

CapeSym, Inc.

Radiation Detection Solutions

SrI₂(Eu) **Plug & Play Developer's Kit**

SrI₂(Eu) Developer's Kit

Developer's kit is a plug-and-play SrI₂(Eu) radiation detection solution ready to measure in less than 30min after the box is opened. It consists of a high performance SrI₂(Eu) scintillation crystal coupled to a super-bialkali photomultiplier tube (PMT), plug-on digital MCA with high voltage (usbBase) and browser-based graphical user interface.

Table of contents:

Overview of SrI ₂ (Eu) scintillation properties.....	2
Internal activity.....	3
Energy resolution.....	4
Developer's kit drawing and overview.....	5
Kit description and graphical user interface.....	6
Performance versus count rate.....	7
Energy resolution versus temperature.....	8



CapeSym, Inc. manufactures novel scintillator crystals and other crystalline detectors at its 10,000 sq. ft. facility in Massachusetts, USA. Our products leverage decades of experience in crystal growth, materials science, chemistry, solid state physics, thermo-fluid transport, and engineering design.

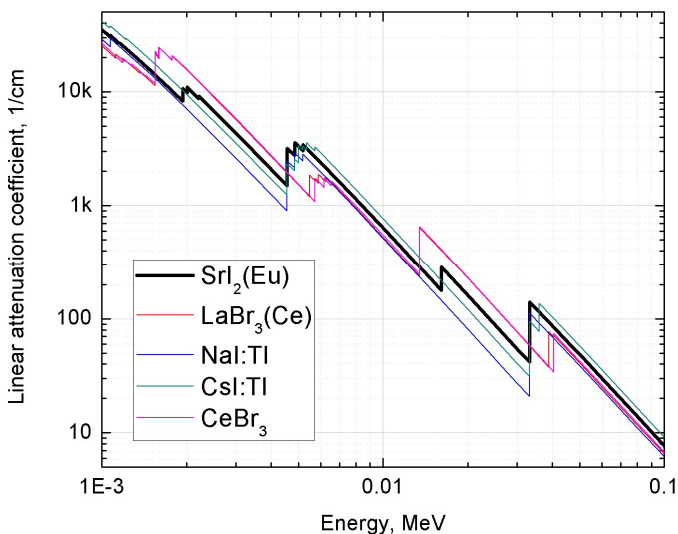
Europium-doped Strontium Iodide ($\text{SrI}_2(\text{Eu})$) gamma detectors have a very high light output ranging from 80,000-100,000 ph/MeV and energy resolutions as good as 3.2% at 662 keV for $\varnothing 1.0$ inch crystals.

Light Yield	80,000 ph/MeV
Energy Resolution @ 662keV	3.2% for $\varnothing 1.0''$ 3.5% for $\varnothing 1.5''$
Decay Time	1-3 μs
Emission Range	400-480 nm
Max Emission	430 nm

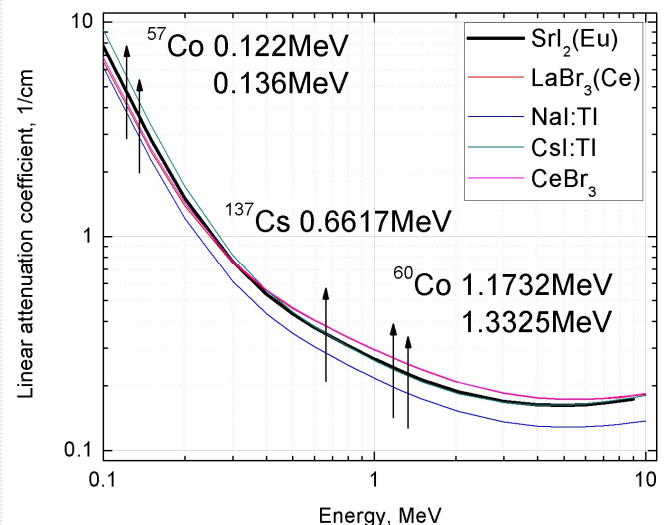
Density	4.59 g/cm^3
$Z_{\text{effective}}$	49
Intrinsic activity	0.03-0.05 Bq/cm^3
Moisture Sensitivity	Hygroscopic (similar to $\text{NaI}(\text{Tl})$)
Refractive Index	1.85

CapeSym's proprietary crystal growth process is now routinely producing up to 110cc crystals. The patent-pending process is based on decades of experience in crystal growth and crystal growth process simulation.

