22.02

INTRODUCTION TO APPLIED NUCLEAR PHYSICS

Lecture 2

SEMI-EMPIRICAL MASS FORMULA

$$M(Z,A) = Zm(^1H) + Nm_n - B(Z,A)/c^2$$

- With binding energy given by:

$$B(A,Z) = a_v A \quad - a_s A^{2/3} \quad - a_c Z(Z-1)A^{-1/3}$$
$$-a_{sym}\frac{(A-2Z)^2}{A} \; + \; \delta a_p A^{-3/4}$$

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Volume

Surface

Coulomb

symmetry

pairing

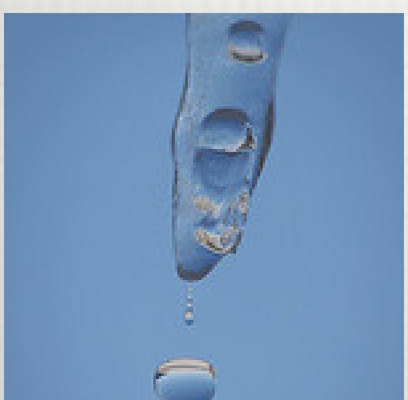


Photo courtesy of cdw9 on Flickr.

CHART of NUCLIDES (Z vs. A)

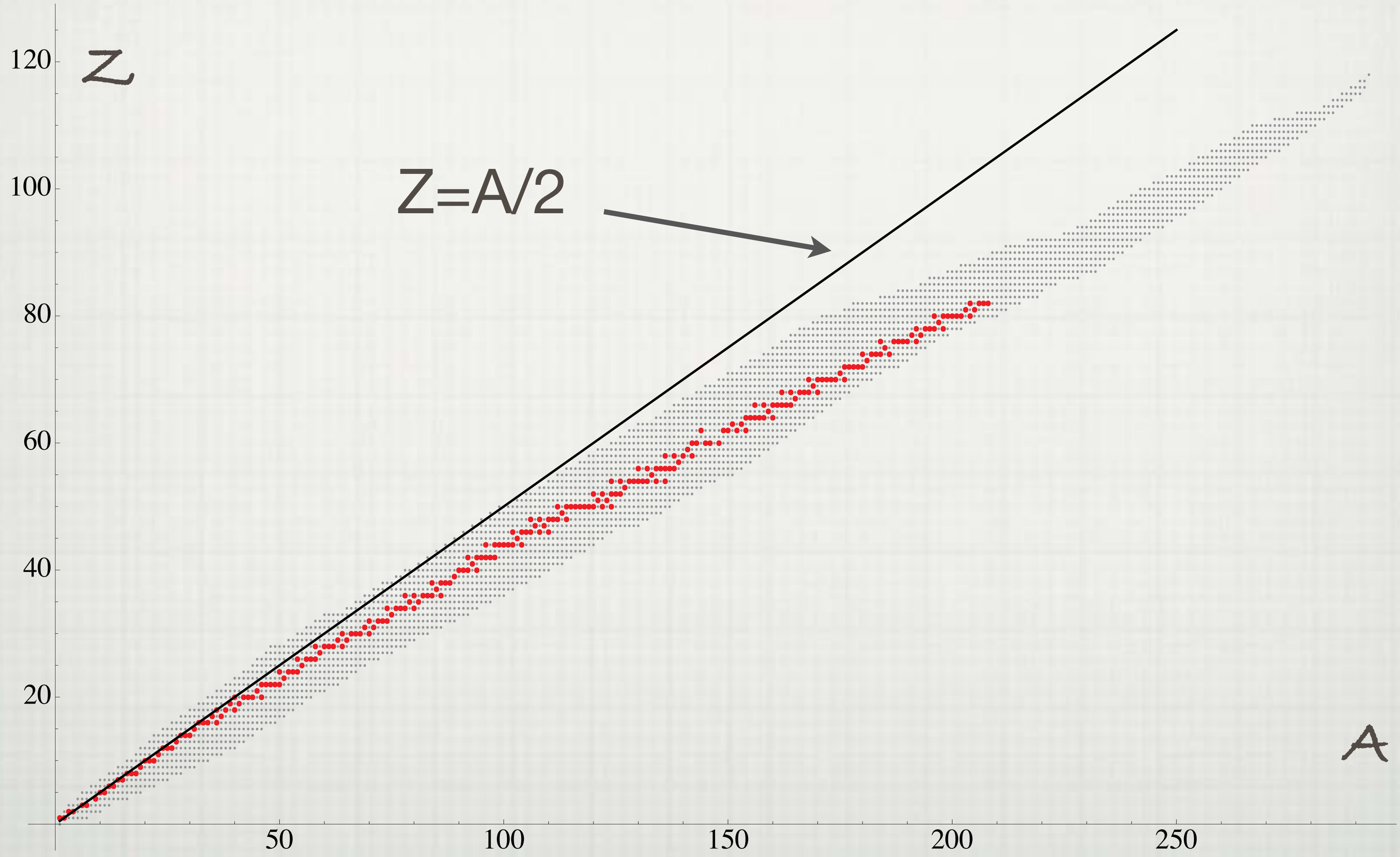
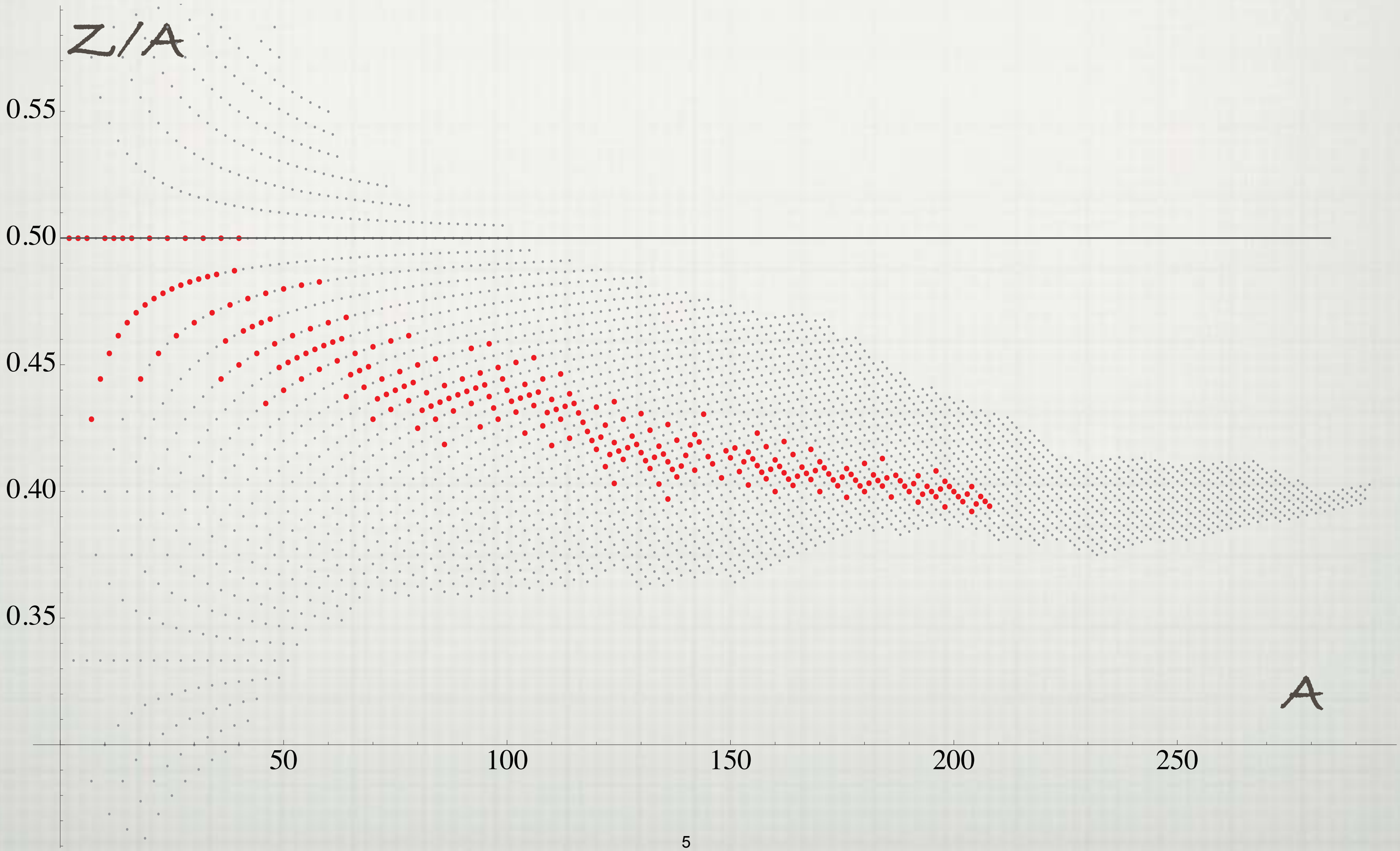
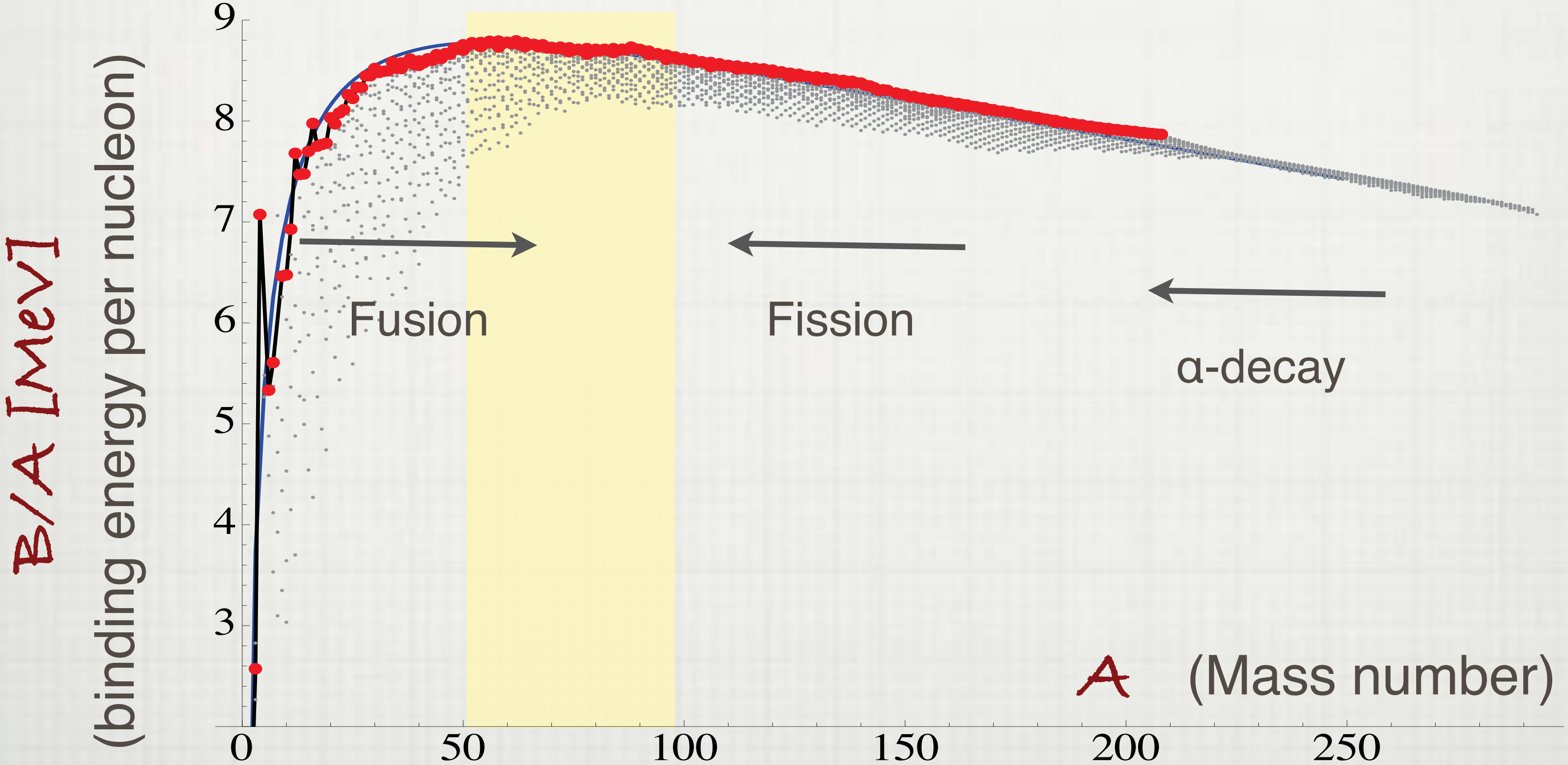


