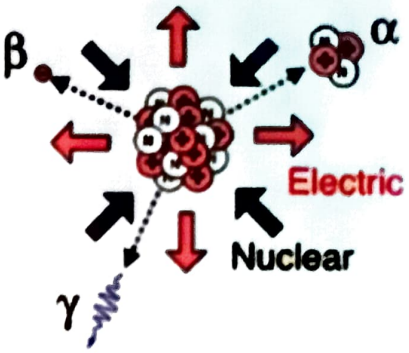
UNIT – V
RADIOPHARMACEUTICALS

POINTS TO BE COVERED IN THIS TOPIC

- RADIO ACTIVITY
- MEASUREMENT OF RADIOACTIVITY
- PROPERTIES OF α, β, γ RADIATIONS
- HALF LIFE
- RADIO ISOTOPES AND STUDY OF RADIO ISOTOPES , SODIUM IODIDE
- STORAGE CONDITIONS, PRECAUTIONS AND PHARMACEUTICAL APPLICATION OF RADIOACTIVE SUBSTANCES

RADIO ACTIVITY



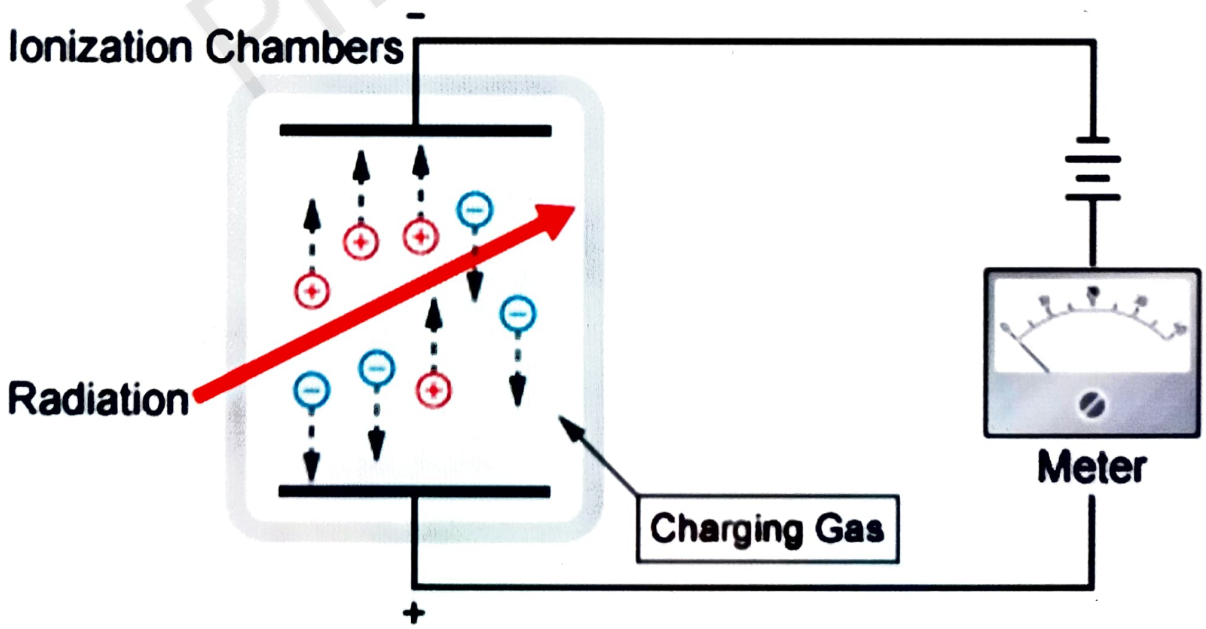
- The phenomenon of **spontaneous emission** of certain kind of **invisible radiation** by certain substance is called **radioactivity.**
- The substances which **emit** such **radiation** is called **radioactive substance.**
- **Radiopharmaceuticals** are used in medicines. It is used to treat **cancerous tumors,** to diagnose **thyroid disorders** and other metabolic disorders including **brain function.**

MEASUREMENT OF RADIOACTIVITY

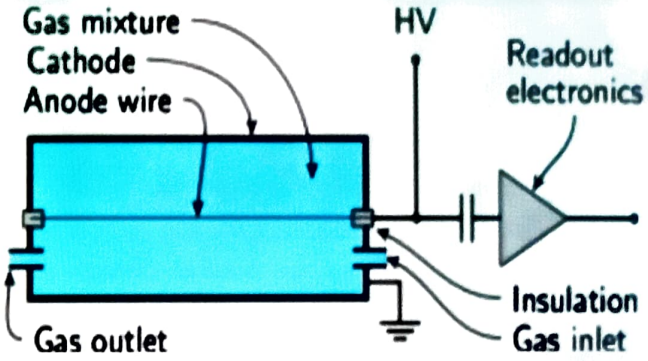
- To **measure the radiations** of **alpha, beta and gamma rays** many techniques involving **detection and counting** of individual **particles or photons** have been available.

