Question #80046, Physics / Atomic and Nuclear Physics

If an electron had exist inside the nucleus. Then its de-Broglie wavelength would be rough of the order of nuclear diameter I.e.0.0001m. How much energy corresponds to this wave length? How much energy in MeV and explain how these results prove that the electron cannot exist inside nucleus

Solution

The energy of the electron is

$$E = \frac{hc}{\lambda} = \frac{1.24 \cdot 10^3\ eVnm}{0.0001\ nm} = 1.24 \cdot 10^7 eV = 12.4\ MeV.$$

Therefore, if the electron exists in the nucleus, it should have energy of the order of 12.4 MeV. However, it is observed that beta-particles (electrons) ejected from the nucleus during beta–decay have energies of approximately 3 MeV, which is quite different from the calculated value of 12.4 MeV. The reason that electron cannot exist inside the nucleus is that experimental results show that no electron or particle in the atom possess energy greater than 4 MeV.

Therefore, it is confirmed that electrons do not exist inside the nucleus.