$$\frac{P(E_{ucn})}{dE_{ucn}} = \int \left[\sum (E_0 \to E_{ucn})\, \phi(E_0)\, dE_0 \right] dE_u$$

$$\phi(v)\,dv \simeq v^3 e^{-v^2/kT}\, dv$$

$$\phi(E) = \phi_0 \frac{E}{(k_B T)} e^{-E/T_0} \frac{dE}{k_B T_0} \simeq v\, g(v)\, dv$$

$$E_0 e^{-E_0/T} \sum (E_0 \to E_{ucn}) = E_u e^{-E_u/T} \sum (E_{ucn} \to E_0)$$

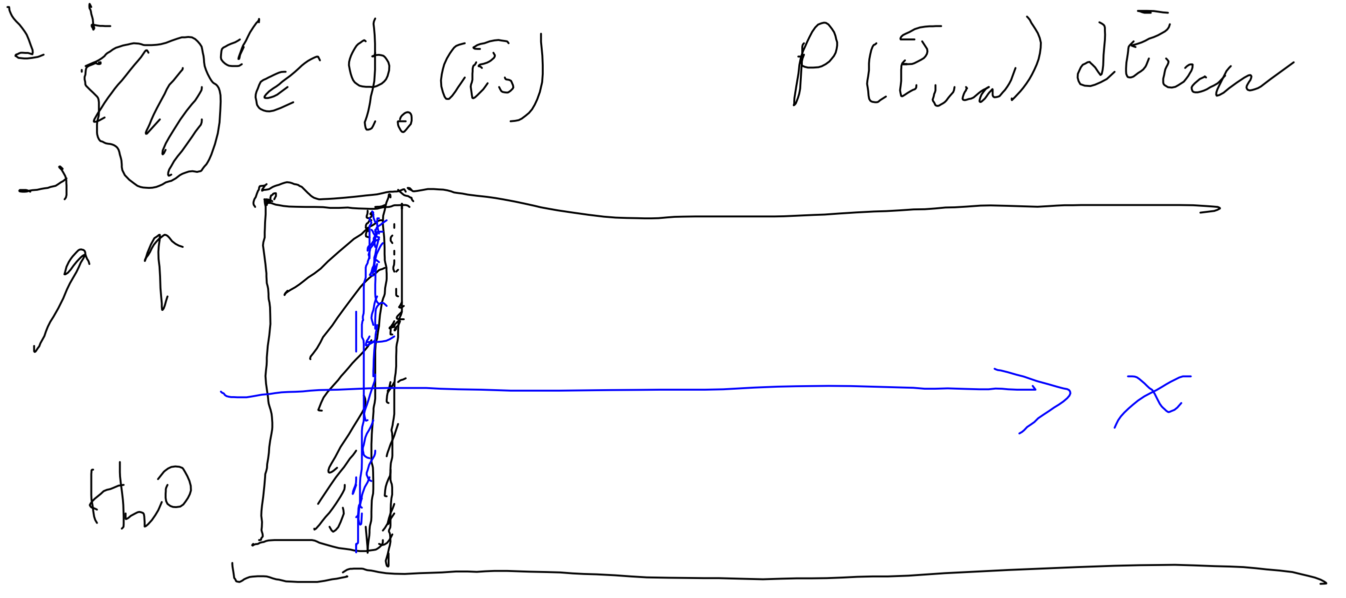
$$\int dE_0 \frac{E_0}{T_0^2} e^{-E_0/T_0} \underline{\sum (E_0 \to E_{ucn})}\, dE_u\, dE_0$$

$$\int dE_0\, e^{-E_0/T_0}\, E_u e^{-E_u/T_1} e^{E_0/T} \sum (E_{ucn} \to E_0)\, dE_u\, dE_0$$

$$\phi_0 \left[\frac{E_u}{T^2} e^{-E_u/T} \right] \frac{T^2}{T_0^2} \int dE_0\, e^{E_0/T^*} \sum (E_u \to E_0)\, dE_u\, dE_0$$

