B.5.3 SG6133 Two-dimensional Reconstruction of a Radioactive Source

Ordering Options

Equipment	
Code	**Description**
WSP5700XAAAA	SP5700 – EasyPET
or	
WK5701XAAAAA	SP5701 – EasyPET Kit
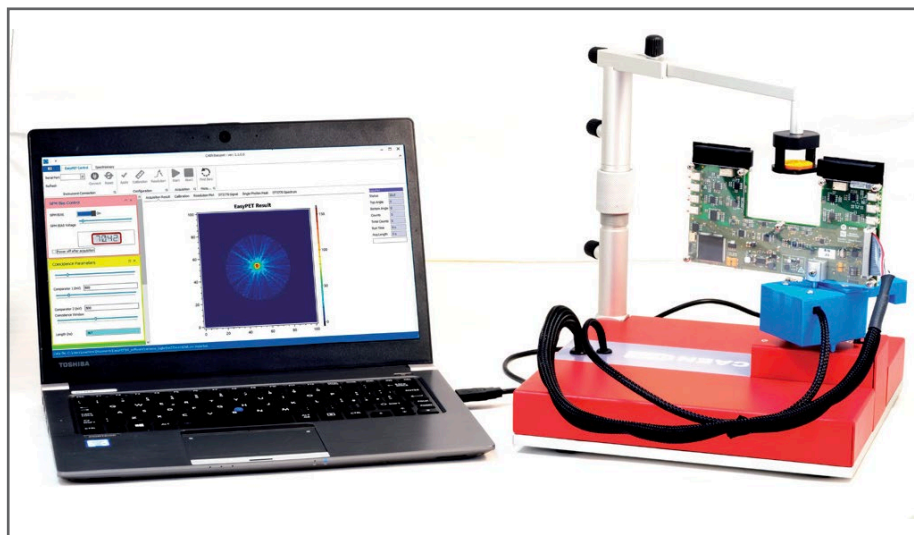
Purpose of the experiment

Understanding the technique of the nuclear imaging and the setup optimization of the parameters by performing two-dimensional image reconstruction of ^{22}Na radioactive source.

Fundamentals

The EasyPET operation principle is simple: two detector modules move together and execute two types of independent movements, around two rotation axes, so as to cover a field of view similar to that of a complete ring of detectors.

The rotation movements are executed by two stepper motors. The bottom motor has a fixed axis, whose position defines the center of the field of view. The bottom motor supports and performs a complete rotation of a second motor, in predefined steps of amplitude α. The axis of the top motor is thus always positioned within a circumference of radius equal to the distance between the two axes. The top motor, in its turn, supports and moves a U-shaped printed circuit board, where a pair of aligned and collinear detector modules is mounted, performing a symmetric scan of range θ around the center, for each position of the bottom motor. In this way, EasyPET can reconstruct an image of a radioactive source placed anywhere within a cylindrical field of view between the pair of detectors. The diameter of the field of view is defined by the amplitude of θ, the range of the top motor scan.

Computed tomography (CT) is a diagnostic imaging test used to create detailed images of internal organs, bones, soft tissue and blood vessels. The cross-sectional images generated during a CT scan can be reformatted in multiple planes, and can even generate three-dimensional images which can be viewed on a computer monitor, printed on film or transferred to electronic media. CT scanning is often the best method for detecting many different cancers since the images allow your doctor to confirm the presence of a tumor and determine its size and location. CT is fast, painless, non-invasive and accurate. In emergency cases, it can reveal internal injuries and bleeding quickly enough to help save lives.
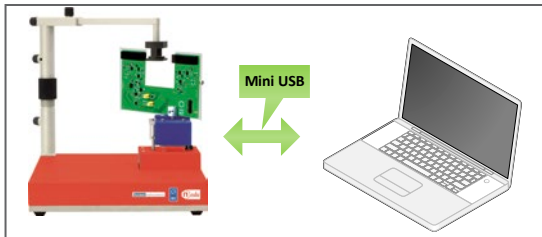The first commercially viable CT scanner was invented by Sir Godfrey Hounsfield in United Kingdom at EMI Central Research Laboratories using X-rays.

http://www.radiologyinfo.org/en/submenu.cfm?pg=ctscan

Equipment

SP5700 - EasyPET

Model	SP5700
Description	EasyPET

p. 150

Requirements

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


Experimental setup block diagram.

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.   The parameters involved in the setup optimization for the two-dimensional reconstruction of the source image are three: the detectors operating voltage, the coincidence time window and the threshold. Place the source holder between the two detector modules and tune the parameters to estimate the DCR contribution.

Place the ^{22}Na radioactive source in the holder and repeat the measurement tuning the parameters in order to obtain a good image reconstruction of the radioactive source.

Results

Tuning the parameters, the students can directly observe and understand their effects on the imaging measurements. At fixed threshold, the image contrast changes due to the time window width. The use of the lowest possible coincidence time window of the system is mandatory to achieve a good image contrast. Fixing the bias voltage and the time window, it is interesting to observe how the threshold affects the image contrast. This parameter choice is dictated by a trade off between the signal to noise ratio and efficiency maximization. The threshold value and the coincidence time window should be set by choosing the best compromise.
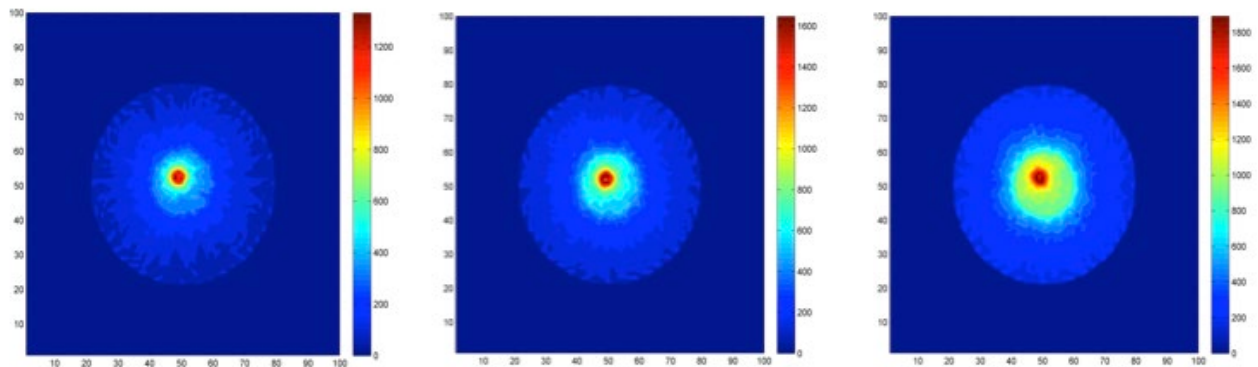
^{22}Na source distribution image as a function of coincidence time window , at fixed threshold and bias voltage.