CHART of NUCLIDES (Z/A vs. A)

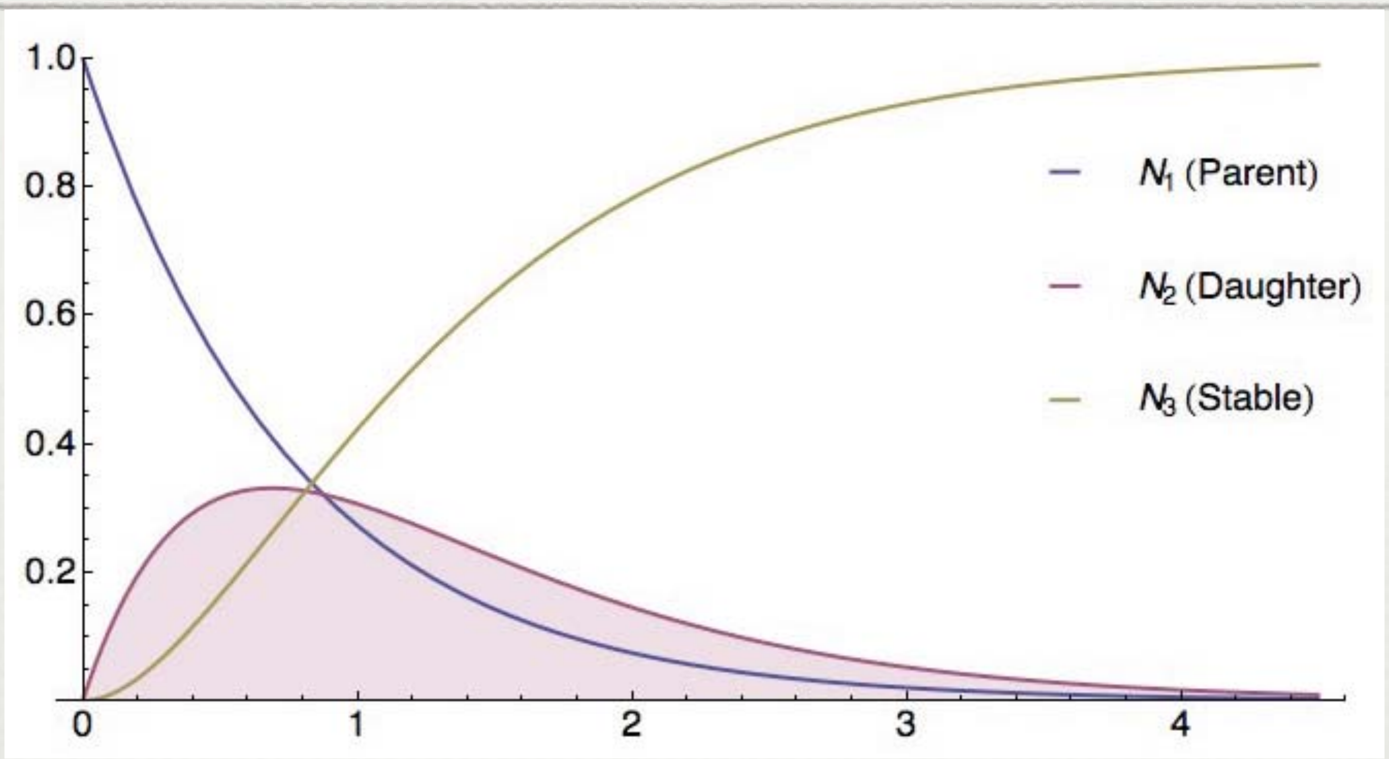


B/A: MAXIMUM



Maximum B/A for 50 < A < 100

RADIOACTIVE DECAY CHAIN