1-100 keV

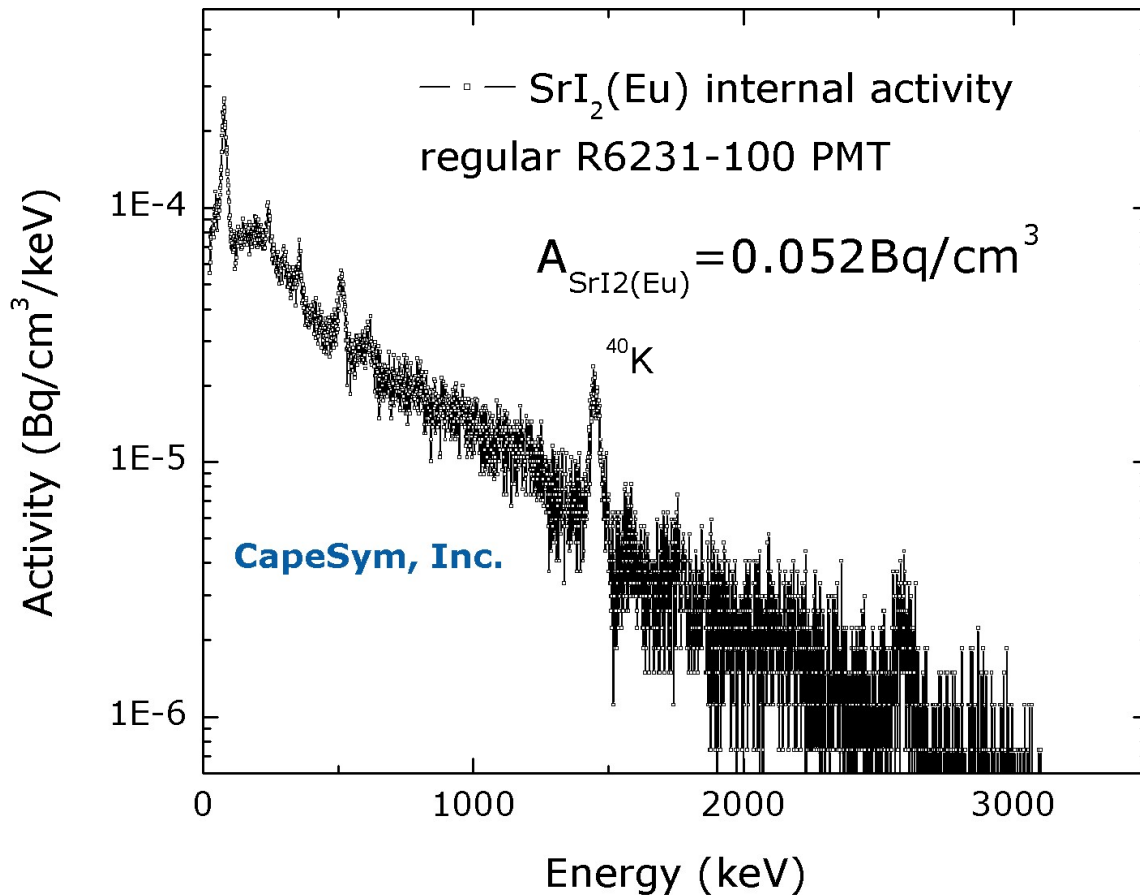


100 keV-10 MeV

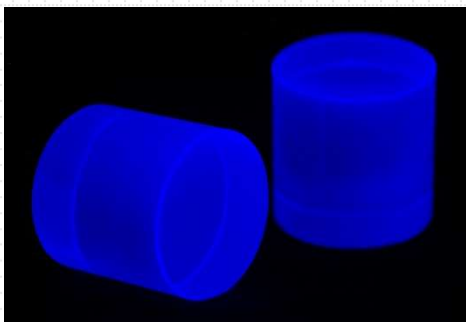


$\text{SrI}_2(\text{Eu})$ was originally proposed as a radiation detector by R. Hofstadter (U.S. Patent No. 3,373,279) in 1968. Due to unoptimized Eu concentration and longer than $\text{NaI}(\text{Tl})$ decay time, it did not draw significant attention at that time. In 2008 scientists from Lawrence Livermore National Laboratory (USA) spearheaded the development of $\text{SrI}_2(\text{Eu})$ into a leading edge radiation detector.

