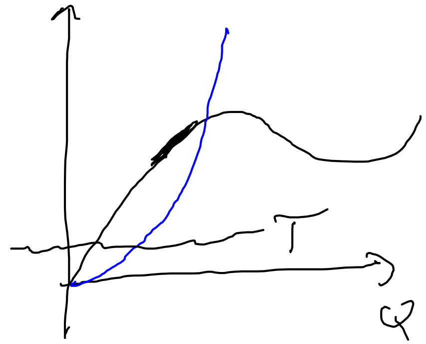
$$\int \sigma(E_1 \to E_u)\, dE_1 \; N \phi_0(E_1) = P$$



$$\int \sigma(E_u \to E_1)\, dE_1 \qquad E_1 \gg E_4$$

$$\frac{d^2\sigma}{d\Omega\, d\omega} = a_{coh}^2 \left(\frac{k_1}{k_u}\right) S(Q, \omega)\, \underline{d\Omega}$$

$$\omega = E_1 - E_u \approx E_1$$

$$|Q| = |\vec{k}_1 - \vec{k}_u| \sim k_1$$

$$Q^2 = k_1^2 + \cancel{k_u^2} - 2 k_1 k_u \cos\theta$$

$$Q\, dQ = k_1 k_u \sin\theta\, d\theta \qquad d\Omega = 2\pi \sin\theta\, d\theta$$

$$= \frac{k_1 k_2}{2\pi}\, d\Omega$$

$$S(Q,\omega) = S(Q)\,\frac{\delta(\omega-\omega_0(Q))\,e^{-\hbar\omega/2T} + \delta(\omega+\omega_0(Q))\,e^{\hbar\omega/2T}}{e^{\hbar\omega_0/2T} + e^{-\hbar\omega/2T}}$$

$$\int S(Q,\omega)\,d\omega = S(Q)$$

$$\frac{d^2\sigma}{d\omega\, d\Omega} = \frac{k_1}{k_u}\, a^2 S(Q)\, \delta(\omega-\omega_0(Q))\, e^{-\hbar\omega_0/2T}$$

$$\int d\omega\left(\ \right) = 2\pi \frac{Q\,dQ}{k_1 k_u^2}\, k_1 a^2 S(Q)$$

$$Q = k_1 \qquad \omega = E_1 = \frac{Q^2}{2m} = \frac{k_1^2}{2m}$$

$$d\omega = \frac{k_1}{m}\, dk_1 = v_n^* \, dk_1$$

$$\omega - \omega_0(Q) = \left(\frac{k_1^*{}^2}{2m} + \frac{k_1^*}{m}(k_1 - k_1^*) - \cancel{\omega_0(k_1^*)}\right) - \frac{\partial\omega_0}{\partial k_1}\bigg|_{k_1^*}(k_1 - k_1^*)$$

$$\frac{k_1^{*2}}{2m} = \omega_0(k_1^*) = c k_1^*$$

$$\delta(\omega-\omega_0(Q)) = \delta\left[(k_1 - k_1^*)(v_n^* - v_g^*)\right] = \frac{v_n}{|v_n - v_g|}\,\delta(k_1 - k_1^*)$$

$$d\omega \qquad dk_1$$

$$\int d\omega\left(\ \right) = 2\pi\frac{Q\,dQ}{k_1 k_u^2}\, k_1 a^2 S(Q)\, \frac{v_n}{|v_n - v_g|}\, \underline{\delta(k_1 - k_1^*)\, dk_1}$$

$$\alpha$$

$$Q = k_1 \pm k_u$$

$$dQ = 2k_u$$

$$\int \sigma(E_u \to E_1)\, dE_1 = 4\pi\left(\frac{k_1}{k_u}\right) a^2\, S(k_1^*)\, \alpha\, e^{-\hbar\omega^*/T}$$

$$\int \sigma(E_1 \to E_u)\, dE_1 = \int dE_1\, \frac{E_u}{E_1}\, \sigma(E_u \to E_1)\, e^{+E_1/T}$$

$$= \frac{E_u}{E_1^*}\, \cancel{e^{E_1^*/T}}\, \sigma_{coh}\, \frac{k_1}{\cancel{k_u}}\, S(k_1^*)\, \alpha\, \cancel{e^{-E_1^*/T}}$$

$$P(E_{ucn})\, dE_{ucn} = N\sigma_{coh}\left(\frac{k_u}{k_1^*}\right) S(k_1^*)\, \alpha\, \phi(E^*)\, dE_{ucn}$$

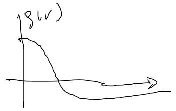
$(n-\bar{n})$

$\Delta B = 2$

$|\bar{n}\rangle \quad B = -1$

$\mu_{\bar{n}} = -\mu_n$

$(p + \pi^-)$



$s = +1/2$

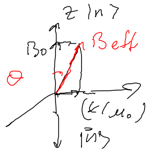
$$H = \begin{vmatrix} +\mu \cdot B & \epsilon \\ \epsilon & -\mu \cdot B \end{vmatrix} \begin{bmatrix} a \\ b \end{bmatrix}$$

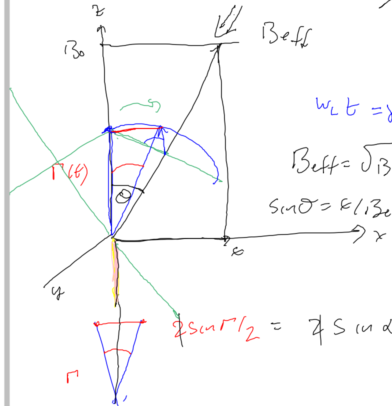
$\psi = a|n\rangle + b|\bar{n}\rangle$

$i\hbar \dot{a} = W_L a + \epsilon b/\hbar$

$i\hbar \dot{b} = \epsilon a - W_L b$

$\tan\theta = \dfrac{\epsilon}{B_0}$



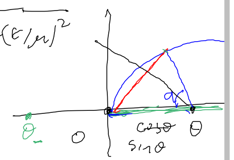


$P_{n\to\bar{n}}(t)$

$W_L t = \gamma B_{eff} t = \alpha$

$B_{eff} = \sqrt{B_0^2 + (\epsilon/\mu)^2}$

$\sin\theta = \epsilon / B_{eff}$



$2\sin\Gamma/2 = \cancel{2}\sin\alpha/2 \sin\theta$

$\psi = a|n\rangle + b|\bar{n}\rangle \qquad P_n = |b|^2$

$a^2 + b^2 = 1$

$\sigma_z = |a|^2 - |b|^2 = \cos\Gamma$

$|a|^2 + |b|^2 = 1$

$\cancel{2}|b|^2 = (1 - \cos\Gamma)\frac{1}{2} = \sin^2\Gamma/2$

$= \sin^2\alpha/2 \, \sin^2\theta =$

$$P_{n\to\bar{n}}(t) = \left[\frac{\epsilon^2}{(B_0^2 + \epsilon^2)} \sin^2 t\sqrt{B_0^2 + \epsilon^2} \right]$$

$\sim \dfrac{\epsilon^2}{B_0^2} \cancel{\sin^2}(B_0 t)^2$

$B_0 t \ll 1$

1 milli gauss

1 second $\quad W_L t \; 2\pi(3) \sim$

$\sim (\epsilon^2 t^2) = \left(\dfrac{t}{\tau_{n\bar{n}}}\right)^2$