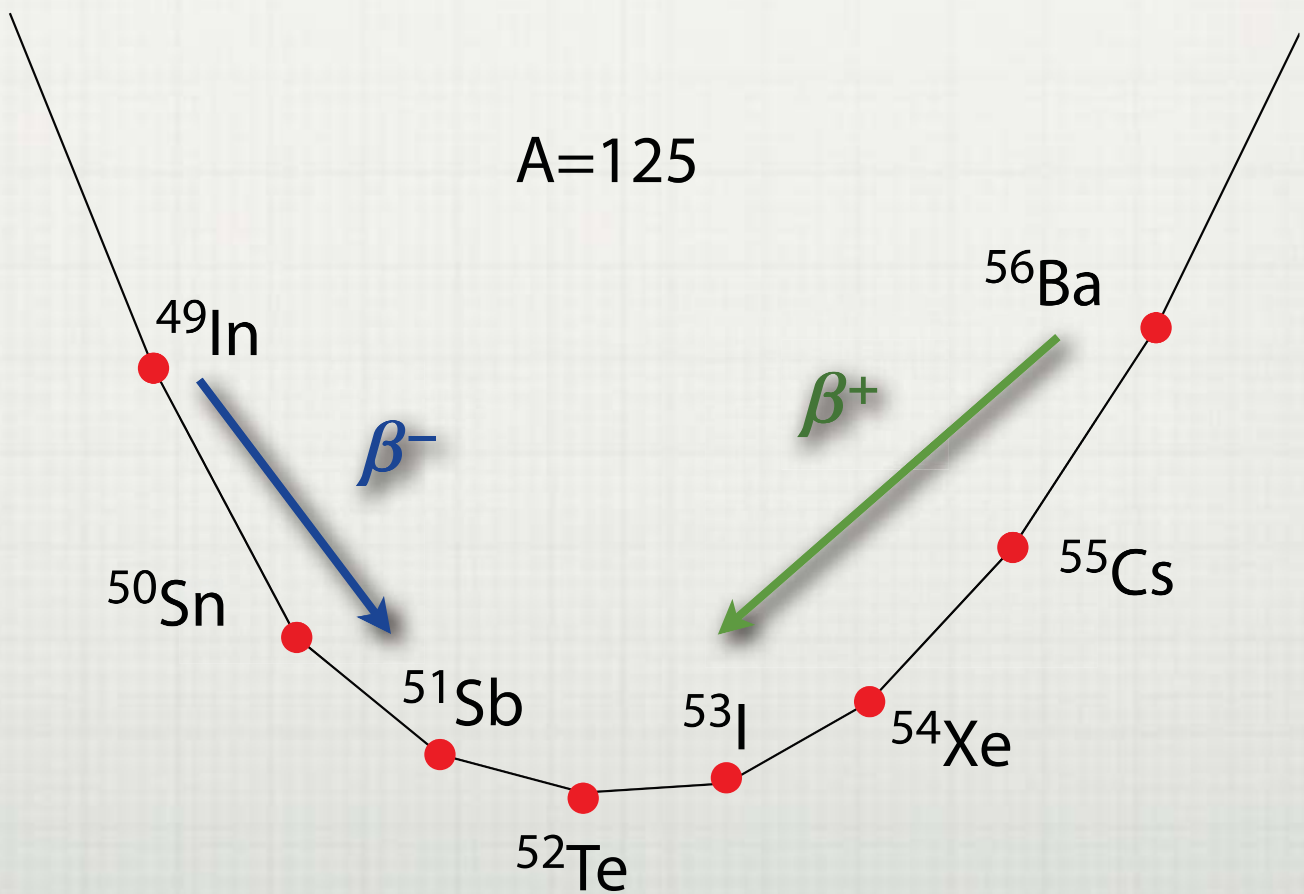
$$N_1(t) = N_0 e^{-\lambda_1 t}$$

$$N_2(t) = N_0 \frac{\lambda_1 \left(e^{-\lambda_1 t} - e^{-\lambda_2 t}\right)}{\lambda_2 - \lambda_1}$$