Because Strontium has a naturally stable isotopic composition, SrI₂(Eu) crystals enjoy the lowest intrinsic activity among high energy resolution scintillators available on the market. When compared to LaBr₃(Ce), intrinsic activity of SrI₂(Eu) is up to fifty times smaller[†].



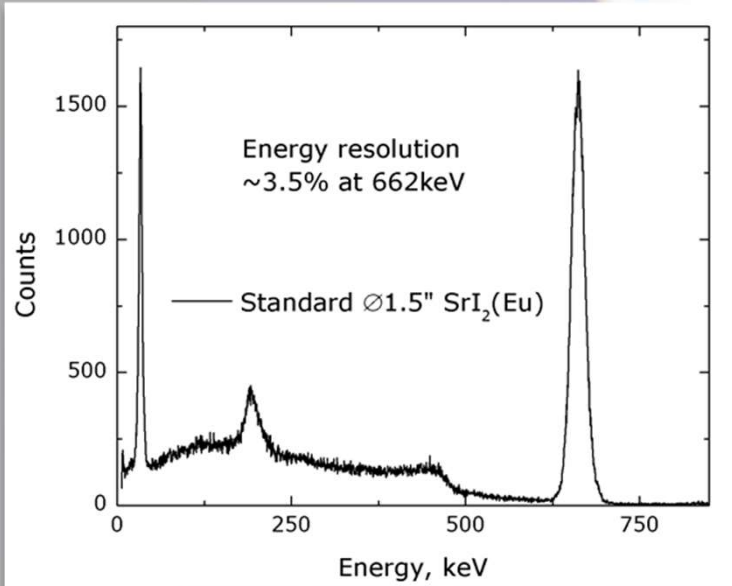
The above chart shows the internal activity spectrum of a standard 1.5" SrI₂(Eu) kit, as measured inside a Pb castle with 2 inch thick walls.



Strontium commonly occurs in nature, being the 15th most abundant element on Earth, estimated to average approximately 360 parts per million in the Earth's crust and is found chiefly as the sulfate mineral celestine (SrSO₄) and the carbonate strontianite (SrCO₃). Of the two, celestine occurs much more frequently in deposits of sufficient size for mining (from wikipedia.org). Although Strontium Iodide salt becomes corrosive when exposed to air, Strontium is fundamentally non toxic.

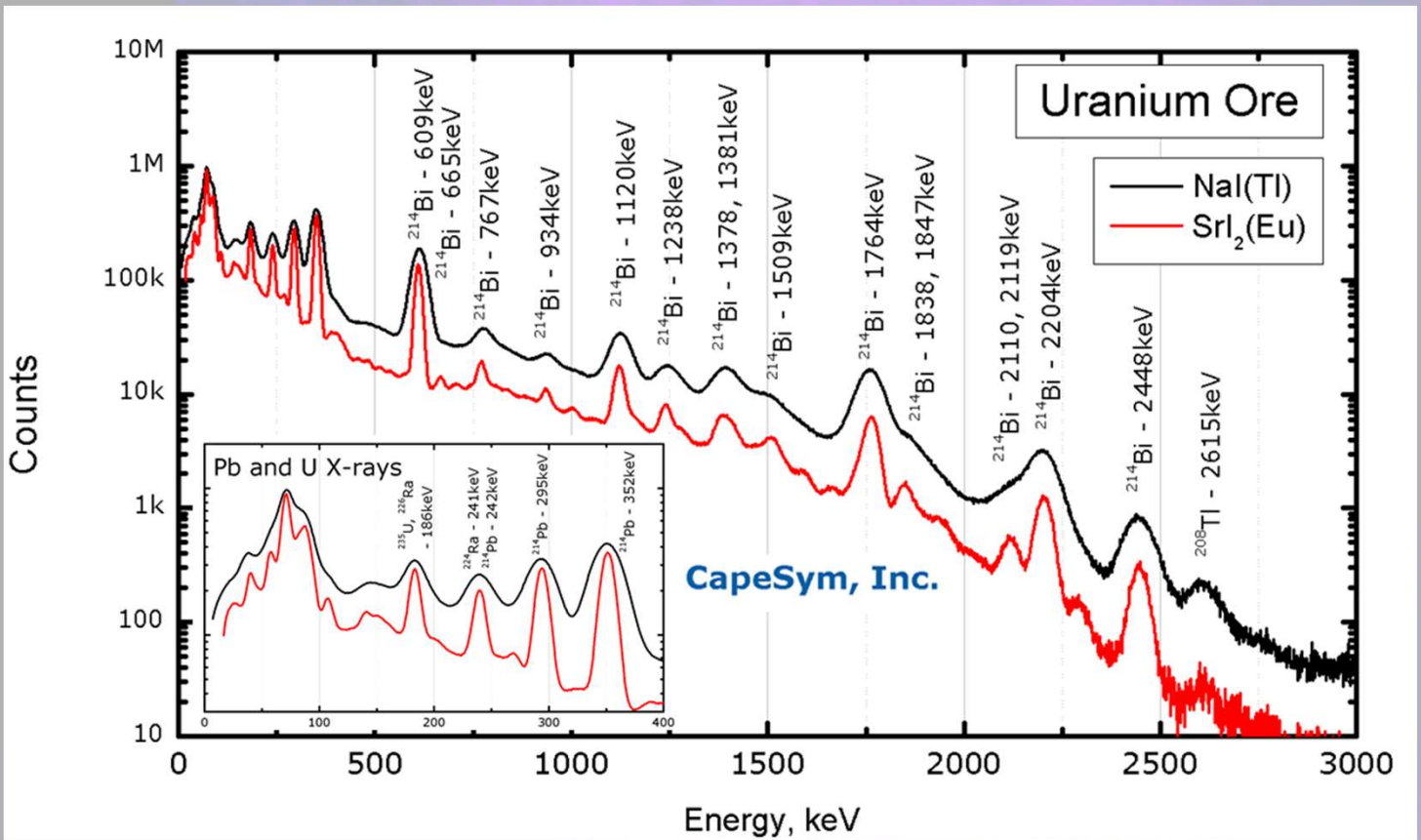
[†]Quarati et al. <https://cds.cern.ch/record/1537367/files/p427.pdf>

