. ***University Hamma Lakhdar of El Oued,***

Faculty of Exact Sciences

Lecture 4 in Technical English/ First Year Master Physics

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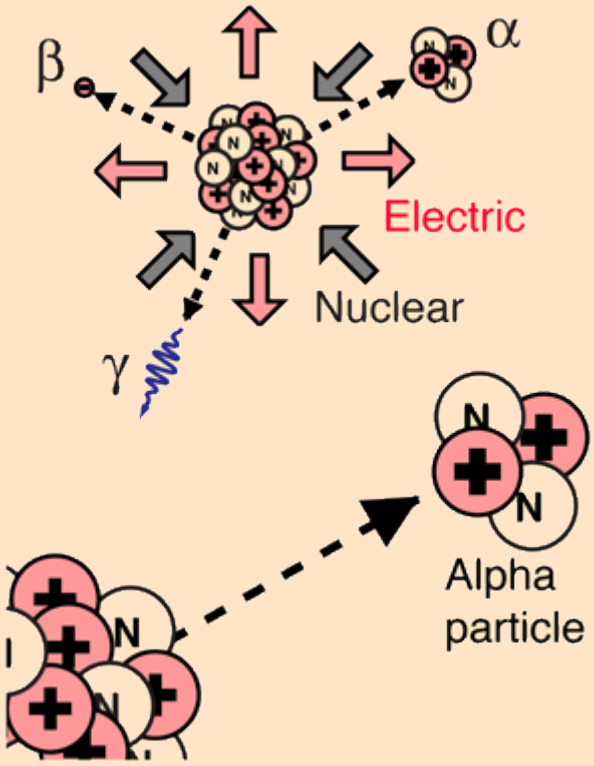
Radioactivity refers to the particles which are emitted from nuclei as a result of nuclear instability. Because the nucleus experiences the intense conflict between the two strongest forces in nature, it should not be surprising that there are many nuclear isotopes which are unstable and emit some kind of radiation. The most common types of radiation are called alpha, beta, and gamma radiation, but there are several other varieties of radioactive decay.

Radioactive decay rates are normally stated in terms of their half-lives, and the half-life of a given nuclear species is related to its radiation risk. The different types of radioactivity lead to different decay paths which transmute the nuclei into other chemical elements. Examining the amounts of the decay products makes possible radioactive dating.

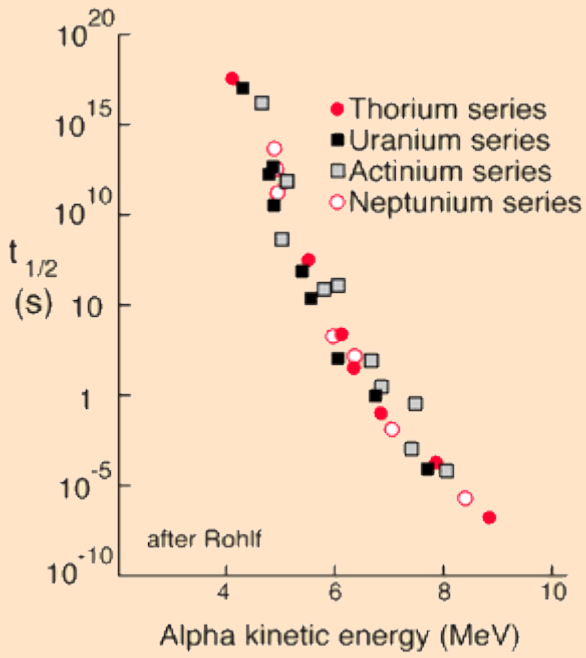
Radiation from nuclear sources is distributed equally in all directions, obeying the inverse square law.

Alpha Radioactivity



Composed of two protons and two neutrons, the alpha particle is a nucleus of the element helium. Because of its very large mass (more than 7000 times the mass of the beta particle) and its charge, it has a very short range. It is not suitable for radiation therapy since its range is less than a tenth of a millimeter inside the body. Its main radiation hazard comes when it is ingested into the body; it has great destructive power within its short range. In contact with fast-growing membranes and living cells, it is positioned for maximum damage.