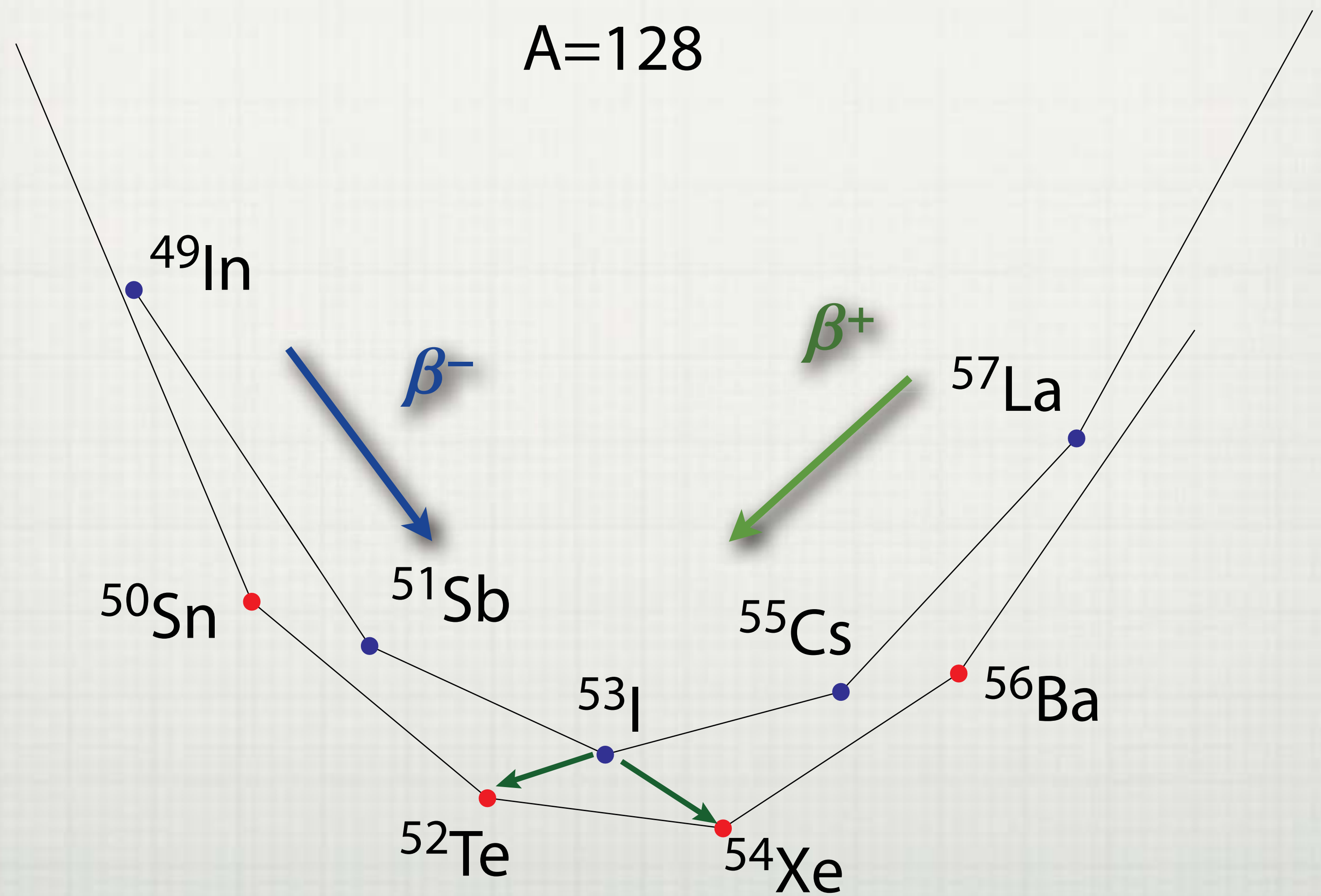
$$N_3(t) = N_0 \frac{\lambda_1 \left(1 - e^{-\lambda_2 t}\right) - \lambda_2 \left(1 - e^{-\lambda_1 t}\right)}{\lambda_1 - \lambda_2}$$