When $\text{SrI}_2(\text{Eu})$ crystals are properly encapsulated, coupled to the photodetector and light collection is optimized, the typical energy resolution is from 3.0% to 3.5% at 662keV and from 2.0% to 2.5% at 1332keV.



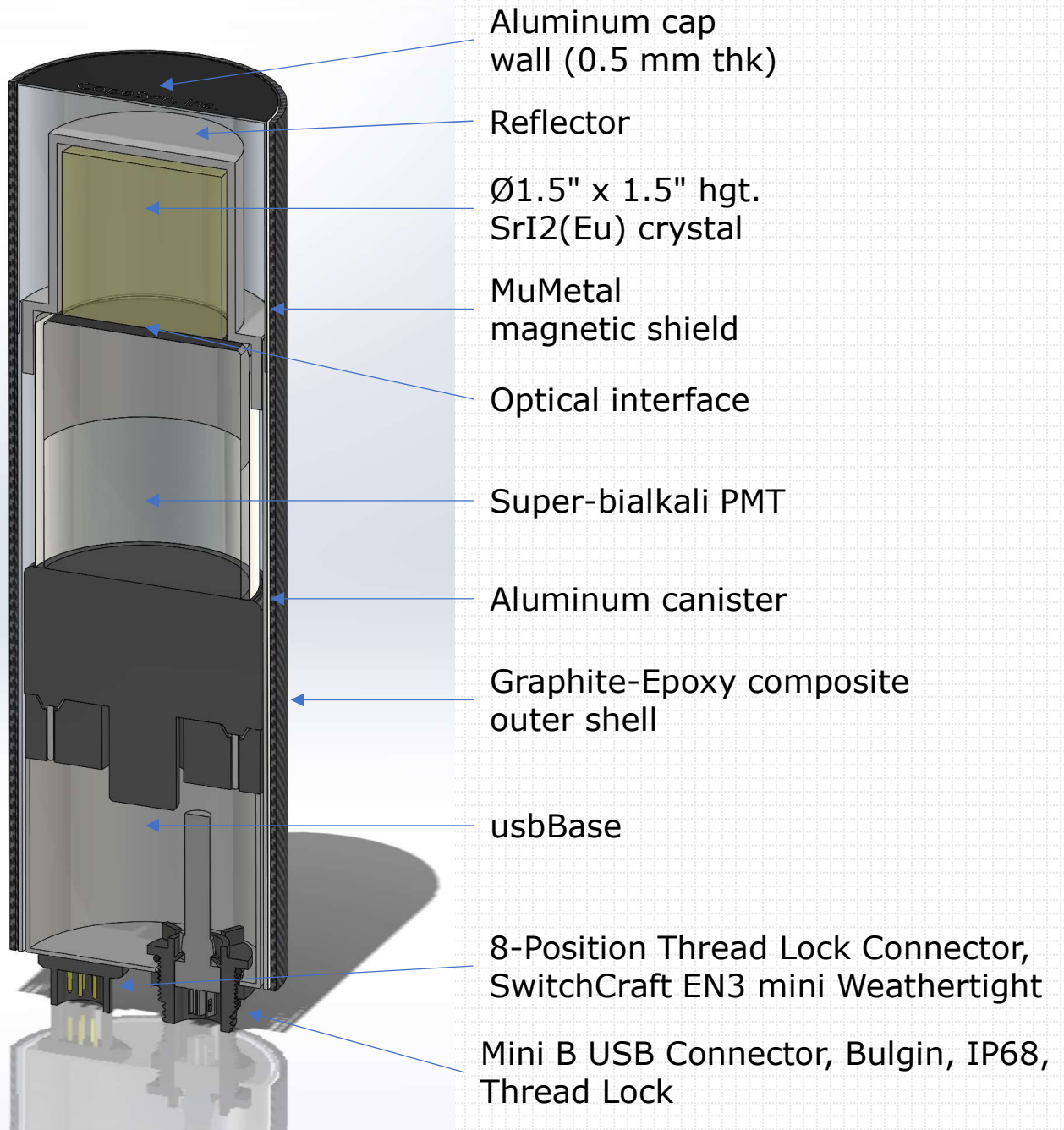
Typical uncorrected[†] energy resolution for CapeSym's $\text{SrI}_2(\text{Eu})$ kit at 662keV:

