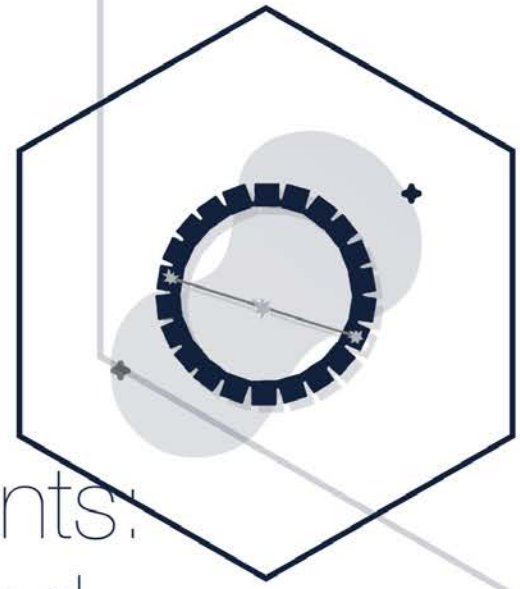
CAEN
Tools for Discovery

CAEN EDUCATIONAL
edu.caen.it



HANDBOOK OF EXPERIMENTS

SG6131G Nuclear Imaging – PET

Basic Measurements: γ Spectroscopy and System Linearity

Nuclear Physics and Radioactivity

EDUCATIONAL KIT

SP5701

CAEN S.p.A. · Via Vetraia 11, 55049 Viareggio (LU) Italy · www.caen.it — © 2026 CAEN S.p.A. All rights reserved.
Specifications are subject to change without notice.

CAEN EDUCATIONAL · SG6131G

Basic Measurements: γ Spectroscopy and System Linearity

Categories: CAEN Experiments, Nuclear Physics and Radioactivity | Tags: Nuclear Imaging, Nuclear Physics, PET, γ Spectroscopy

Difficult	Execution Time	Data Analysis	Radioactive Sources
		Yes	Yes

Hardware setup

This experiment guide is referred to the **SP5701** educational kit.

Equipment: SP5701 – EasyPET Kit

Model	SP5700	DT5770	Additional Tool
Description	EasyPET	Desktop Multi-Channel Analyzer	^{22}Na Radioactive source (recommended: 1/2 inch disc, 10 µCi)

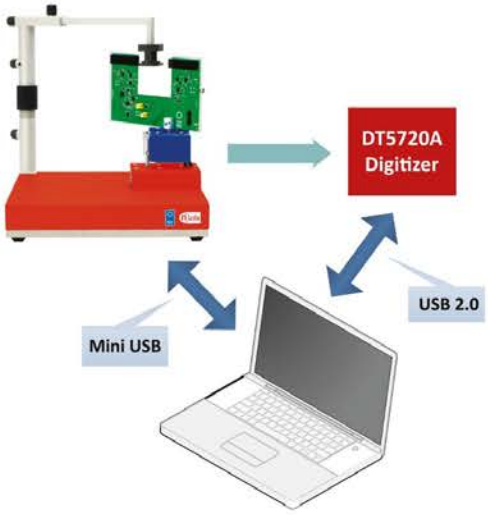
Purpose of the experiment

Gamma spectroscopy studies by using a gamma radioactive sources and by analysing the signals produced by the interaction of the gamma with one of the scintillating crystals of the system.

Fundamentals

The **EasyPET detector system** is composed of two Silicon Photomultipliers (SiPM) coupled to scintillating crystals. The EasyPET operation principle is simple: the two small detector cells, each composed of a small scintillator crystal coupled to a silicon photomultiplier (SiPM), develop a signal when they detect a photon emitted by the source. In order to perform the gamma spectroscopy measurements using one of the two detector systems, it is important underline that the detector is characterized by a noise component, caused by spurious events occurring randomly and independently from the illumination field. This noise, called Dark Count Rate (DCR), depends mainly on the sensor technology and on the operating temperature, with a rate from 100kHz up to several MHz per mm^2 at 25°C. The DCR decreases with the lowering of the temperature (about a factor 2 of DCR reduction every 8°C). In addition, the operating voltage has an impact on the DCR since it's connected to the electric field and as a consequence to the active volume of the sensor and to the triggering probability of the charge carrier. This noise component affects the resolution of a generic gamma spectrum composed of system noise peak, Compton distribution and Photo-peak.

