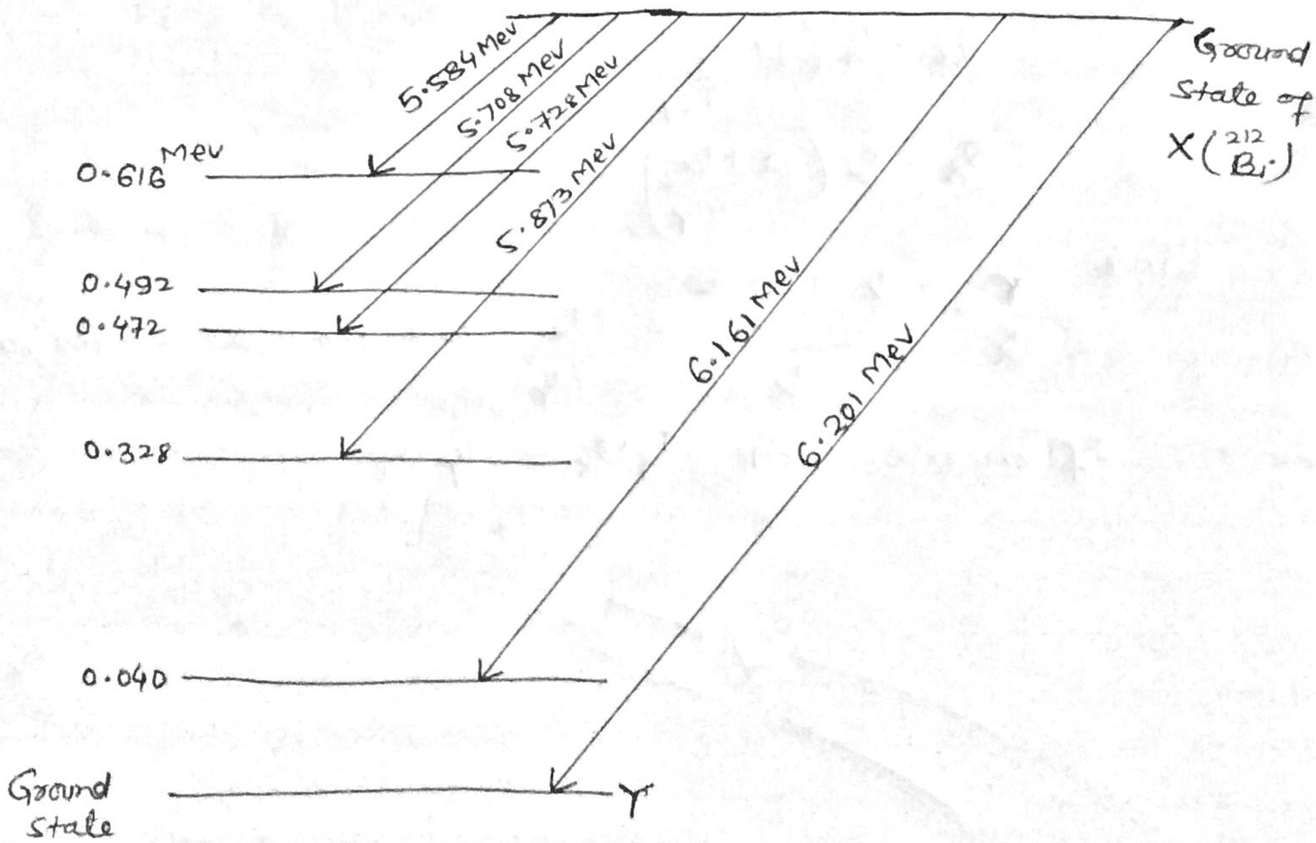
: α - spectrum and fine structure :-

For a number of nuclei, the measured value of T_α always giving only one sharp line spectrum. This is because the emission of an α - particle is a resulting energy transition between two definite nuclear energy states - the initial state is that of the parent nucleus and the final state is that of the daughter nucleus.

However, there are α - emitters which exibit fine structure in the line spectrum. The phenomenon has been confirmed experimentally by Rosenblum using 180° magnetic spectograph. The observed fine structure is an evidence of existence of discrete energy levels in nuclei.



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Nucleus, like electron have discrete spectra of excited states and as such α-decay would leave the daughter Nucleus γ either in the ground state or one of the allowed excited state to its, the value of T_α must be discrete. When the nucleus γ falls from an excited state to its ground state through electromagnetic transition, γ-ray photons are emitted whose energy being equal to the energy difference between the two states. This shows that γ-rays are associated along with α-decay.

If E_γ be the energy of a photon, then

$$E_\gamma = Q_\alpha - (T_\alpha + T_\gamma)$$

$$= Q_\alpha - T_\alpha\left(1 + \frac{T_\gamma}{T_\alpha}\right)$$

$$= Q_\alpha - T_\alpha\left(1 + \frac{M_\alpha}{M_\gamma}\right) \text{ ---}$$

Since $\frac{T_\gamma}{T_\alpha} = \frac{\frac{1}{2}M_\gamma v_\gamma^2}{\frac{1}{2}M_\alpha v_\alpha^2} = \frac{M_\alpha}{M_\gamma}$ as for the conservation of momentum $M_\alpha v_\alpha = M_\gamma v_\gamma$

Teacher's Signature : ....