# 22.01 - Recitation #6

- Please grab a snack, get up off the sofa, look at something that isn't a screen for 5 mins!
- Please turn on your video (if possible) and mute yourself.
- These slides are at: *bit.ly/2201Rec6*

# Outline + Intended Learning Outcomes (ILOs)

- Everything...
- Start the process of remembering what you learnt 5 weeks ago!

# Explaining Terms

- **Atomic mass**

- **Excess mass**

- **Binding energy**

1 amu

neutron

proton

electron

What does "excess mass" really mean?

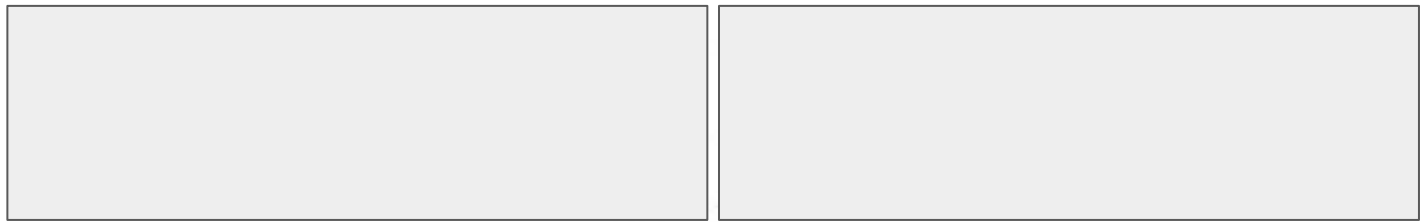
$$B(A, Z) \equiv$$

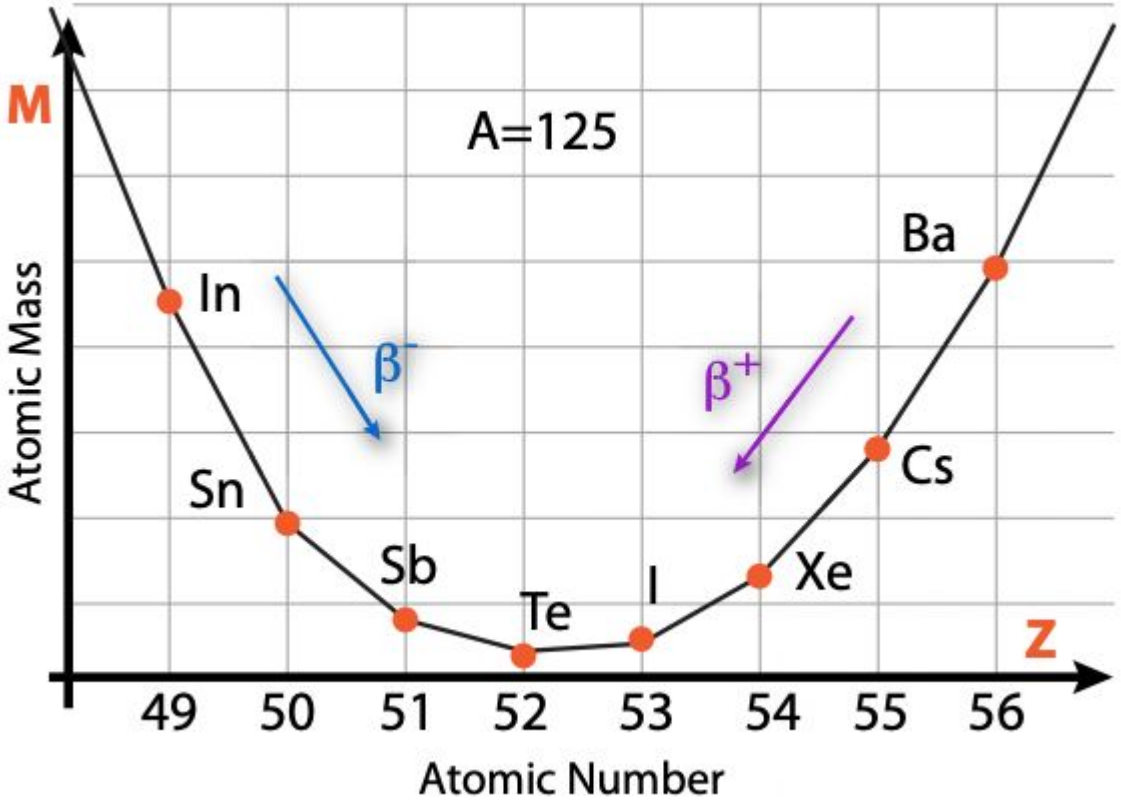
$$Q =$$

| Decay | Individual Particle Reaction | Full Nuclear Reaction |
|---|---|---|
| Alpha | $a$ | |
| Beta - | | ${}^{A}_{Z}X_{N} \rightarrow {}^{A}_{Z+1}X'_{N-1} + e^{-} + \bar{\nu}$ |
| Beta + | | ${}^{A}_{Z}X_{N} \rightarrow {}^{A}_{Z-1}X'_{N+1} + e^{+} + \nu$ |
| Electron Capture | | ${}^{A}_{Z}X_{N} + e^{-} \rightarrow {}^{A}_{Z-1}X'_{N+1} + \nu$ |
| Gamma (IT) | $\gamma$ | |
| Internal Conversion | $e^{-}$ | |
| ... | | $N/A$ |

# Semi-Empirical Mass Formula

$$B(A, Z) = \qquad (4.10)$$