IONISATION CHAMBER

- An **ionization chamber** consists of chamber **filled with gas** and fitted with **two electrodes** kept at different **electrical potentials** and a measuring device to indicate the flow of **electric current.**
- The fill gas can be **Ar, He, air etc.**

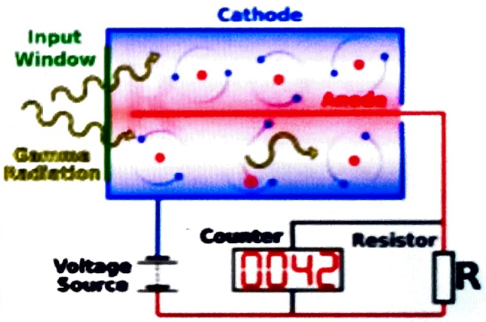


PROPORTIONAL CONTER



- If the **electric field** gradient between the **anode and cathode** is increased by increasing the **applied voltage,** the **electrons produced** in the **primary ionization** further ionize the **gas molecule** e.g. the number of **ion pair** is multiplied.
- For each **primary electron liberated** , a large number of **additional electrons** are liberated, the current pulse through **electrical current** is **greatly amplified.**
- In a **certain original number** of **ion pairs.**
- **Proportional counters** operate in this voltage region.
- They are **usually operated** in pulse mode and are used in the form of **gas filled** or gas **flow counters** for a, b and fission **frequent counting.**

GEGIER - MULLER CONTER



- It is one of the **oldest radiation detector** types in existence, having been introduced by **Geiger and muller in 1928.**
- They can detect **α, β, γ radiations.**
- It **consist of a cylinder** made up of **stainless steel** or **glass** coated with silver on the **inner side** which acts as **cathode.**
- **Coaxially inside** the tube a **mounted fine** were works an as **anode.**
- It is having the mixture of **ionizing gas** which contain a **small proportion quenching vapour.**
- The function of **quenching vapour are –**
  i. To **prevent the false pulse.**
  ii. To **absorbs the photons** emitted by excited atoms molecule returning to their **ground state.**

- Radiation when enters the tube through a thin section of outer wall causes ionization atoms of the gas.
- When a high voltage is maintained between two electrodes, the electrons and charged ions are attracted by the anode and cathode respectively.
- Each particle of radiation produces a brief flow or pulse of current which can be recorded by a scalar.

PROPERTIES OF α, β, γ RADIATIONS

α Rays

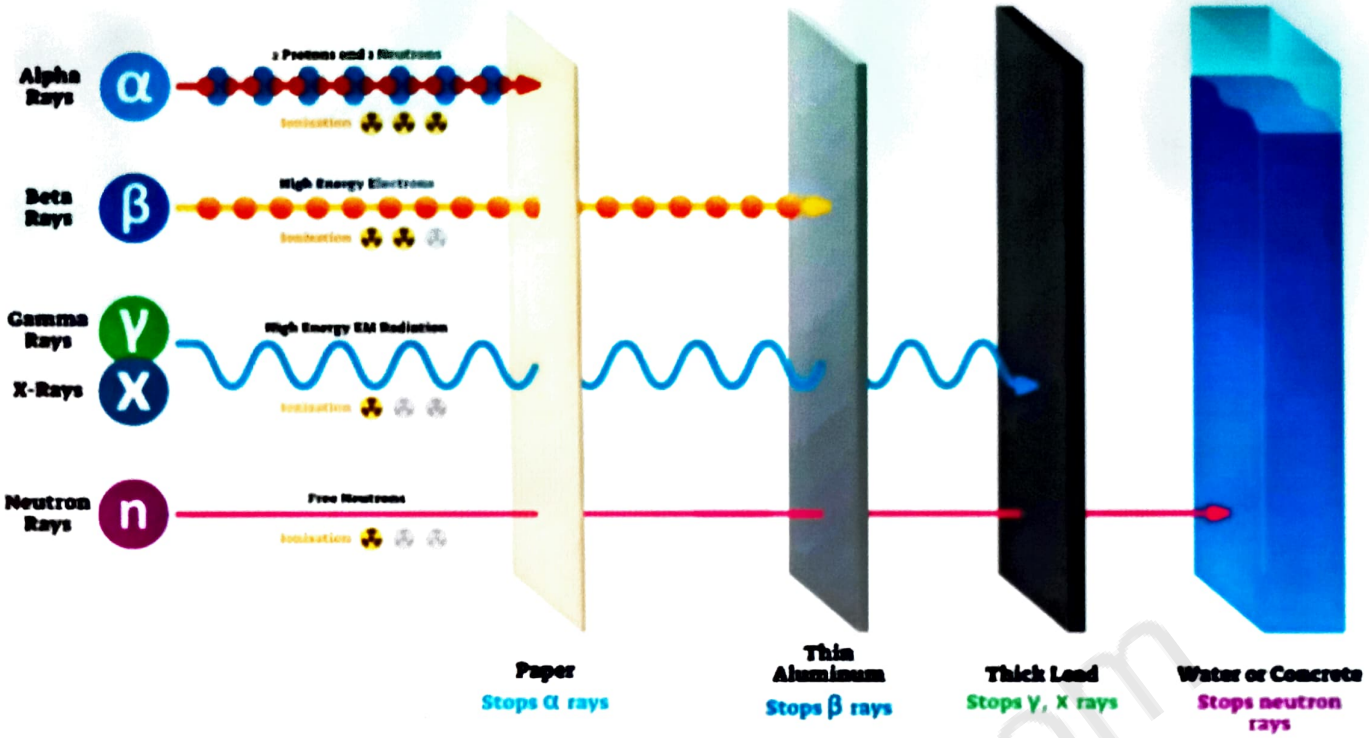
- These rays or particles are positively charged.
- It consists of two unit positive charge and has a mass which is nearly four times that of hydrogen atom.
- These are heavy, slow moving and their penetration power is slow.
- These rays ionize the gas through which they pass.
- During the emission of α-particle from a radioactive element , atomic number decreases by 2 unit and mass number decrease by 4 units.

