

Answer on Question #44199, Physics, Nuclear Physics

Question:

Calculate in J and MeV units the binding energy per nucleus and binding energy per nucleon for ${}^{19}_9F$

Mass of proton = 1.00728 u

Mass of neutron = 1.00867 u

Actual atomic mass of ${}^{19}_9F = 18.99840u$

1 u = 931.9 MeV nucleus⁻¹

=1.493x10⁻¹⁰ J nucleus⁻¹

Answer:

Binding energy is the energy required to split the nucleus of an atom into its component parts. The binding energy per nucleus equals:

$$B = 9 \cdot m_p c^2 + 10 \cdot m_n c^2 - m_F c^2$$

where m_p is mass of the proton, m_n is mass of the neutron, m_F is mass of ${}^{19}_9F$ nucleus.

$$\begin{aligned} B &= (9 \cdot 1.00728 + 10 \cdot 1.00867 - 18.99840)u = 143.345 \text{ MeV} \\ &= 2.29653 \cdot 10^{-11} \text{ J} \end{aligned}$$

The binding energy per nucleon equals:

$$b = \frac{B}{A}$$

where A is number of nucleons in nucleus.

$$b = 7.54447 \text{ MeV} = 1.2087 \cdot 10^{-12} \text{ J}$$