$$CP|K_0\rangle = -|\bar{K}_0\rangle$$

$$K_{S,L} = |K_0\rangle \mp |\bar{K}_0\rangle$$

$$CP|K_S\rangle = +|K_S\rangle \rightarrow \pi^- \, \pi^+$$

$$\tau_S \ll \tau_L$$

$$CP|K_L\rangle = -|K_L\rangle \rightarrow \pi^+ \, \pi^0 \, \pi^-$$

$$\tau_S \sim .86 \times 10^{-10}\ \text{s}$$

$$\tau_L \sim 5.17 \times 10^{-8}\ \text{sec}$$

$$K_0 \rightarrow (2\pi)$$

$f \sim 2 \times 10^{-3}$ of decays

Strong CP Problem

$$\bar{\Theta}_{cp} [\quad]$$

$$n_{edm} \rightarrow 3\times10^{-16}\,\Theta \sim e\text{-cm}$$

$$\Theta \sim 10^{-10}$$

Peccei-Quinn $\Rightarrow$ Axion.

Standard Model

CKM matrix

Baryon Asymmetry - developed as part of Universe evolution

requires
a) B violation
b) CP violating

B violating process → CP conjugate process would have the same rate

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Experiments - neutron

$[\rho(ex)E]$ $\quad P_e = e x_{cm}$

$$eE(\delta x)\,\tau \gtrsim \hbar$$

$$\delta x \gtrsim \frac{\hbar}{(e\tau E)\,N^{1/2}}$$

$$N = I\,T$$

$$\delta x = \frac{3\times10^{-16}}{G\,\sqrt{T}}$$

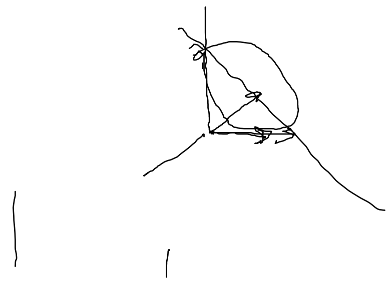
$$G = \left(E\,\tau\,I^{1/2}\right)_{beam}$$

UCN $\quad N = (\rho_v V)\left(\frac{T}{\tau}\right) \quad \Rightarrow \delta x = \frac{\hbar}{eE\sqrt{T\tau\rho V}}$

$$G = \left(E\sqrt{\tau\rho V}\right)$$

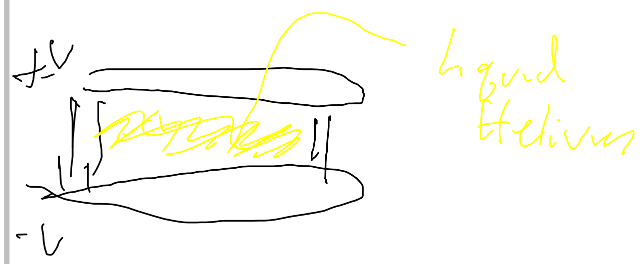
$\tau_{Beam} = 10^{-2}$ sec $\qquad G_{Beam} \sim 3\times10^5$

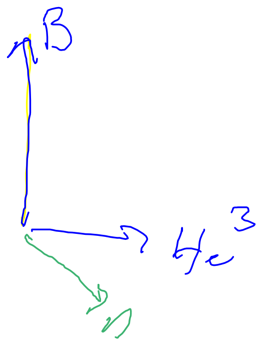
UCN ~ 300 sec $\qquad$ UCN ~ 10^8



LANL collaborators

He^3 co-magnetometer





$(\gamma_3 = 1.1\, \gamma_n)$

5×10^3 b

$He^3 + n \to H^3 + p$ + 750 keV → UV light

$S = 0$

$= 1 \quad \sigma_{abs} = 0$ $\qquad$ $I \parallel S \Rightarrow \sigma_{abs} = 0$

$$\frac{1}{\tau_\pm} = \frac{1}{\tau_w} + \underbrace{(1 \pm P_3)(N\sigma_3) v_{UCN}}$$

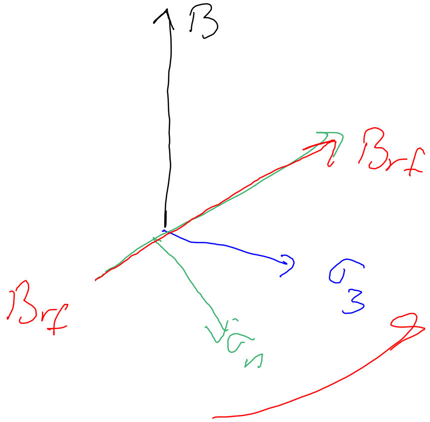
$$S_\pm = \rho\, \tau_\pm$$

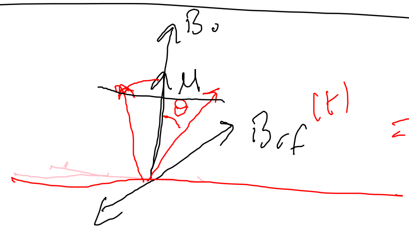
$$\frac{1}{\tau_{abs}} = (1 \pm P_n \cdot P_3)(N \sigma_3 v)$$

$$P_n \cdot P_3 \sim \cos(\underline{(\gamma_3 - \gamma_n)} B t)$$

Title: Apr 25 - 12:38 PM (6 of 7)

Dressed neutron





$= B_d \sin \omega_d t$

$\omega(t) = \gamma B(t) = \dot{\theta}(t)$

$$\theta(t) = \frac{\gamma B_d}{\omega_d} \cos \omega_d t$$

$$\langle \cos \theta(t) \rangle = \frac{1}{T} \int_0^T dt \cos \theta(t) = J_0\left(\frac{\gamma B_d}{\omega_d}\right)$$

$$\gamma_3 J_0(\alpha \gamma_3) \stackrel{?}{=} \gamma_n J_0(\alpha \gamma_n)$$

$$1.1 \cancel{x} J_0(1.1 x_c) = \cancel{x} J_0(x_c) \qquad J_0(x_c) \sim .75$$