



CAEN Educational Handbook

Nuclear and Particle Physics Experiments



<https://edu.caen.it>



Difficulty



Execution Time



SP5700 - EASYPET

Purpose of the experiment

Evaluation of the spatial resolution of a PET system composed of two detector modules..

Fundamentals

The main goal of the PET studies is to obtain a good quality and detailed image of an object by the PET scanner. The parameters involved and critical to good quality image formation are several: spatial resolution, sensitivity, noise, scattered radiations, and contrast.

The spatial resolution is a fundamental characteristics of a tomographic system and its determination is mandatory for a PET system. The spatial resolution of a PET scanner is a measure of the ability of the device to faithfully reproduce the

image of an object. It is empirically defined as the minimum distance between two points in an image that can be detected by a scanner.

In the EasyPET the dominant factor determining the spatial resolution is represented by the width of the scintillating crystals. Another effect that degrades the spatial resolution of the system is the so-called sampling error. It is associated to the distribution of the lines of response in the field of view and is a direct consequence of the rotation and scanning granularity.

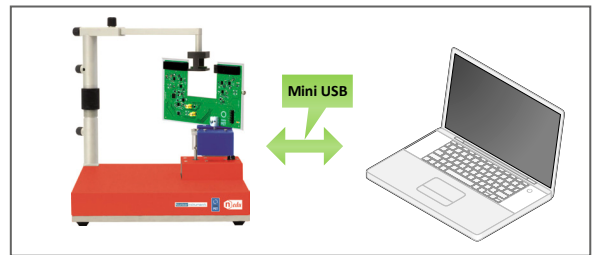
Requirements

^{22}Na Radioactive source (recommended: 1/2 inch disc, 10 μCi). 

Carrying out the experiment

Mount the arm of the source holder on the column fixed on the system base, fix the U-shaped board to the top stepper motor and connect the flat cable to the U-shaped board and to control unit. Connect to PC and power ON the system. Set and optimize the parameters as bias voltage, threshold and coincidence time windows. In order to perform the spatial resolution measurement, the radioactive source is placed between the two detectors, on the line of response passing through the center. Its position is kept fixed while the system acquires the number of coincidence counts for successive scanning positions of the detector pair. The acquisition time is chosen in relation to the source activity to have enough statistics. The system response function is obtained plotting the number of coincidence counts for each position as a function of the distance between the source and the line

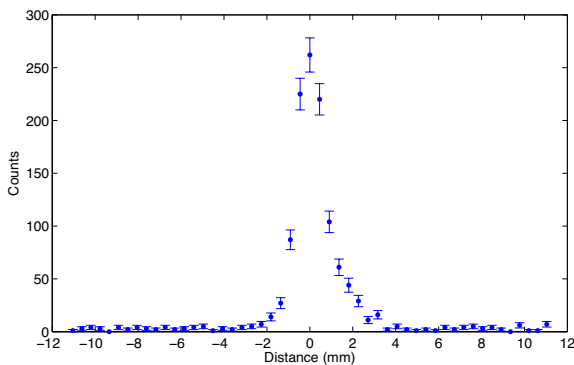
of response (the distance is calculated as the product of the source-scanning axis distance and the scanning angle tangent). The resulting curve can be interpreted as the radioactive source distribution convoluted with the system spatial resolution.



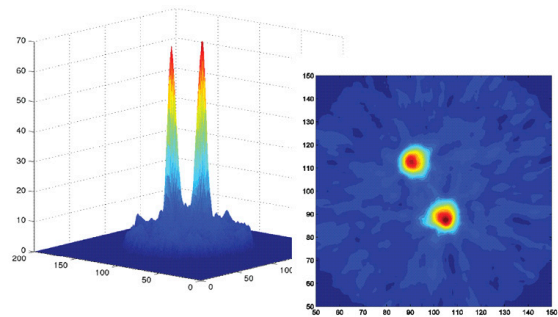
Experimental setup block diagram.

Results

The estimated spatial resolution is $\sim (1.45 \pm 0.4)$ mm, which is comparable to the spatial resolution of the small animal PET systems.



Resolution Plot.



^{22}Na sources, 5 μCi , 2.7 mm $\varnothing$ and 9 mm apart.