M
A=125
Atomic Mass
In
Sn
Sb
Te
I
Xe
Cs
Ba
β⁻
β⁺
Z
49
50
51
52
53
54
55
56
Atomic Number

# Activity

$$A(t) = A_0 e^{-\lambda t}$$

$$t_{1/2} = \ln(2)/\lambda$$

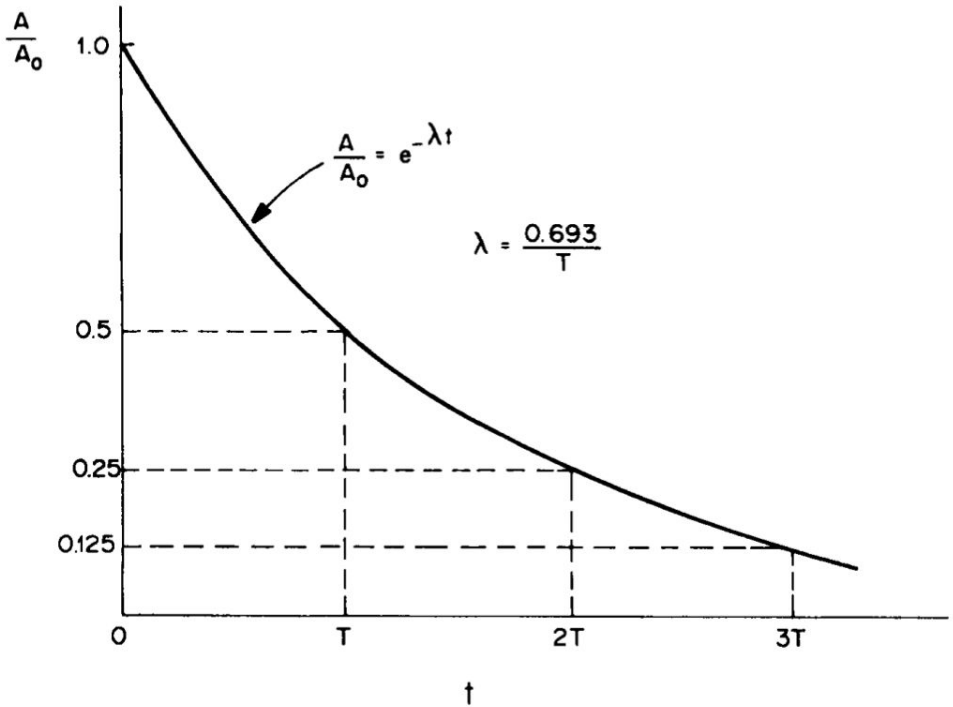



**Fig. 4.1** Exponential radioactivity decay law, showing relative activity, $A/A_0$, as a function of time $t$; $\lambda$ is the decay constant and $T$ the half-life.



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# Burning isotopes in a reactor

1kg of Fe-55 is put into a reactor with thermal flux = 1E14 [n/cm^2/s]

- What is the removal rate of Fe-55? [atoms/s]
- How much Fe-55 will there be after 1 year? [kg]

- Quiz 1 Resources
  - 2201-Study-Sheet.pdf
  - 22.01 F16 Quiz 1 Solutions.pdf
  - 2201-F17-Quiz-1.pdf
  - 2201-F18-Quiz-1-Solutions.pdf

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Review 4-5pm Today

Office Hours 8-8.45am Monday

Office Hours 3-4pm Tuesday

Questions?

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# 22.01 Introduction to Nuclear Engineering and Ionizing Radiation

Spring 2024

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