- Ø1.0" - 3.2±0.3%**
- Ø1.5" - 3.5±0.4%**



[†]Digital correction options are available upon request

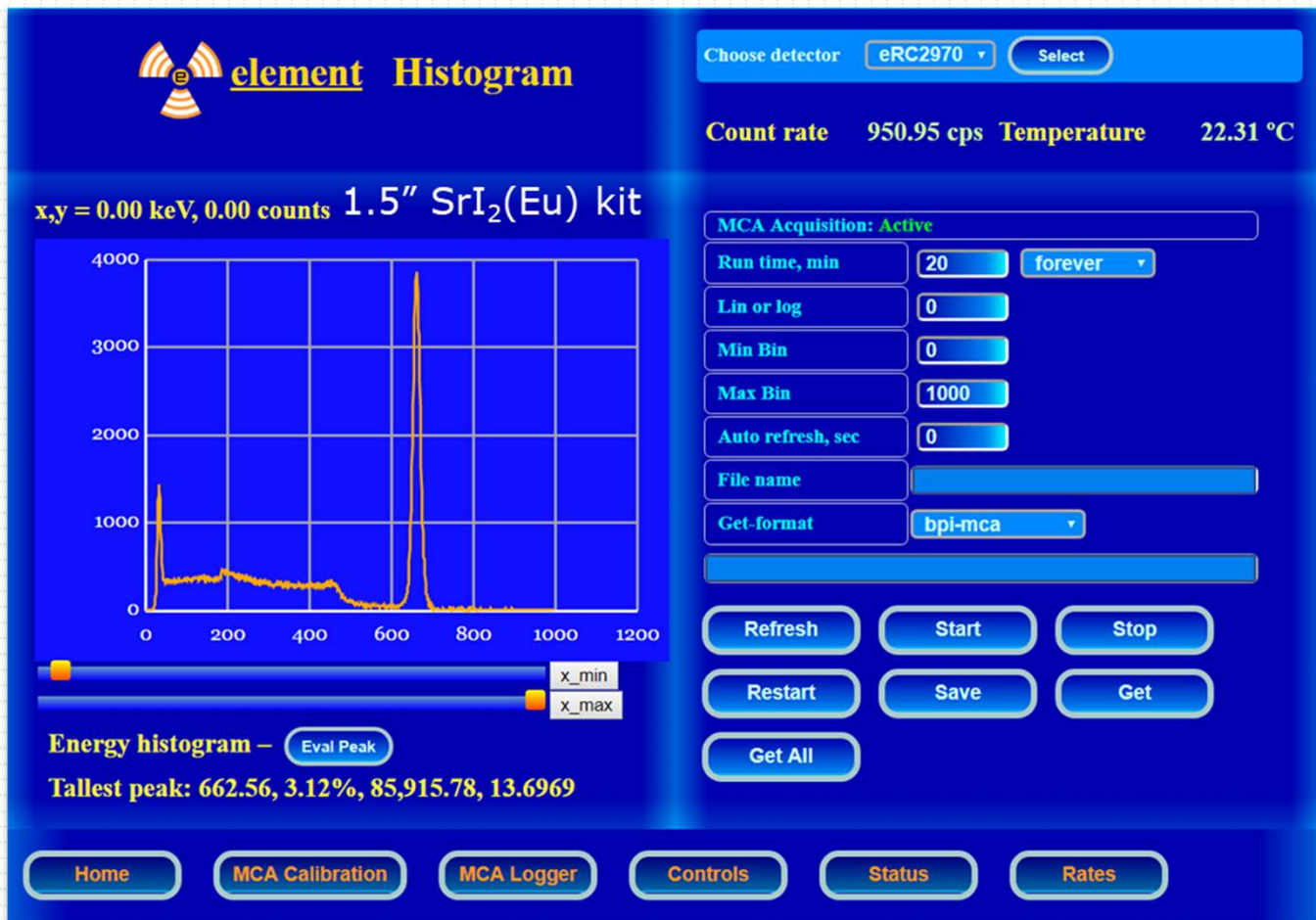
CapeSym's plug-and-play SrI₂(Eu) developer's kit makes high-energy resolution gamma spectroscopy easy. It consists of a high performance SrI₂(Eu) scintillation crystal coupled to a PMT, plug-on digital MCA with high voltage (usbBase from Bridgeport Instruments) and browser-based GUI. It can be used as a stand alone spectrometer, or as an OEM building block.



