

NUCLEAR PHYSICS: STRUCTURE, BINDING

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Supplementary Material for
PHY 3305 (Modern Physics)
Harris, Ch. 11.1-11.2

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PLUM PLUDDING MODEL



J. J. Thompson

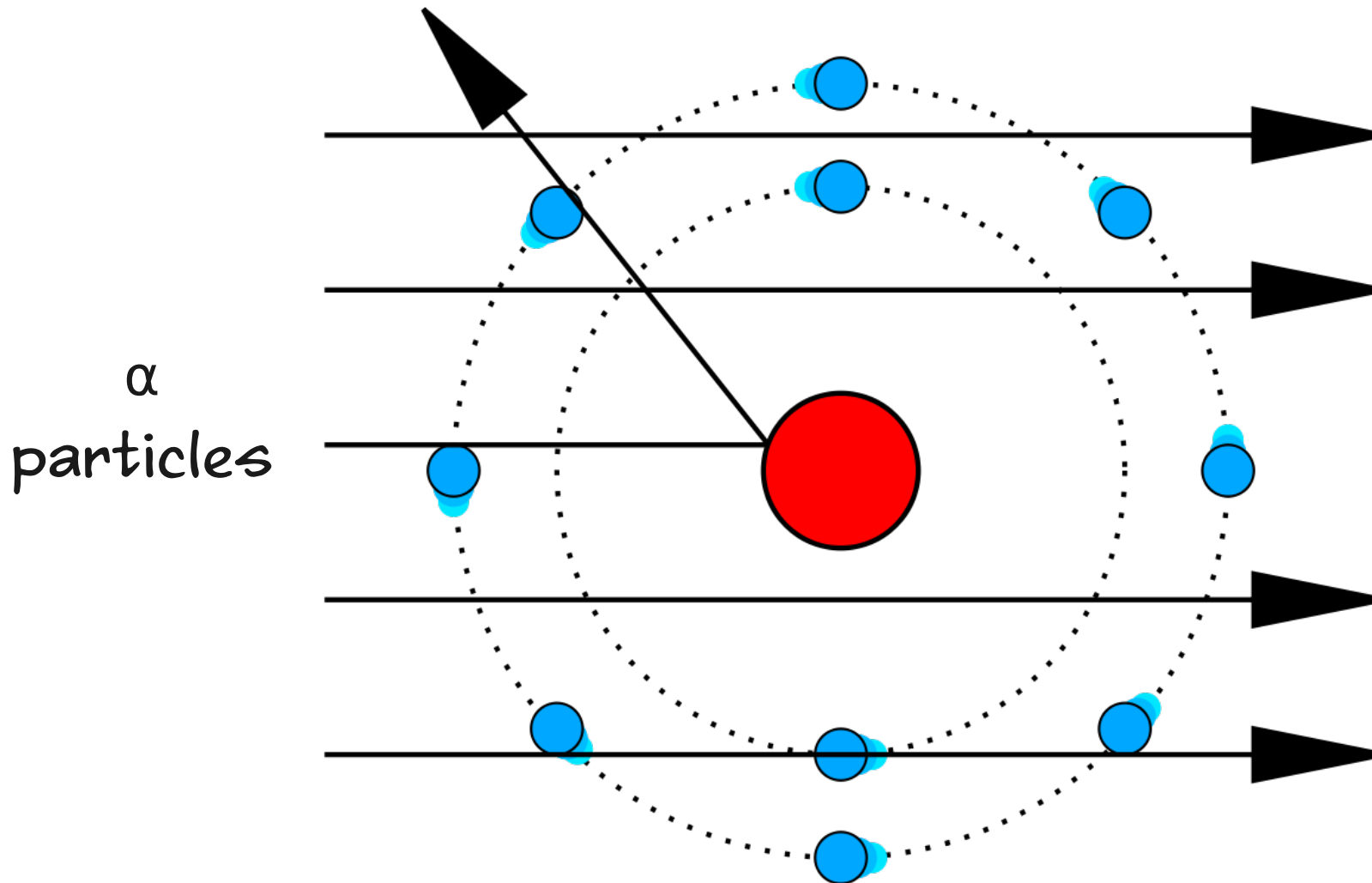
ERNEST RUTHERFORD



"It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you. On consideration, I realized that this scattering backward must be the result of a single collision, and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive centre, carrying a charge."