Alpha Barrier Penetration

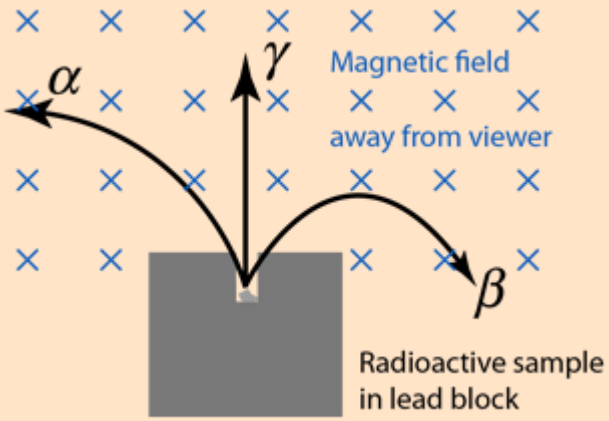


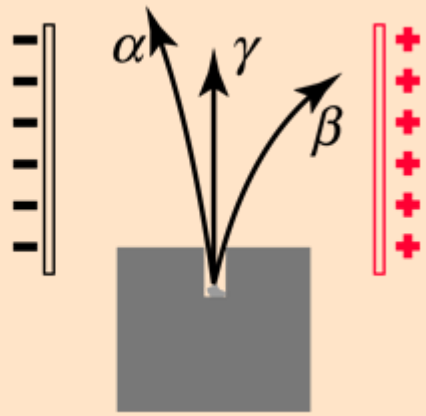
The energy of emitted alpha particles was a mystery to early investigators because it was evident that they did not have enough energy, according to classical physics, to escape the nucleus. Once an approximate size of the nucleus was obtained by Rutherford scattering, one could calculate the height of the Coulomb barrier at the radius of the nucleus. It was evident that this energy was several times higher than the observed alpha particle energies. There was also an incredible range of half lives for the alpha particle which could not be explained by anything in classical physics.

The resolution of this dilemma came with the realization that there was a finite probability that the alpha particle could penetrate the wall by quantum mechanical tunneling. Using tunneling, Gamow was able to calculate dependence for the half-life as a function of alpha particle energy which was in agreement with experimental observations.

Alpha, Beta, and Gamma

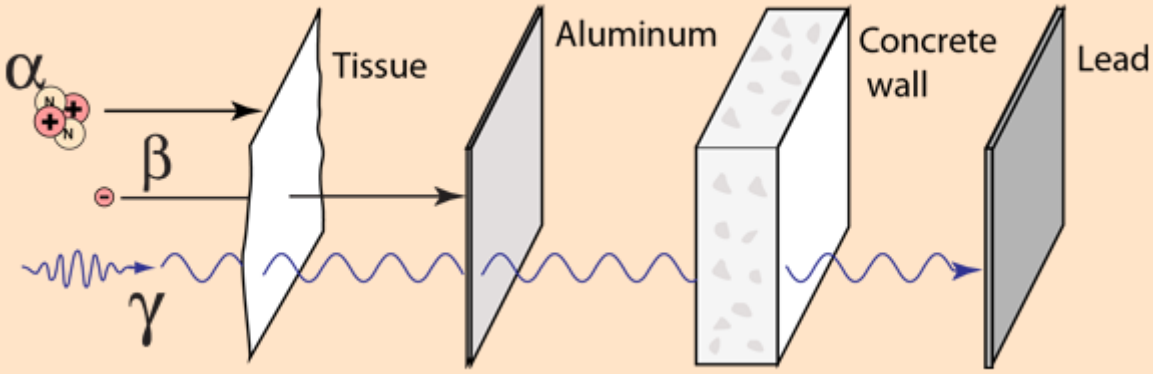
Historically, the products of radioactivity were called alpha, beta, and gamma when it was found that they could be analyzed into three distinct species by either a magnetic field or an electric field.





Penetration of Matter

Though the most massive and most energetic of radioactive emissions, the alpha particle is the shortest in range because of its strong interaction with matter. The electromagnetic gamma ray is extremely penetrating, even penetrating considerable thicknesses of concrete. The electron of beta radioactivity strongly interacts with matter and has a short range.



Read carefully the text above and answer the questions below:

- Translate the underline words in the text to Arabic.
- Translate in Arabic the below short paragraph from the text:

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