp \vec{v}_2$ so $\vec{B}_2 \neq 0$

Violates Newton's third law and hence momentum conservation.