Carrying out the experiment

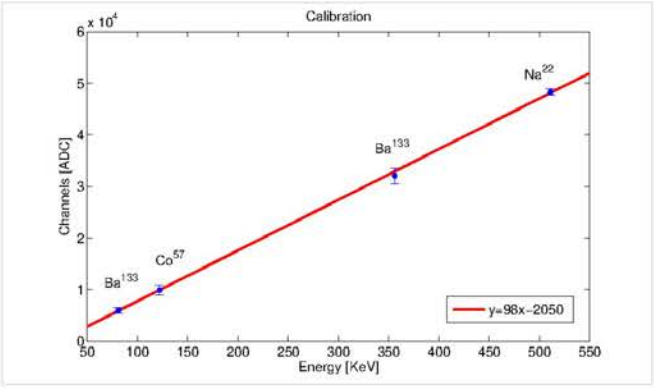


Experimental setup block diagram.

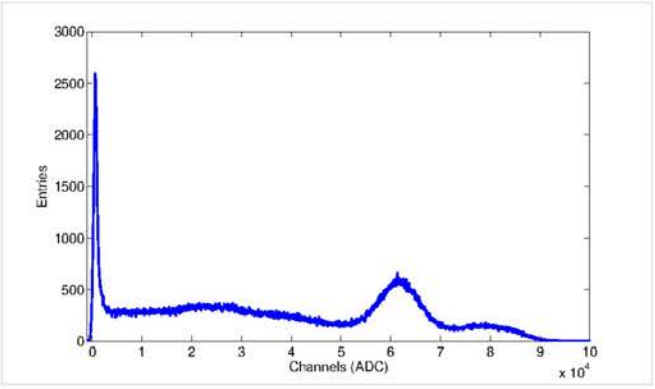
- Mount the arm of the source holder on the column fixed to the system base, fix the U-shaped board to the top stepper motor and connect the flat cable to the U-shaped board and to the control unit.
- Connect to PC and power ON the system.
- Choose one detection system and connect its analog output to channel input of the DT5770, then use the comparator output to trigger the MCA and choose the threshold in mV of the signal output.
- Place the radioactive source as close as possible to the detector chosen and acquire the energy spectrum thanks to a Multi Channel Analyzer.
- Repeat the measurements with several gamma radioactive source in order to study the linearity system.

Results

The γ-spectrum shows the Compton continuum, related to the continuum of energies released by the Compton scattered electrons, and the Photo-Peak, the full-energy peak corresponding to the photoelectric absorption of the incident gamma. The peak around zero represents the system noise. The conversion between the channels number and the energy can be performed by a calibration. The system linearity is checked by using several radioactive sources. If the response of the system is linear, the output signals are directly proportional to the incident gamma energies.



Energy Calibration.



Energy spectrum of ^{22}Na source.

HEADQUARTERS

CAEN S.p.A.

Via Vetraia 11
55049 - Viareggio
Italy

Phone +39 0584 388 398
Fax +39 0584 388 959
info@caen.it
www.caen.it



WORLDWIDE

CAEN GmbH

Brunnenweg 9
64331 Weiterstadt
Germany
Phone +49 212 254 40 77
Fax +49 212 254 40 79
info@caen-de.com
www.caen-de.com

CAEN Technologies, Inc.

1 Edgewater Street - Suite 101
Staten Island, NY 10305
USA
Phone: +1 (718) 981-0401
Fax: +1 (718) 556-9185
info@caentechnologies.com
www.caentechnologies.com

CAENspa INDIA Private Limited

B205, BLDG42, B Wing,
Azad Nagar Sangam CHS,
Mhada Layout, Azad Nagar, Andheri (W)
Mumbai, Mumbai City,
Maharashtra, India, 400053
info@caen-india.in
www.caen-india.in

CAENsn SAS

Gare du Nord Business Centre 14,
Rue De Dunkerque
75010 Paris
France
info@caen-sn.fr
www.caen-sn.fr