ACTIVITY 2: BASIC PHYSICS OF A PET

BACKGROUND

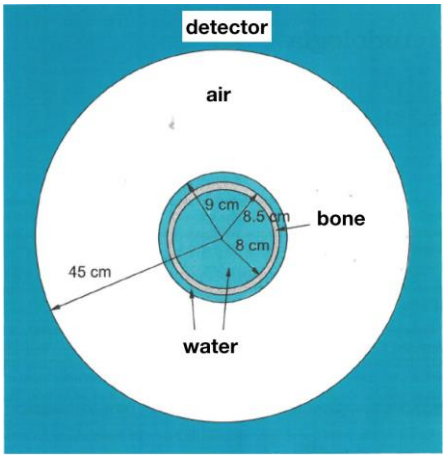
- Positron emission tomography (PET) is a medical imaging technique widely used in Nuclear Medicine. It is based on the detection in coincidence of the two 511 keV photons that are emitted after the annihilation of the positron produced in beta+ decay of radioisotopes that are introduced in the patient organ to be studied.
- The purpose of this activity is to simulate the operation of a simplified PET in order to analyze in order to analyze the basic physical processes at play.

MATERIALS

- A Monte Carlo simulation code (see Readme-MC document)
- Emission spectra of radioisotopes. Among others, they can be obtained from the following link: http://www.lnhb.fr/donnees-nucleaires/donnees-nucleaires-tableau/
- Possible radioisotopes to be considered: ^{11}C, ^{13}N, ^{15}O, ^{18}F, ^{68}Ga, ^{82}Rb.

TASKS

- T1: To design the geometry of the problem as indicated in the figure. It consists of a series of concentric spheres simulating a head (brain, skull and skin) and a detector whose purpose is just to stop the particles that reach it (therefore it can be built up with any material).



- T2: To study the beta+ emission spectra of the various radioisotopes.
- T3: To determine the distribution of the distances between the source and the point where the positrons emitted are annihilated.
- T4: To study the characteristics of the particles reaching the detector. Pay particular attention to pairs of photons with 511 keV.