Tareas 3 – Física Nuclear

19 de Febrero 2025

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

2. Can a given nucleus have both β^+ and β^- decay modes? If yes, Give an example.

3. The α-decay of a ^{238}Pu ($\tau = 127\,\text{years}$) nuclide into a long lived ^{234}U ($\tau = 3.5 \cdot 10^5\,\text{years}$) daughter nucleus releases 5.49 MeV kinetic energy. The heat so produced can be converted into usefull electricity by radio-thermal generators (RTG's). The *Voyager 2* space probe, which was launched on 20/8/1977, flew past four planets, including Saturn, which it reached o 26/8/1981. Saturn's separation from the sun is 9.8 AU.
   (a) How much plutonium would an RTG on Voyager 2 with 5.5% efficiency have to carry so as to deliever at least 395 W electrc power when the proble flies past Saturn?
   (b) How much electric power would then be available at Neptune (24/8/1989, 30.1 AU)?
   (c) Where is Voyager 2 today?
   (d) How much power delivers the RTG today?

4. Naturally occuring uranium is a mixture of the ^{238}U (99.28%) and ^{235}U (0.72%) isotopes.
   (a) How old must the material of the solar system be if one assumes that at its creation both isotopes where present in equal quantities? (^{235}U: $\tau = 1.015 \cdot 10^9\,\text{years}$. ^{238}U: $t_{1/2} = 4.5 \cdot 10^9\,\text{years}$)
   (b) How much energy per uranium nucleus is set free in the decay chain $^{238}\text{U} \rightarrow ^{206}\text{Pb}$?

5. El programa, 3. parte: Usa el programa (subroutina) de la tarea 1 y 2 y calcula (a) la masa del nucleo definido por (A, Z, N), (b) la masa del nucleo "vecino" $(A-4, Z-2, N-2)$ que podia resultar de un decaimiento α. Decide con la diferencia de masas que el decaimiente α es posible y (como extra) respresenta el reultado graficamente. Como otro extra: El mismo calculo para el decaimiento con el $^{8}_{4}$Be.