1.INVESTIGATION ON POSITRON EMISSION DETECTOR :-

Positron emission tomography is functioning imaging technique which is used to observe metabolic processes in the body based on the detection of small amounts of positron-emitter-labelled biologic molecules. It is performed after the administration to the patient of a radio-tracer, a biomolecule labeled with a radioactive atom emitting positrons. The system detects pairs of gamma rays emitted indirectly by a positron emitting radiotracer.

A PET scanner consists of a set of detectors arranged in ring geometry surround the object to be imaged and are designed to convert these high-energy gamma quanta into an electrical signal that can be fed to subsequent electronics and two opposite detector segments rotate around the patient covering 360◦. The line passing through the annihilation point and connecting two opposite detector channels is called Line of Response (LOR). Acquisition from detector pairs at various angular views (tomographic acquisition) followed by appropriate reconstruction algorithms allows for estimation of the tracer bio distribution within the imaged object with a finite spatial resolution and sensitivity. The width of this window is usually chosen to be twice the time resolution of the PET detectors. PET detectors have fast response due to the demand for detection of photon events. They have a finite time resolution of a few nanoseconds allowing for detection of photon events within a predefined time window. These detectors pick up the pattern of radioactivity from the radiopharmaceutical in the body. A computer analyses the patterns and creates 3-dimensional color images of the area being scanned. Degrees of brightness on a PET image represent different levels of tissue or organ function. [1]

2.THE CONCEPT OF POSITRON :-

Positron is also called positive electron and it is positively charged subatomic particles having the similar mass and magnitude of charge as the electron and constituting antiparticle of a negative electron. As positrons pass through human tissue they results up their kinetic energy principally by Coulomb interactions with electrons. The remaining mass of the positron is the equal to that of the electron, the positrons may undergo large deviations in direction with each Coulomb interaction and they follow a twisty path through the tissue as they results their kinetic energy. When the positrons reach thermal energies, they start to interact with electrons either by annihilation which produces two photons which are anti-parallel in the positron is frame by the formation of a hydrogen-like orbiting couple called positronium.

POSITRON EMISSION :-

Positron emission is a secondary type of radioactive decay known as beta decay. Where proton inside a radionuclide nucleus is transformed into a neutron while releasing a positron and an electron neutrino. Positrons are discharges in the positive beta decay of proton-rich radioactive nuclei and are obtained in pair production where the energy of a gamma ray in the field of a nucleus is transformed into an electron-positron pair. Positron emission occurs when a proton in a radioactive nucleus changes into a neutron and releases a positron and an electron neutrino. They will decay to correct the imbalance. It increases the number of neutrons and decreases the number of proton and occurs when a proton in a radioactive nucleus changes into a neutron and releases a positron and an electron neutrino. Most nuclei are unstable if the neutron-proton ratio is because there are too many protons. They will decay to correct the imbalance. Positron emission increases the number of neutrons and decreases the number of protons. This makes the nucleus more stable. In positron emission, the [atomic number](http://socratic.org/chemistry/a-first-introduction-to-matter/atomic-number) Z decreases by one while the [mass number](http://socratic.org/chemistry/a-first-introduction-to-matter/mass-number)  remains the same. [2]

3.NUCLEAR MEDICINE :-

Nuclear medicine procedures are non-invasive. It is a medical imaging that avail small quantities of [radioactive](https://www.radiologyinfo.org/en/glossary/glossary.cfm?gid=605) material to diagnose and regulates the severity of or treat a variety of diseases. The images are digitally generated on a computer and transferred to a nuclear medicine physician, who interprets the images to make a diagnosis. It involves giving a patient a small amount of radioactive medication, called a radiopharmaceutical. This makes the body slightly radioactive for a short time. A special nuclear medicine camera detects the radiation, which is emitted from the body, and takes images or pictures of how the inside of the body is working. Many different organs can be imaged depending on the type of radioactive medication used. The radioactive medication is most commonly injected into the blood stream through a vein, but might be given in different ways.

NUCLEAR MEDICINE RELATED TO PET :-

The main differences between PET scans and nuclear medicine is that the PET scan disclose the cellular level metabolic changes occurring in an organ or tissue while nuclear imaging techniques show the physiological function of the tissue or organ and PET will show only the anatomy or structure. A PET is a nuclear medicine test and a nuclear medicine test will show function, not anatomy like a PET will. Some patients will get a PET-CT and this is where the image of a PET is laid over the image of a CT so that doctor can see both function or activity as well as the anatomical sight. Nuclear medicine is any test where a radio-isotope is administered into the body so that the radiation is in the body and a scan picks it up instead of a radiation beam directed into the body from an outside source. The PET machine is like a camera that detects the isotope. [3]

4.HYDROGEN IONS ACCELERATED TO DESIRED ENERGY TO PRODUCE RADIOTRACER DUE TO CYCLOTRONS :-

Radioactive tracers are obtained from carrier molecules which are placed strongly to a radioactive atom. These carrier molecules vary largely depending on the purpose of the scan. Some tracers includes molecules that interact with a specific protein or sugar in the body and can even employ the patient’s own cells.

Cyclotrons plays an important role to accelerate the hydrogen ions to desired energy to produce radiotracer. It accelerate charged particles using a high-frequency alternating voltage. A perpendicular magnetic field causes the particles to spiral in a circular path so that they re-encounter the accelerating voltage many times. Ions of a light particle such as hydrogen or helium are injected into the centre of the cyclotron where they are accelerated by the electrically charged Dees will encounter repulsive force from the end of one dee followed by attractive force on edge of another dee. The Dees are high voltage cavities that change polarity at a high frequency. The magnet forces the charged particles to move in a circular path. As the particle gains energy the circular path increases in radius until it reaches the energy desired whereupon it is extracted and directed to a target material where a nuclear reaction forms the radionuclide of choice. Negatively charged ions are extracted from the ion source using alternating high voltage and accelerate using RF power. The beam extraction system consists of a stripper foil, which changes the ion polarity to positive and thus steering the ions to hit the target according to the target selection by bombarding the proton beam and thus produce PET radioisotope. The simplicity of the design for proton-only cyclotrons resulted in cyclotrons which accelerate H− ions capable of two or more simultaneous beams of varying energies and intensities. The modern cyclotron is fully controlled by a computer and capable of running with minimal attention. [4]

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