What the ultimate Natural Units of material are?

Decay Energy

Since amounts of energy accompanying nuclear decays and nuclear reactions are huge, Einstein’s theory suggesting mass being equivalent to energy ($E = m c^2$) is useful and applicable.

The energy involved in decay is often represented by $Q$. The energy released is at the expense of mass. Thus, the total mass of the products is less than the total mass of the reactants.

$$Q = \text{Total mass of reactants} - \text{Total mass of products}$$

The energy of decay is mostly carried carried by the light particles, alpha, beta or gamma, but a little bit is carried by the daughter nucleus due to recoil.

- **Energy in Gamma Radiation**
  
  An isomer is a nucleus with excess energy, because one of the nucleons is at an excited energy level. When this nucleon returns to its lowest energy level, the energy is converted into a photon (gamma ray), and the process is also called isomeric transition (IT). The frequency of the photon corresponds to the available energy:

  $$h \nu = E_i - E_f$$

  where $E_i$ and $E_f$ stand for the energies of the initial and final levels (or states).

- **Energy in beta decay**

  Most beta spectra have some high-intensity peaks at certain energies superimposed on a continuous spectrum. To explain these spectra was difficult initially. The peaks is now known as due to internal conversion and Auger electrons.

  The parent nuclei have the same mass and so do the daughter nuclei. Yet beta-particle energies range from 0 to a maximum seem to suggest that energy is not conserved in beta decay.

  Based on the principle of conservation of energy, Pauli (1900-1958) suggested that a neutrino with spin $\frac{1}{2}$ is emitted.

- **Energy in alpha decay**

  Alpha particles emitted by a nuclide have some distinctive energies. A plot of the number of alpha particles against energy shows a few peaks.

  Typical alpha energies range between 1 and 11 MeV, with most of them within 4 to 8 MeV.

Contributors

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