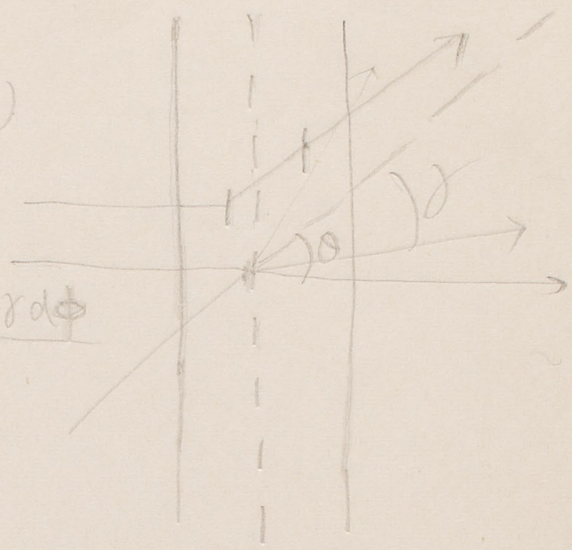
E22 120 P06　4(+1)

○ Oblique Incidence



θ なる angle で入る neutron が
$(z, z+dz)$ で $(\gamma, \gamma+d\gamma)(\phi, \phi+d\phi)$
なる scattering をやる prob. は

$$e^{-\frac{z}{\lambda_0\cos\theta}} \cdot \frac{dz}{\lambda_0\cos\theta} \cdot \frac{2\sin\gamma\cos\gamma\, d\gamma\, d\phi}{2\pi}$$

その中 出て行くには

$$\times\, e^{-\frac{h-z}{\lambda\cos\theta'}}$$

$$\cos\theta' = \cos\theta\cos\gamma + \sin\theta\sin\gamma\cos\phi.$$

$$\nu = \nu_0 \cos\gamma.$$

$\frac{\pi}{2} \geq \theta, \gamma$ が きまって居ると $(\cos\theta, \cos\gamma, \sin\theta, \sin\gamma > 0)$
φの積分限界が

$$\cos\phi_c = -\cot\theta\cot\gamma$$

に下の所では大 $\theta' < \frac{\pi}{2}$ になる　故に

$$\int_{-\phi_c}^{+\phi_c} d\phi\, e^{-\frac{h}{\lambda\cos\theta'}} \frac{e^{\left(\frac{1}{\lambda\cos\theta'} - \frac{1}{\lambda_0\cos\theta}\right)h} - 1}{\frac{1}{\lambda\cos\theta'} - \frac{1}{\lambda_0\cos\theta}} \cdot \frac{2\sin\gamma\cos\gamma\, d\gamma}{\lambda_0\cos\theta\ 2\pi}$$

$$= \frac{2\sin\gamma\cos\gamma\, d\gamma}{\lambda_0\cos\theta\ 2\pi} \cdot \left\{ e^{-\frac{h}{\lambda_0\cos\theta}} \cdot \int_{-\phi_c}^{+\phi_c} \frac{d\phi}{\frac{1}{\lambda\cos\theta'} - \frac{1}{\lambda_0\cos\theta}} - \int_{-\phi_c}^{+\phi_c} \frac{e^{-\frac{h}{\lambda\cos\theta'}}\, d\phi}{\frac{1}{\lambda\cos\theta'} - \frac{1}{\lambda_0\cos\theta}} \right\} = \frac{dE}{2\pi E_0} \frac{1}{\lambda_0\cos\theta} \left\{ \frac{e^{-\frac{h}{\lambda_0\cos\theta}}}{\lambda_0\cos\theta} \int_{-\phi_c}^{\phi_c} \frac{d\phi}{\lambda\cos\theta'(\lambda_0\cos\theta - \lambda\cos\theta')}\right.$$

$\frac{1}{h}$

θ が $\frac{\pi}{2}$ に近くなければ

$$\cong \frac{dE}{2\pi E_0}\frac{1}{\lambda_0\cos\theta}\left\{\frac{\cancel{\times}-\frac{h}{\lambda_0\cos\theta}}{\cancel{\lambda_0\cos\theta}}\left(\cancel{\int\frac{d\phi}{\lambda\cos\theta'}}+\int\frac{d\phi}{\lambda_0\cos\theta-\lambda\cos\theta'}\right)\right.$$

$$\left.+\int_{-\phi_c+\delta}^{\phi_c-\delta}\frac{\frac{h}{\lambda\cos\theta'}}{\frac{1}{\lambda\cos\theta'}-\frac{1}{\lambda_0\cos\theta}}d\phi\right\}$$

$$\cong \frac{dE}{E_0}\cdot\frac{h}{\lambda_0\cos\theta}\cdot\frac{1}{\cancel{\pi}}\arccos\{-\cot\theta\cdot\cot\gamma\}$$

$$\cot\gamma=\frac{\sqrt{\frac{E}{E_0}}}{\sqrt{1-\frac{E}{E_0}}}=\frac{1}{\sqrt{\frac{E_0}{E}-1}}$$

$$\int_0 f(\theta)\,d\theta\cdot\frac{dE}{E_0}\cdot\frac{h}{\lambda_0\cos\theta}\cdot$$

$$+\int_{\cot\theta\leq\sqrt{\frac{E_0}{E}-1}}^{\frac{\pi}{2}-\delta} f(\theta)\,d\theta\cdot\frac{dE}{E_0}\cdot\frac{h}{\lambda_0\cos\theta}\cdot\frac{\arccos\left\{\frac{-x}{\cot\gamma}\right\}}{\pi}$$

$$\lambda_0\cos\theta=h$$

$$+\int_{\frac{\pi}{2}-\delta}^{\pi} f(\theta)\,d\theta\cdot\frac{dE}{E_0}\cdot\frac{1}{2}\qquad \cancel{2\sin\gamma\cos\gamma\,d\gamma}$$