MASS PARABOLA

- M(Z,A=cst): Mass of nuclides at constant mass # A



MASS PARABOLA



MASS PARABOLA

M(Z,A=cst): Mass of nuclides at constant mass # A

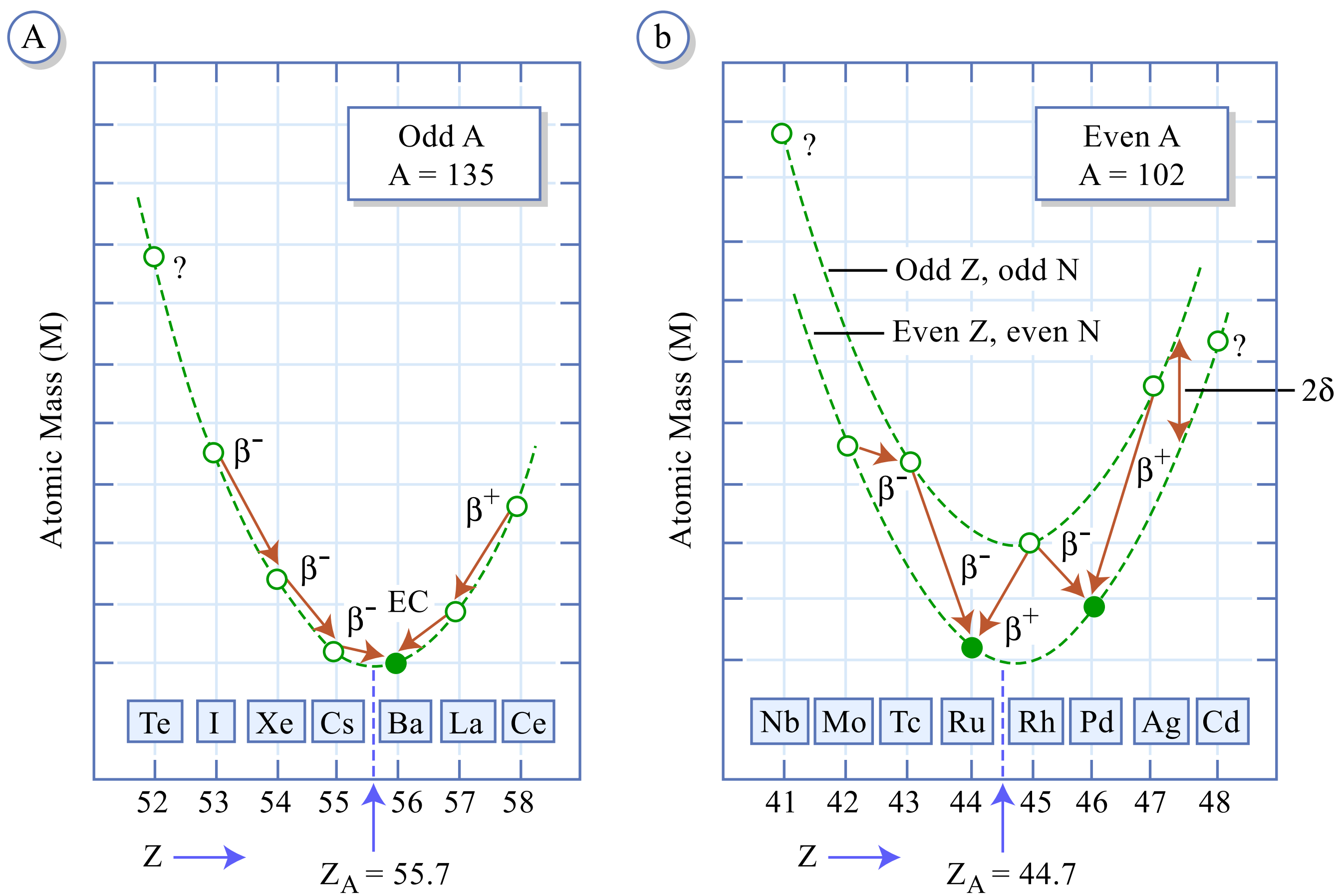


Figure by MIT OpenCourseWare. After Meyerhof.