C.1.5 Detection Efficiency

SG6214D
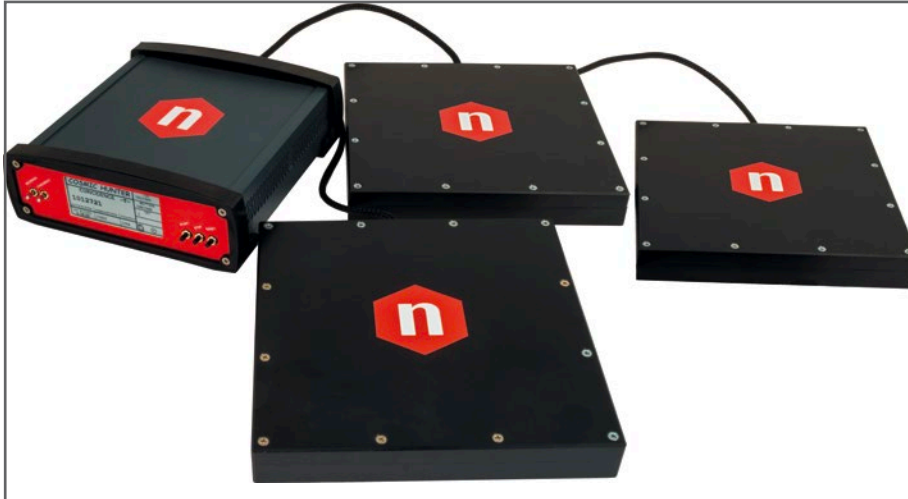
Ordering Options

Equipment	
Code	**Description**
WK5620CHAAAA	SP5620CH - Cosmic Hunter

Purpose of the experiment

To goal of the experiment is the evaluation of the detection efficiency of the scintillating tiles that make up the system.

Fundamentals

Detection efficiency is the probability that a particle is detected after crossing the sensitive volume of the detector. Detection efficiency is dependent upon the incidence angle, the cross-section through which the particle interacts with the scintillator, and on its physical dimensions. The efficiency of a detector can change depending upon the bias voltage applied and upon the particle type and energy. The efficiency (ε) is defined experimentally as the ratio between the number of detected particles (N_0) and the number of particles incident upon the detector surface (N):

$$\varepsilon = N_0 / N$$

The number of the particles detected in coincidence between additional detectors can be expressed as the product between the impinging particles and the efficiency of each detector. The following expressions can be assumed for the double and triple coincidences:

$$N_{AC} = \varepsilon_A {}^* \varepsilon_C {}^* N_0 \qquad and \qquad N_{ABC} = \varepsilon_A {}^* \varepsilon_B {}^* \varepsilon_C {}^* N_0$$

Thus, the detection efficiency of the scintillating tile positioned in the middle can be expressed as:

$$\varepsilon_B = N_{ABC} / N_{AC}$$

Equipment

SP5620CH - Cosmic Hunter

Model	SP5620CH	SP5622	DT5622
Description	Coincidence Module	Detection System	Detection System
	p. 139	p. 139	p. 139

Requirements

Additional SP5622 - Detection System, DT1081A Four-Fold Programmable Logic Unit (Discriminator, Coincidence and Scaler modules in one solution) and a Cable Adapter are needed.
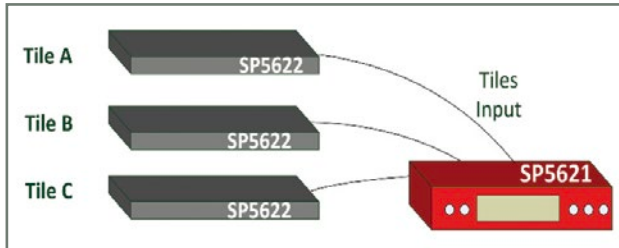
Experimental setup block diagram

### Carrying out the experiment

Connect the cable connectors of the three SP5622 to the tile inputs located on the rear panel of the SP5621 module. Power on the SP5621 module and start the acquisition via the front panel START button. When a charged particle crosses the black tile it's energy is converted into scintillation light. The photons which are produced are detected by the photosensor and converted into an electrical signal. The number of counts for each scintillator may be viewed via the SP5621 display. Select triple scintillator coincidence mode via the related button on the front panel, then select the integration time of the measurement. Arrange the geometry of the detectors as depicted in the diagram above. Be sure to keep this geometry for the duration of the experiment. This system configuration allows the user to test the efficiency of the central scintillating tile. Connect the signal outputs of the three scintillating tiles to an external apparatus in order to identify double and triple counts at the same time, which correspond to the same cosmic ray.

To estimate the detection efficiency of the upper and lower scintillating tiles change the detector positions and repeat the measurement.

Results

The efficiency value for each detector should be very close to one another.
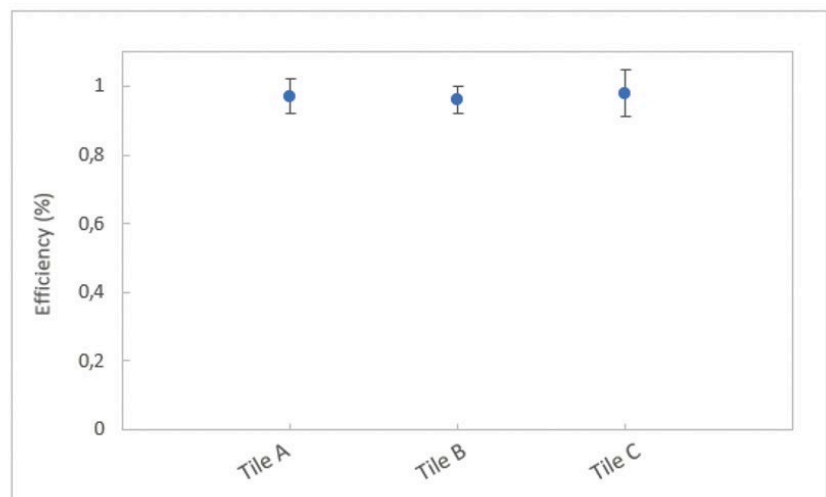
Detection efficiency of the three scintillating tiles – SP5622