β – rays

- These rays or particles are negatively charged.
- They have negligible mass.
- These are having smaller mass, higher speed and thus β particle are much more penetrating than α particle.
- They have lower ionizing power than α- rays
- During the emission of β particle from a radioactive element , atomic number increases by 1 unit and there is no change in mass number.

γ – rays

- These rays are neutral i.e. do not carrying charge.
- The particle of these rays has negligible mass.
- As they do not have any mass, their ionizing power is also very poor.
- They are not affected by magnetic field and are having the speed of light.



HALF LIFE

- **Radioactive isotopes** or **nuclides** continue to decay for a **particular period of time.**
- The **half – life** is used to designate the time required for one **half of atoms** originally present to complete their **emission of radiation.**
- **Half-life** is defined as the time in which the **amount of radionuclide decays** to half its **initial value.**
- It can be calculated by formula

$$t1/2 = \frac{0.693}{\lambda}$$

- **Half –** life of various **radioactive elements** varies as ^{131}I has 8 days ^{65}Zn has **150 days** , **Na has 2 – 6 days** , while ^{238}U **has** 4.5×10^4 days

RADIO ISOTOPES AND STUDY OF RADIO ISOTOPES

- **Atoms** of an **element** which have the same **atomic number** but have **different mass** number are called **isotopes.**

❖ APPLICATION OF RADIOISOTOPES

- ✓ **Medicine - Diagnostics and treatment** of diseases, sterilization of **surgical and clinical** products, etc.
- ✓ **Industries and terminology** - In **construction, materials** and welding will be reviewed, **control production processes**, and **conduct research.**
- ✓ **Art - Restoring art objects**, establishing historical or **artistic objects, etc.**
- ✓ **Research - Sciences** such as **astronomy, engineering**, and medicine.
- ✓ **Agriculture - Food conservation, eradication of plague**, etc.
- ✓ **Pharmacology** - Prior to being approved for use by the **public, drugs are studied** for their metabolism.
- ✓ **Archaeology** - determining the **age of geological events**, etc.

➢ STUDY OF RADIO ISOTOPES SODIUM IODIDE I_{131}

- The treatment of **thyroid cancer** and **hyperthyroidism** is among the most common uses of **sodium iodide I_{131}.**
- A radioactive **anti-thyroid drug** falls under the category of **propylthiouracil (PTU)** and **methimazole (Tapazole)**, but it is not prescribed by doctors unlike other **anti-thyroid medications.**
- Several **sodium iodide** compounds, **including I_{131}**, readily absorb through the **mouth** and become **trapped inside** the thyroid gland.
- The **thyroid gland** is damaged by the **irradiation** caused by **trapped sodium iodide I_{131}.**
- In turn, this results in a **reduction in thyroid gland** activity, which **reduces thyroid hormone** production.
- By excreting **sodium iodide, I_{131}** through the **urine, the kidneys** rid the body of excess **sodium iodide.**
- Within several weeks, most of the **sodium iodide** absorbed by the **body is lost.**
- This **radioactivity** is **half-life after eight days.**

STORAGE, HANDLING AND PRECAUTIONS OF RADIOACTIVE MATERIAL

- A care should be taken to protect and personal from harmful radiation during handling and storage of radioactive materials emits.
- The following precautions are taken while working with radiodetectors , radio assay , traces experiments, manufacturing or handling of radioactive materials.

1. These materials should be handled with forceps or suitable instruments and direct contact should be avoided.
2. Any substance which is taken internally (foods , drinks, smokes etc.) should not be carried in laboratory where radioactive materials are used.
3. Sufficient protective clothing or shielding must be used while handling the materials.
4. Radioactive materials should be kept in suitable labelled containers shield by lead bricks any preferably in remote corner.
5. Areas where radioactive materials are used or stored should be monitored constantly.
6. The final disposed of radioactive material should be done with great care to animals and environment.