The Kinchin Pease Approach:

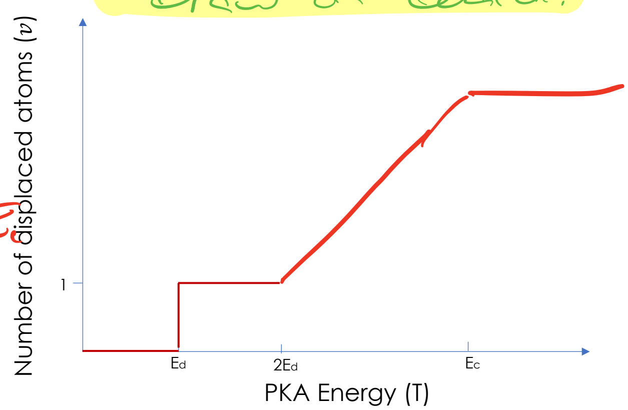
$\nu(T) = 0 \quad T < E_d$

$\nu(T) = 1 \quad E_d \le T \le 2E_d$

$\nu(T) = T/2E_d \quad 2E_d \le T \le E_c$

$\nu(T) = E_c/2E_d$

Draw on board!



↳ ∴ knowing T_{max} ($\hat{T}$) is critical to determining the functions to use!

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Example calculation…

$a_0 = 0.2866$ nm

Assume a pure piece of BCC iron is irradiated in a reactor with a monoenergetic flux of 5E13 cm^3/s 1 MeV neutrons. Calculate the time it takes to reach 1 dpa in the iron sample.

$N_{BCC} = \frac{2}{0.2866^3}$

$= 8.5E22 \frac{\text{atoms}}{cm^3}$

$R_d = \frac{\#\text{disp.}}{cm^3 s} = N \int_{\check{T}}^{\hat{T}} \Phi(E_i)\sigma_D(E_i)\,dE_i$ (1)

since mono-energetic, no int:

$R_d = N \Phi \sigma_D(E_i)$

→ remember: $\sigma_D(E_i) = \underbrace{\int_{\check{T}}^{\hat{T}} \sigma_s(E_i,T)}\nu(T)\,dT$

↳ hard sphere: indep. of T

$\therefore \sigma_D(E_i) = \frac{\sigma_s(E_i)}{\gamma E_i} \int_{\check{T}}^{\hat{T}} \nu(T)\,dT$ (2)

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Example calculation…

→ we need to know $\hat{T}$ to see what $\sigma(T)$ integral(s) we need:

$$\hat{T} = \gamma E_i = \frac{4 m_1 m_2}{(m_1 + m_2)^2} E_i = \frac{4 \cdot 1 \cdot 56}{(1+56)^2} \cdot 1E6\ eV$$

(3)

$$\hat{T} = 68944\ eV = 68.9\ keV$$

→ is this greater than E_c?

$$E_c = 56\ Da\left(\frac{keV}{da}\right) \approx 56\ keV$$

$\therefore \hat{T} > E_c \Rightarrow$ full integrals needed

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Go to canvas page and show cheat sheet

Example calculation…

$$\therefore \sigma_D = \frac{\sigma_s(E_i)}{\gamma E_i}\left[\int_0^{E_d} 0\, dT + \int_{E_d}^{2E_d} 1\, dT + \int_{2E_d}^{E_c} \frac{T}{2E_d}\, dT + \int_{E_c}^{\gamma E_i} \frac{E_c}{2E_d}\, dT\right.$$

↳ cheat sheet simplifys:

$$R_d = \frac{N \Phi \sigma_s}{2 \underbrace{\gamma E_i}_{\hat{T}} \underbrace{E_d}_{40\,eV}}\left(\gamma E_i E_c - \frac{E_c^2}{2}\right)$$

σ_s → 3 barns

$$\therefore R_d = \frac{8.5E22\ \text{atoms/cm}^3 \cdot 5E13\ n/\text{cm}^2/\text{s} \cdot 3E\text{-}24}{2 \cdot 68944\ eV \cdot 40\ eV} \cdots$$

$$\left(68944\ eV \cdot 56000\ eV - \frac{(56000\ eV)^2}{2}\right)$$

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$$R_d = 5.3E15\ \text{disp}/\text{cm}^3\text{s} \cdot \frac{1}{8.5E22\ \text{atoms}}$$

$$K_0 = R_d/N = 6.2E\text{-}8\ \text{dpa/s}$$

of to get to 1 dpa
$t = 16129032\ s$ or
~ 187 days.

You might find this helpful:

Part I: The radiation damage event

Objective: Develop a fundamental understanding of the physics of the radiation damage event

Day	Date	Lec. #	Topic	Lecture Notes	Assignments	Other resources/details
Tuesday	Aug. 30	1	Introduction	Notes / Recording	-	-
Thursday	Sept. 1	2	Basic particle interactions	Notes / Recording	-	Alt. basic particle derivation
Tuesday	Sept. 6	3	Collision Kinematics	Notes / Recording		Collision Derivation
Thursday	Sept. 8	4	Interatomic Potentials & Cross Sections	Notes / Recording	PS#1	Flux/Fluence/Cross-sections/[illegible]ergy transfer quick review
Tuesday	Sept. 13	5	Simple Disp. Theory		-	Displacement Integrals / [illegible]ersions
Thursday	Sept. 15	6	Energy loss & K-P modifications		-	
Tuesday	Sept. 20	-	Focus, Channel, Range	-	PS1 due	-
Thursday	Sept. 22	7	*No lecture - Prof. Field out of town*			
Tuesday	Sept. 27	8	Damage Cascades		PS#2	Arc-dpa Paper

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Brain storming

- Why would the K-P model not be correct? (but reasonable)

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