SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai

DEPARTMENT OF RADIOGRAPHY AND IMAGING TECHNOLOGY

COURSE NAME : Quality Control, Radiobiology andRadiation Safety in Radiodiagnosis/Imaging otherthan X-ray related.

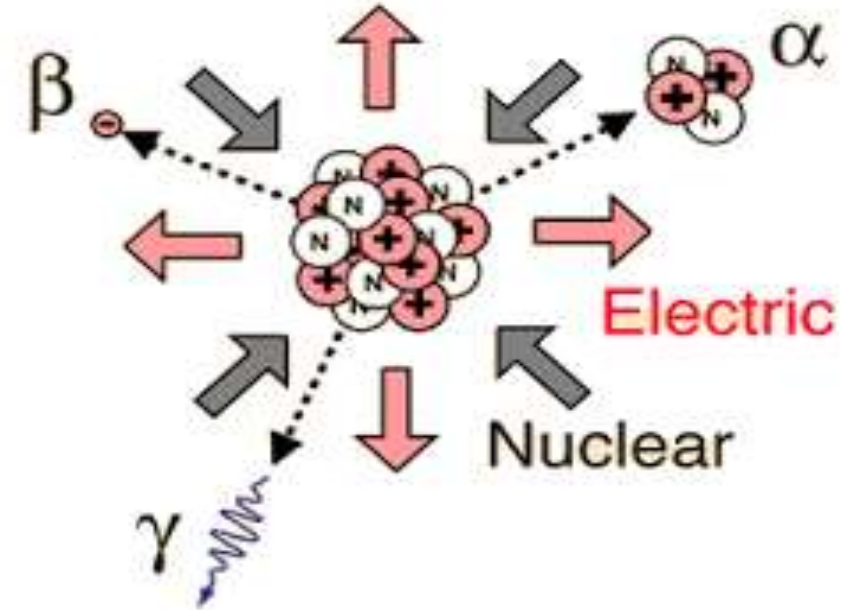
UNIT:1 Radiation Quantities and Units

TOPICS : RADIOACTIVY

FACULTY NAME : Ms. DHANA LAKSHMI .M

INTRODUCTION TO RADIOACTIVITY

- Spontaneous emission of particles or energy from unstable atomic nuclei
- Discovered by Henri Becquerel in 1896
- Further developed by Marie & Pierre Curie
- Natural phenomenon happening all around



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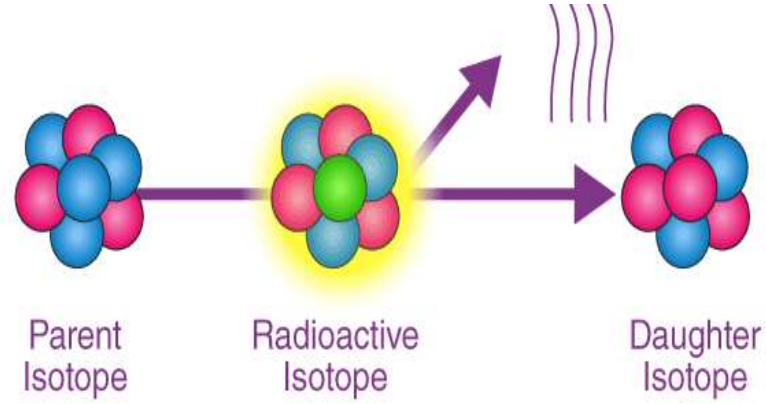
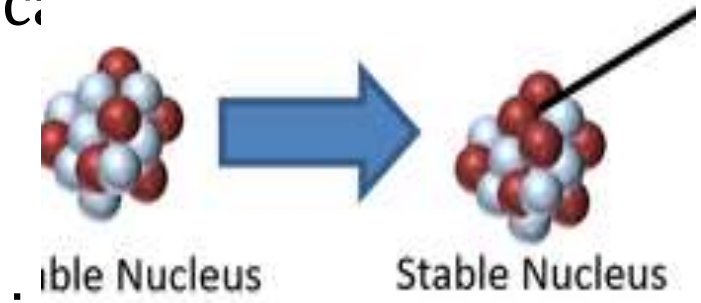