-Ernest Rutherford

GEIGER-MARSDEN EXPERIMENT (1909)



PROTONS AND NEUTRONS

PROTON

Charge:
 $+e$

Mass:
 $1.672621637(83) \times 10^{-27}$ kg
 $1.00727646677(10)$ u

Spin:
 $\frac{1}{2}$

Discovered:
1919

NEUTRON

Charge:
0

Mass:
 $1.67492729(28) \times 10^{-27}$ kg
 $1.0086649156(6)$ u

Spin:
 $\frac{1}{2}$

Discovered:
1932

BINDING: DEUTERON

DEUTERON

Charge:
+e

Mass:
2.013553 u

Sum of the masses of the
proton and neutron:

2.015941 u

Difference of the total mass
of the parts and the whole:

$$m_f - m_i = 0.002388 \text{ u}$$

Binding energy: (divide by A to get BE per nucleon)

$$BE \equiv m_f c^2 - m_i c^2 = 2.22 \text{ MeV}$$

Figure 11.12 Binding energy per nucleon versus Z and N .

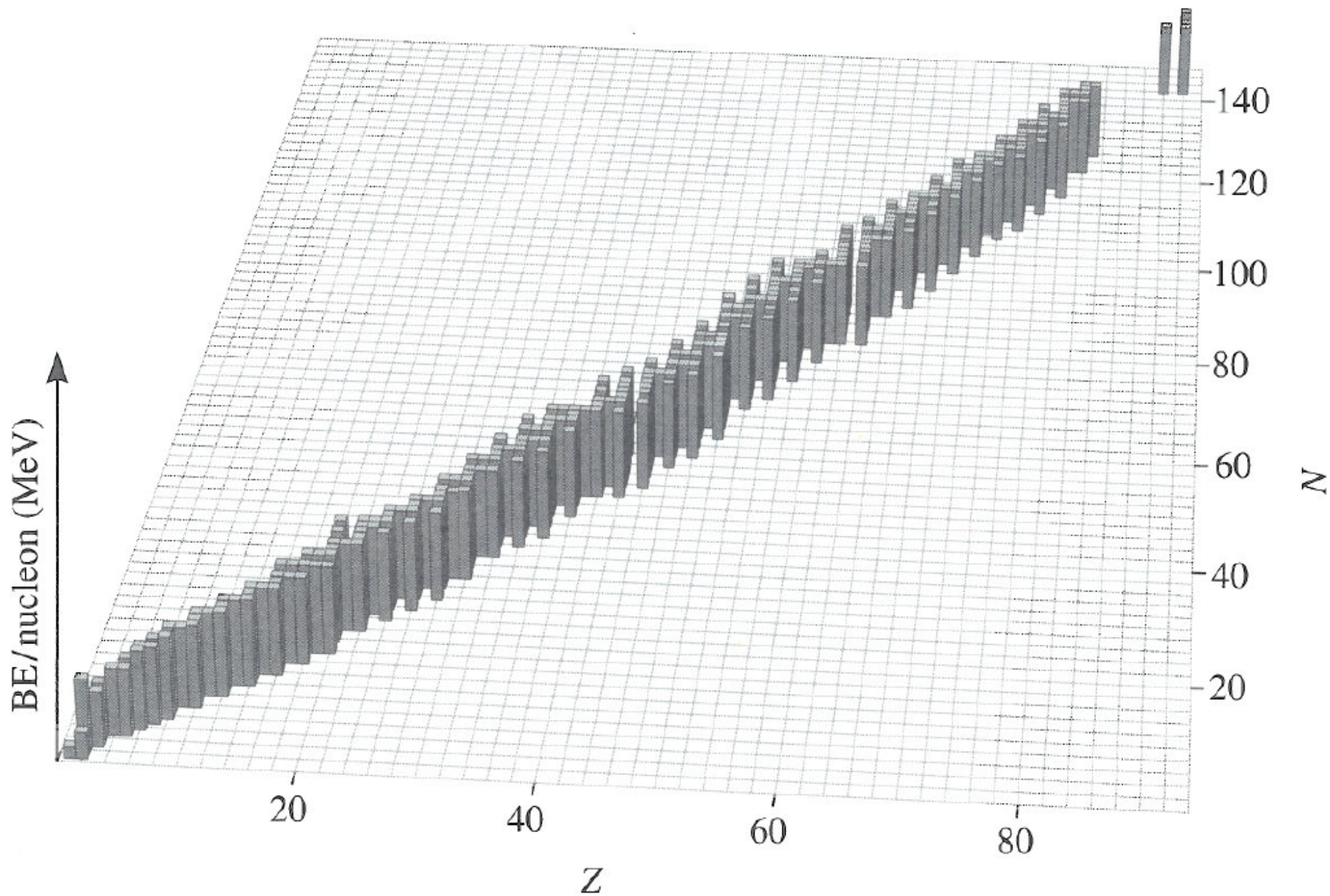


Figure 11.13 Naturally occurring nuclei cluster along the curve of stability.