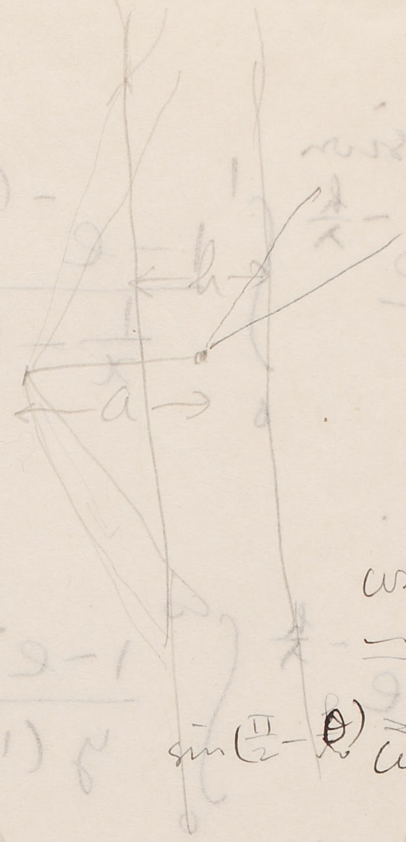
$=$

point sourceから来てくるなら、

$(\theta, \theta+d\theta)$ の間の

伝は N_0 の

$N_0 \frac{\sin\theta\, d\theta}{2}$



transmission

$\frac{\lambda}{2\lambda_0}$

$\theta < \arccos\sqrt{1-\frac{E}{E_0}}$

$\cos\theta = \sqrt{1-\frac{E}{E_0}}$

$\sin\left(\frac{\pi}{2}-\theta\right) = \cos\theta = \frac{h}{\lambda_0}$

$\sqrt{1-\frac{E}{E_0}}$

$\frac{dE}{2E_0} N_0 \left\{ \int \frac{h\, dx}{\lambda_0 x} \right.$

$\cot\theta = \frac{\cos\theta}{\sqrt{1-\cos^2\theta}} = \sqrt{\frac{E_0}{E}-1}$

$+ \int \frac{h}{\lambda_0 x} dx + \frac{1}{2}\left(\frac{h}{\lambda_0}\right)$

$\frac{\cos^2\theta}{1-\cos^2\theta} = \frac{E_0}{E}-1$

$\arccos\left\{\frac{x}{\sqrt{1-x^2}\sqrt{\frac{E_0}{E}-1}}\right\} / \pi$

$= N_0 \frac{dE}{2E_0} \frac{h}{2\lambda_0} \left\{ \log\left(\frac{1}{1+\frac{E}{E_0}}\right) + \log \frac{\left(1-\frac{E}{E_0}\right)^{-\frac{1}{2}}}{\frac{h}{\lambda_0}} \right.$

$= \frac{N_0}{2} \frac{dE}{E_0} \frac{h}{2\lambda_0} \left\{ \log \frac{\lambda_0}{h} \cdot \frac{1}{\sqrt{1-\frac{E}{E_0}}} + \ldots \right\}$ for $\frac{E}{E_0} < 1 - \frac{h}{\lambda_0}$

$\simeq \frac{N_0}{2} \frac{dE}{E_0} \frac{h}{2\lambda_0} \log \frac{\lambda_0}{h}$ for $\frac{E}{E_0} \ll 1$.

transmission

$$\frac{\lambda}{2\lambda_s} e^{-\frac{h}{x}} \int_0^1 \frac{1-e^{-(\frac{1}{x}-1)h}}{\frac{1}{x}-1}\, dx$$

$\frac{1}{x}-1=y.$

$$e^{-\frac{h}{x}y} = x$$
$$e^{-\frac{h}{x}y}\left(-\frac{h}{x}\right)dy = dx$$
$$dy = -\frac{x}{h}\frac{dx}{x}$$
$$y = -\frac{x}{h}\log x$$

$$= \frac{\lambda}{2\lambda_s} e^{-\frac{h}{x}} \int_0^\infty \frac{1-e^{-\frac{h}{x}y}}{y(1+y)^2}\, dy$$

$$= \frac{\lambda}{2\lambda_s} e^{-\frac{h}{x}} \left[\cancel{\int_0^\infty \frac{1-e^{-\frac{h}{x}y}}{y} dy - \int_0^\infty \frac{(1-e^{-\frac{h}{x}y})}{1+y} dy} \right.$$
$$\left. - \int_0^\infty \frac{1-e^{-\frac{h}{x}y}}{(1+y)^2} dy \right]$$

$\left(\frac{1}{y} - \frac{1-y}{y}\right)$ $(1+$

$$= \frac{\lambda}{2\lambda_s} e^{-\frac{h}{x}} \left[\cancel{\left(\frac{\lambda}{h}\right)^2 \int_0^1 \frac{(1-x)\,dx}{x\log x}} \quad \cancel{C + \int_1^\infty \frac{dy}{y}} \right.$$
$$\left[\int_0^\infty \frac{(1-e^{-\frac{h}{x}y})}{y(1+y)} dy - \int_0^\infty \frac{(1-e^{-\frac{h}{x}y})}{(1+y)^2} dy \right]$$

$$= \frac{N_0}{2}\frac{dE}{E_0}\frac{h}{\lambda_0}\log\frac{\lambda_0}{h} \quad \text{for } \frac{E}{E_0} > 1-\left(\frac{h}{\lambda_0}\right)^2$$

$$\sim E \cong E_0$$