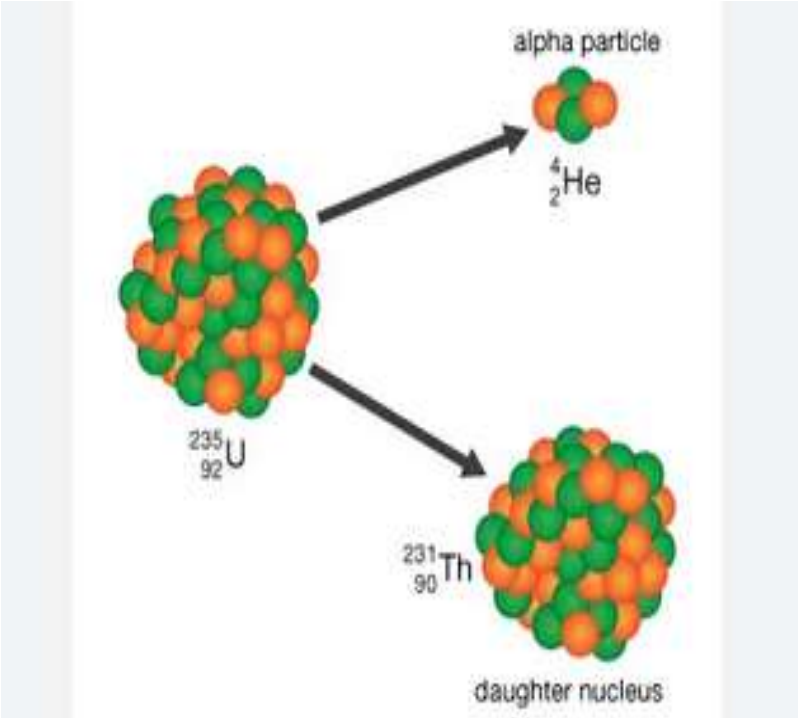
Nuclei Become Unstable

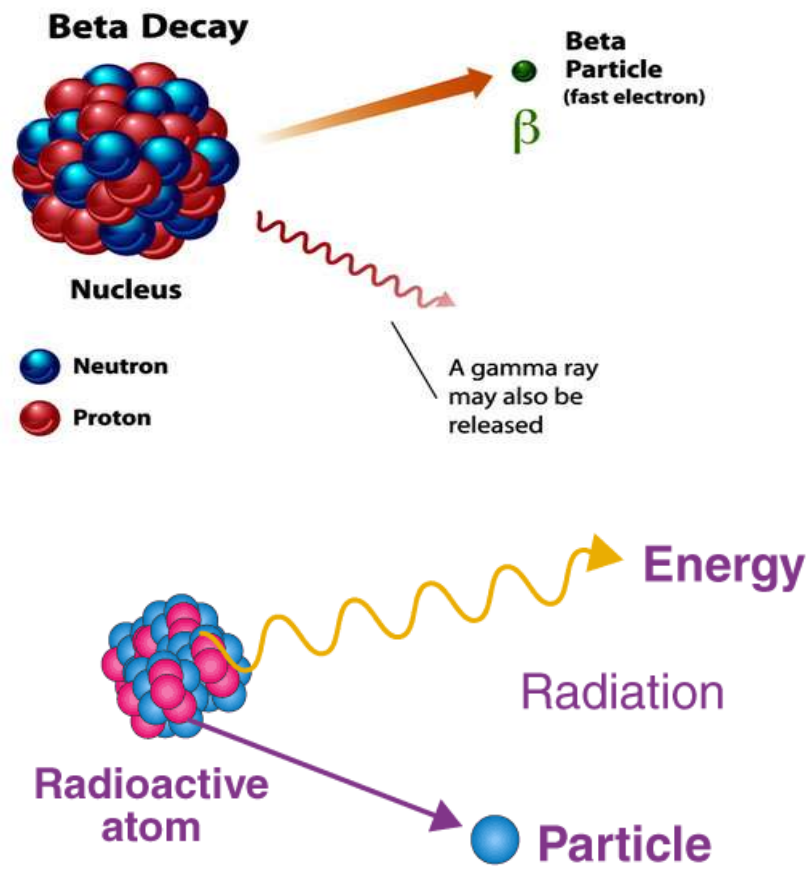
- Imbalance between protons and neutrons
- Too many neutrons → neutron-rich → beta minus dec
- Too many protons → proton-rich → beta plus
- Very heavy nuclei (Z > 82) → alpha decay to reduce siz
- Magic numbers of protons/neutrons give extra stability (2, 8, 20, 28, 50, 82, 126)