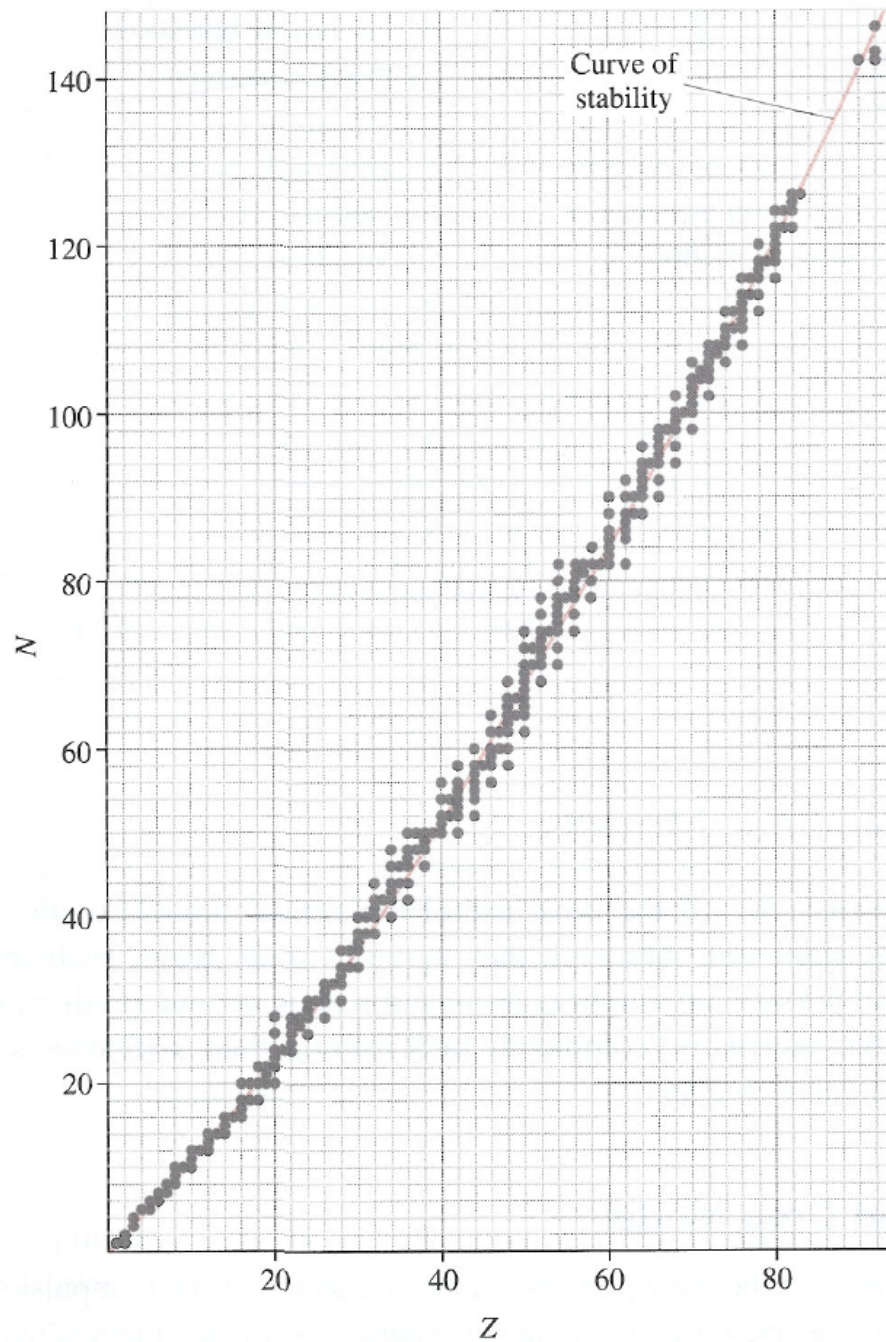
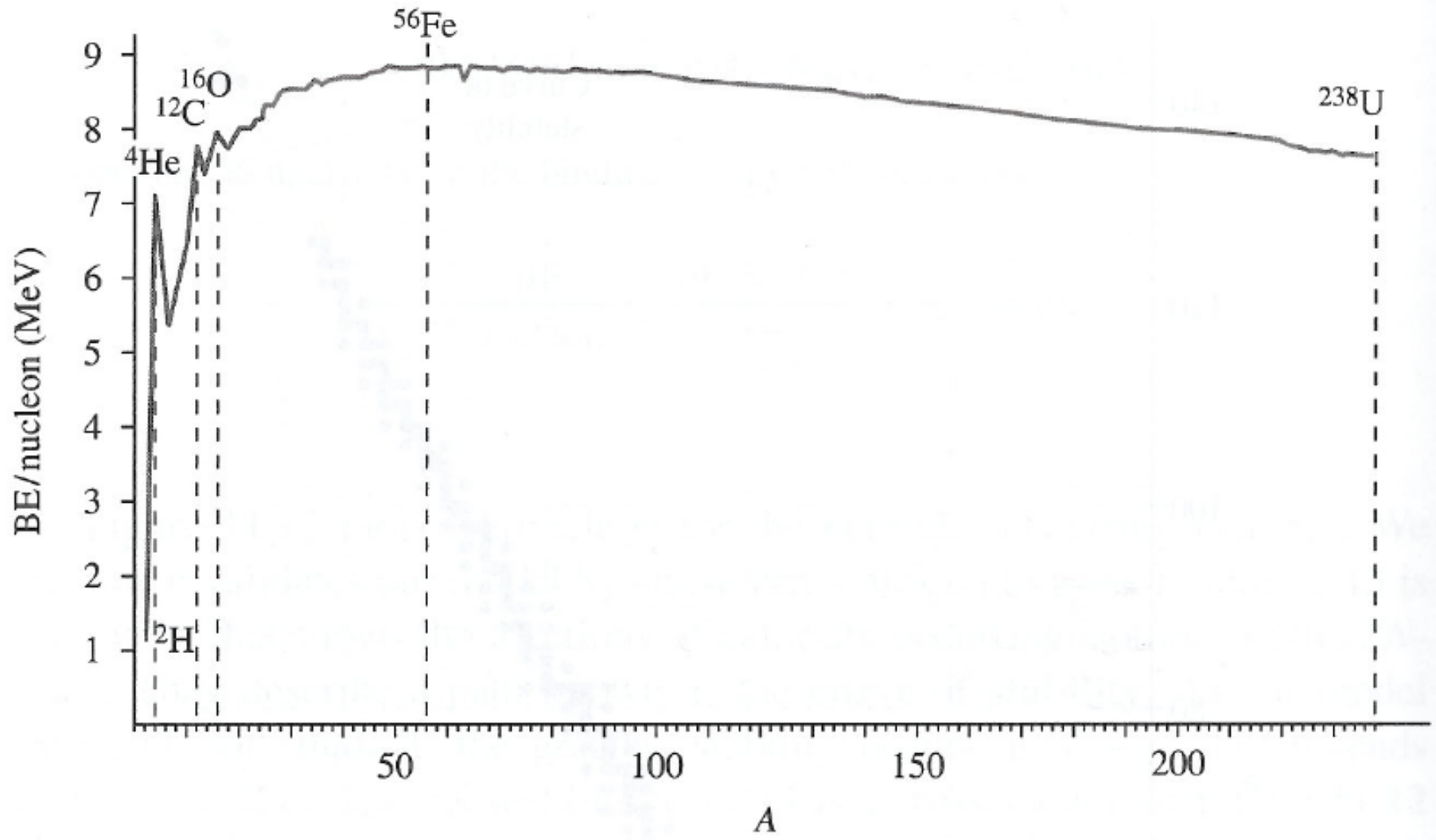


Figure 11.14 Binding energy per nucleon versus A .



NEXT TIME

- Models of the Nucleus
- Applications of Nuclear Theory
- Radioactivity
- Harris: Ch. 11.3-11.6