Tareas 11 Tópicos de la Física Moderna

25 de Noviembre 2020

1. Recall that in the discovery of the neutron, Chadwick ruled out Compton scattering partly on the basis of the observed scattering rate. Why is the neutron-proton cross section much greater than photon-proton cross section?

2. Why does the binding energy per nucleon increase with increasing atomic mass number (A) for small values of A? Why does the binding energy per nucleon decrease with increasing A for large values of A?

3. Why does carbon-12 have a greater binding energy than nitrogen-12?

4. The binding energy per nucleon of ^{235}U is $7.59\,\mathrm{MeV}$. (a) Calculate the mass of the uranium nucleus. (b) Calculate the mass of the ^{235}U atom.

5. Which nucleus do you expect will have larger binding energy, tritium (^{3}H) or ^{3}He? Explain. Calculate the binding energy of each.

6. Which nucleus do you expect will have larger binding energy, ^{12}Be, ^{12}B, ^{12}C, or ^{12}N? Explain. Calculate the binding energy of each.

7. Calculate the binding energies of ^{55}Fe, ^{57}Co, ^{58}Ni. Compare the actual binding energies to the Weizsäcker formula of the liquid drop model.

8. Why are there β^- decays in the four radioactive series? Why are there no β^+ decays?

9. Why is the lifetime of ^{237}Np so much shorter than the lifetime of the leading nuclei in the other three series?

10. If the activity drops by a factor of 32 in 5 seconds, what is the radioactive half-live?

11. Can a given nucleus have both β^- and β^+ decay modes?

12. Why are the photons from nuclear gamma transitions so much larger in energy than photons from atomic transitions?

13. A piece of bone found at the Palace of Knossos contains $100\,\mathrm{g}$ of Carbon and has a ^{14}C activity of 1000 per minute. How long has this chap been dead?

14. (a) A neutron is added to ^{16}O to make the stable isotope ^{17}O. Calculate the binding energy of the neutron. (b) Another neutron is added to ^{17}O to make the stable isotope ^{18}O. Calculate the binding energy of the neutron.

15. For each of the following reactions, identify the particle "X":

    $\begin{aligned}
    (a)\quad &^{23}Mg \rightarrow e^- + \nu_e + X\\
    (b)\quad &X \rightarrow {}^{186}Os + \alpha\\
    (c)\quad &^{11}C \rightarrow e^+ + \nu_e + X\\
    (d)\quad &^{12}N \rightarrow {}^{12}C + \nu_e + X\\
    (e)\quad &p + X \rightarrow {}^{2}H + e^+ + \nu_e
    \end{aligned}$

16. Why does the proton cycle dominate over the carbon cycle at lower temperature?

17. Show that the decay $n \rightarrow pe$ cannot conserve angular momentum.

18. Make a prediction of the spin quantum numbers of the following nuclei: (a) ^{12}C, (b) ^{14}N, (c) ^{16}O, and (d) ^{19}F.