Three Main Types of Radiation

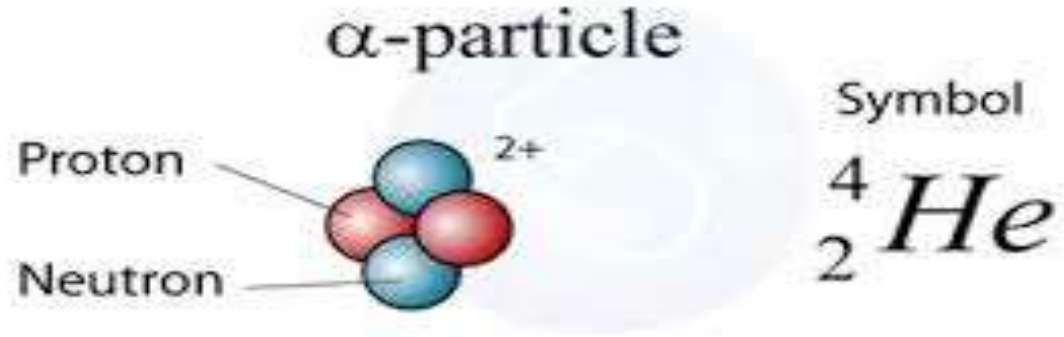
- Alpha (α) particles
- Beta (β) particles
- Gamma (γ) rays





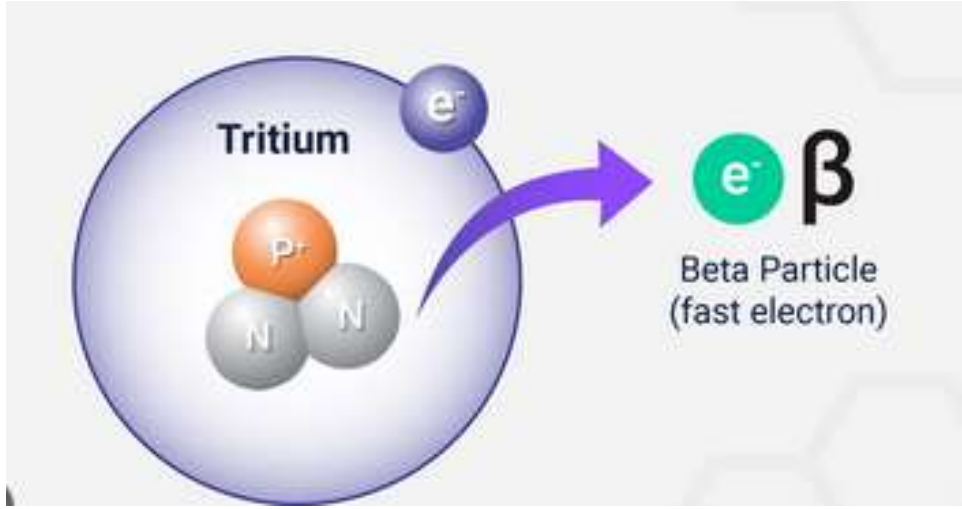
Alpha (α) Radiation

- Helium nucleus: ^{24}He (2 protons + 2 neutrons)
- Charge: +2, Mass: 4 u
- Highly ionizing, low penetration: stopped by paper or skin
- Dangerous only if ingested/inhaled (e.g., radon gas, polonium-210)



