

Problems

10.2 Consequences of Special Relativity 13.

Deuterium (^2H) is an isotope of hydrogen that has one proton and one neutron in its nucleus. The binding energy of deuterium is 3.56×10^{-13} J. What is the mass defect of deuterium?

- a. 3.20×10^{-4} kg
- b. 1.68×10^{-6} kg
- c. 1.19×10^{-21} kg
- d. 3.96×10^{-30} kg

14.

The sun orbits the center of the galaxy at a speed of 2.3×10^5 m/s. The diameter of the sun is 1.391684×10^9 m. An observer is in a frame of reference that is stationary with respect to the center of the galaxy. True or false—The sun is moving fast enough for the observer to notice length contraction of the sun's diameter.

- a. True
- b. False

15.

Consider the nuclear fission reaction $n + {}^{235}_{92}\text{U} \rightarrow {}^{144}_{56}\text{Ba} + {}^{89}_{36}\text{Kr} + 3n + E$. If a neutron has a rest mass of 1.009u, ${}^{235}_{92}\text{U}$ has a rest mass of 235.044u, ${}^{144}_{56}\text{Ba}$ has rest mass of 143.923u, and ${}^{89}_{36}\text{Kr}$ has a rest mass of 88.918u, what is the value of E in joules?

- a. 1.8×10^{-11} J
- b. 2.8×10^{-11} J
- c. 1.8×10^{-10} J
- d. 3.3×10^{-10} J

16.

Consider the nuclear fusion reaction ${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + n + E$. If ${}^2_1\text{H}$ has a rest mass of 2.014u, ${}^3_1\text{H}$ has a rest mass of 3.016u, ${}^4_2\text{He}$ has a rest mass of 4.003u, and a neutron has a rest mass of 1.009u, what is the value of E in joules?

- a. 2.7×10^{-14} J
- b. 2.7×10^{-13} J
- c. 2.7×10^{-12} J
- d. 2.7×10^{-11} J