$$= P(E_{ucn})\, dE_{ucn}$$

$$\frac{1}{T^*} = \frac{1}{T} - \frac{1}{T_0}$$



$$\Sigma_{tot}(E_{ucn}) \sim 10\ cm^{-1}$$

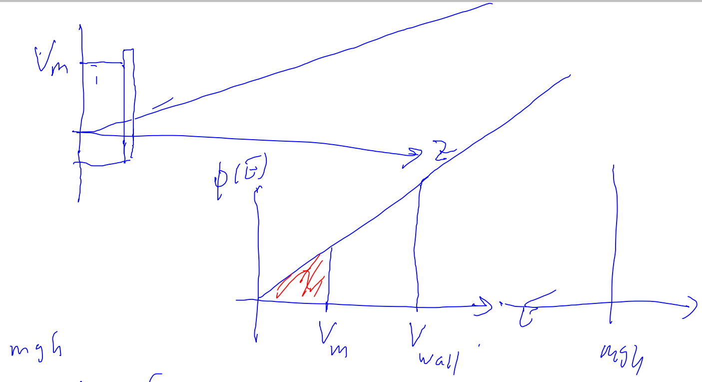
$$\sigma = \Sigma_t / \Sigma_s \gg 1$$

$$\Sigma_t = \Sigma_s + \Sigma_{abs} + \Sigma_{up}$$

$$\dot{J}(E_{ucn}) = \frac{P(E_{ucn})}{\cancel{\Sigma_s}} \frac{1}{4} \Sigma_t \Longrightarrow \frac{\phi_0 f}{4} \left\{ \frac{\Sigma_{in}(u_{cn})}{\Sigma_s + \Sigma_{in} + \Sigma_a} \right\}$$

$$f = \underline{E_{ucn}}\, e^{-E_{ucn}/T}$$

$$J = \frac{1}{4} \rho v$$



mgh
$\simeq 1$ neV/cm

thermal neutron moderator

1) Diffusion length of thermal neutrons

2) Slowing Down Length

3) Size of Moderator

$\boxed{(1) < (2), (3)}$

$\rho = \text{const}$

$$\rho(E)\, dE \sim \phi_{inc} \frac{\sqrt{E_{in}}}{T_0^{1/2}} e^{-E_{in}/T} \frac{dE_{in}}{T_0} = \phi_{Th} \frac{\sqrt{E_T}\, dE\, e^{-E/T}}{T^{3/2}}$$

$$\frac{\rho_T}{\rho_{inc}} \sim \left(\frac{T_0}{T}\right)^{3/2}$$

$\boxed{(1) > (2), (3)}$

$\phi = \text{const}$

$$\phi(E_{inc}) = \frac{E_{in}\, dE_{inc}\, e^{-E_{in}/T}}{T^2}$$

$$\frac{\phi_T}{\phi_{inc}} \sim \left(\frac{T_0}{T}\right)^2$$

$\phi(\vec{r}, E)$

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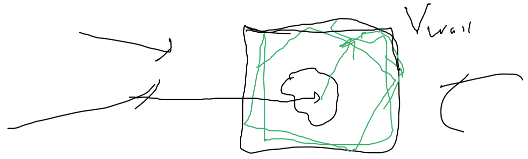
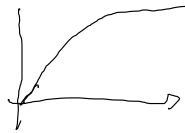


$$\frac{d\rho}{dt} = P - \frac{\rho}{\tau}$$

$$P(E_{ucn})V = \frac{\rho V}{\tau_{tot}}$$

$$1/\tau_{tot} = \boxed{\frac{1}{\tau_{abs}} + \frac{1}{\tau_W} + \frac{1}{\tau_\beta} + \frac{1}{\tau_{holes}}} + \frac{1}{\tau_{upsc}}$$

$$\boxed{\rho_s = P\tau}$$



$$(1 - e^{-t/\tau})\rho_s$$

$$\frac{1}{\tau_W}: \quad \left(\frac{\rho v}{4}\right) A\mu = \frac{\rho V}{\tau_W} \qquad \boxed{\frac{1}{\tau_W} = \frac{\mu v A}{4V}}$$

Δ, $E^* \to E_{ucn}$

0 $E_W < V_W$

$$\cancel{(V_W - V_m)}$$

$$\int dE^* \, \phi(E^*) \underline{\Sigma(E^* \to E_{ucn})} \, dE_{ucn}$$

$$= v_{ucn} \underline{\Sigma(E_{ucn} \to E^*)} \rho(E_{ucn})$$

$$\rho(E_{ucn}) = \left(\frac{1}{v_{ucn}}\right) \frac{E_{ucn}}{E^*} e^{+E^*/T}) \sim v_{ucn}$$

$$E^* e^{-E^*/T} \Sigma(E^* \to E_u) = E_u e^{-E_u/T} \Sigma(E_u \to E^*)$$

$$\frac{\Sigma(E^* \to}{\Sigma(E_u \to} = \frac{E^u}{E^*} e^{E^*/T} \cancel{e^{-E_u/T}}$$