Beta (β) Radiation

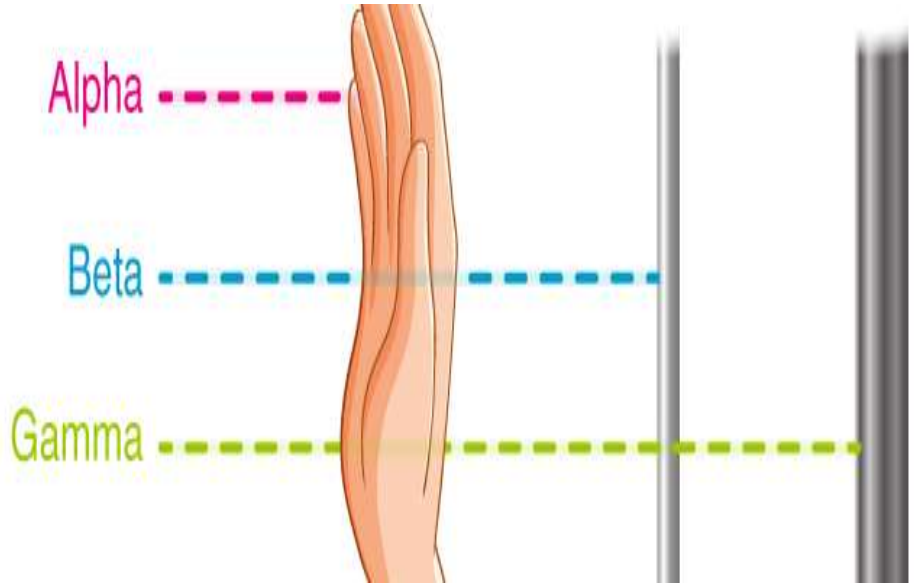
- Two types:
- β^- : fast electron (from $n \rightarrow p + e^- + \bar{\nu}$)
- β^+ : positron (rare in nature)
- Charge: ±1, Mass: ~1/1836 u



- Moderately ionizing, penetration: stopped by few mm of aluminum
- Example: Carbon-14 → Nitrogen-14 + β^-

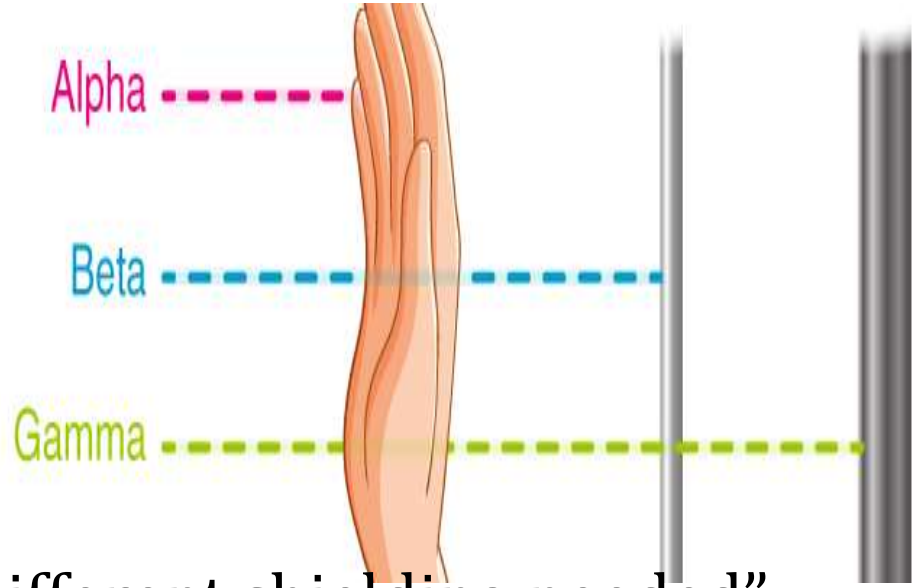
Gamma (γ) Radiation

- High-energy electromagnetic wave (photon)
- No mass, no charge
- Weakly ionizing, very high penetration
- Stopped by thick lead or concrete
- Usually emitted together with α or β



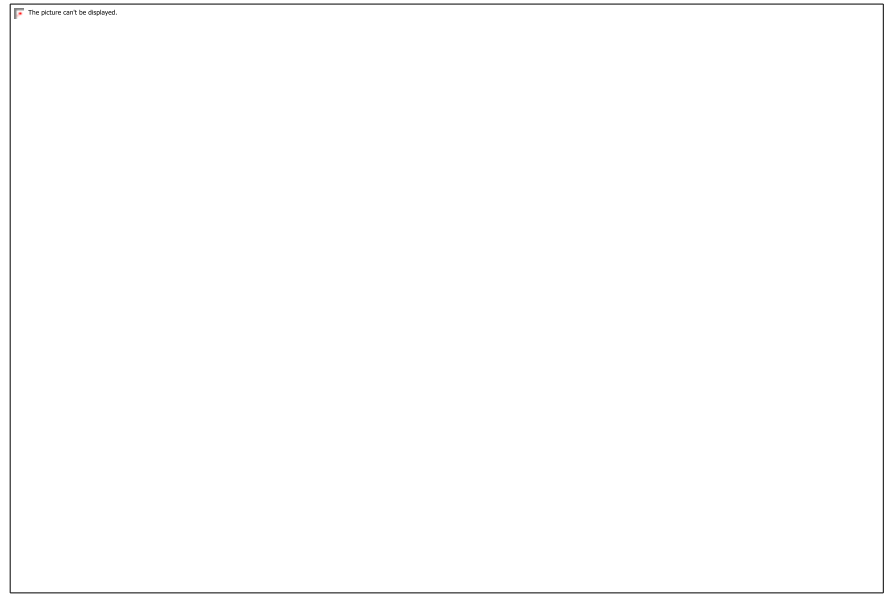
Penetration Power Summary

- Show diagram:
- α stopped by sheet of paper
- β stopped by 3 mm aluminum
- γ needs several cm of lead
- Caption: “Different radiation → different shielding needed”



Half-Life ($T_{1/2}$)

- Time taken for half the radioactive atoms to decay
- Constant for each isotope, independent of amount
- Examples:
- Iodine-131: 8 days
- Carbon-14: 5730 years
- Uranium-238: 4.5 billion years
- Formula: $N = N_0 (½)^n$ where $n = t / T_{1/2}$



Uses of Radioactivity

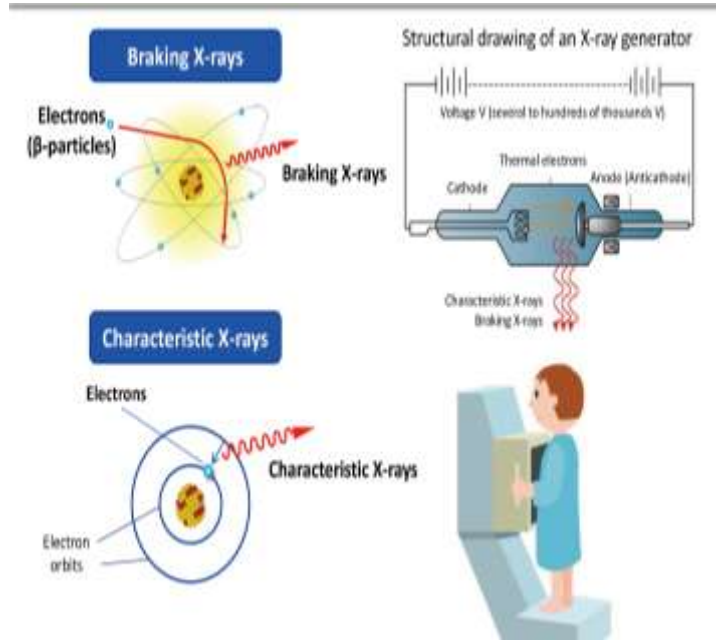
Medical: Cancer treatment (Co-60 gamma), PET scans, tracers

Dating: Carbon-14 (archaeology), Uranium-Lead (rocks)

Energy: Nuclear power plants

Industry: Thickness gauges, smoke detectors (Am-241)

Sterilization of medical equipment



SUMMARY

- Radioactivity is natural and all around us
- Three main types: α, β, γ with very different properties
- Half-life governs how long isotopes remain dangerous/useful
- When handled properly → extremely useful tool
- When mishandled → serious health risk
- “Radiation is like fire: respect it, control it, and it serves us well.”

References

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- https://ce4rt.com/rad-tech-talk/types-of-radiation-why-are-x-rays-used-in-medical-imaging/?srsltid=AfmBOortZXRpBfbW
- https://www.slideshare.net/slideshow/radioactivity-spectrum-of-diagnostic-imaging-and-therapy-x-raypptx/266253279