Dimensions Ø63.50mm x 197mm without connectors

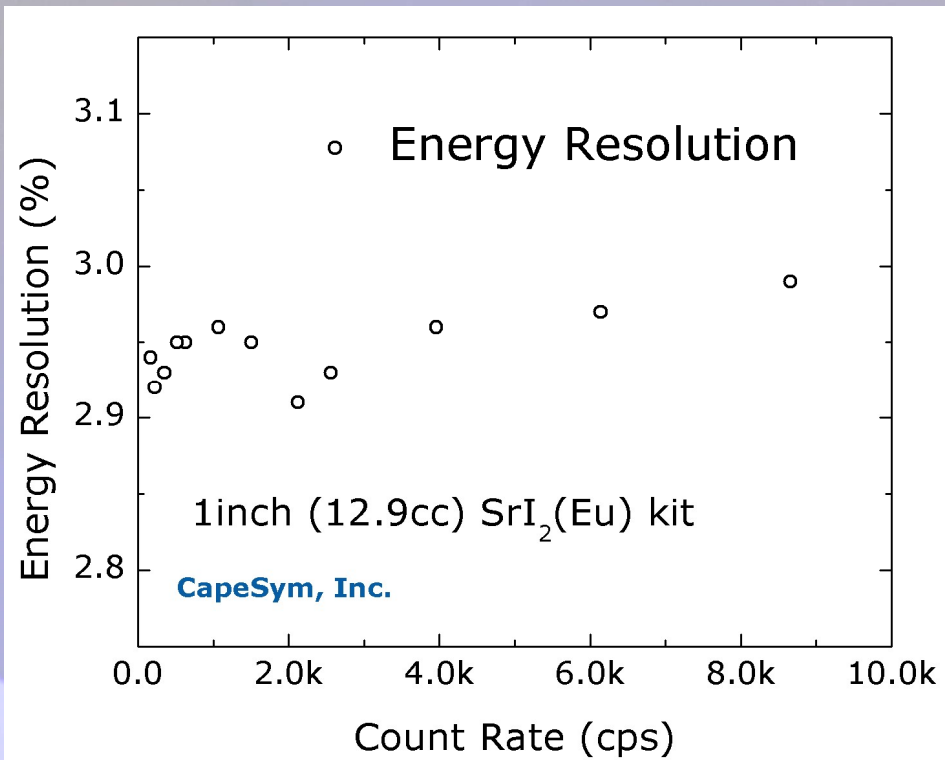
Main features of the developer's kit:

- USB-powered and controlled
- Web-browser base GUI
- Open source API in Python and C++
- Energy resolution $\sim 3.0-3.5\%$ at 662keV
- Low intrinsic activity
- High stopping power
- 30keV to 4MeV energy range
- -30 C to +50 C operation temperature
- Digital pulse-shape acquisition capabilities

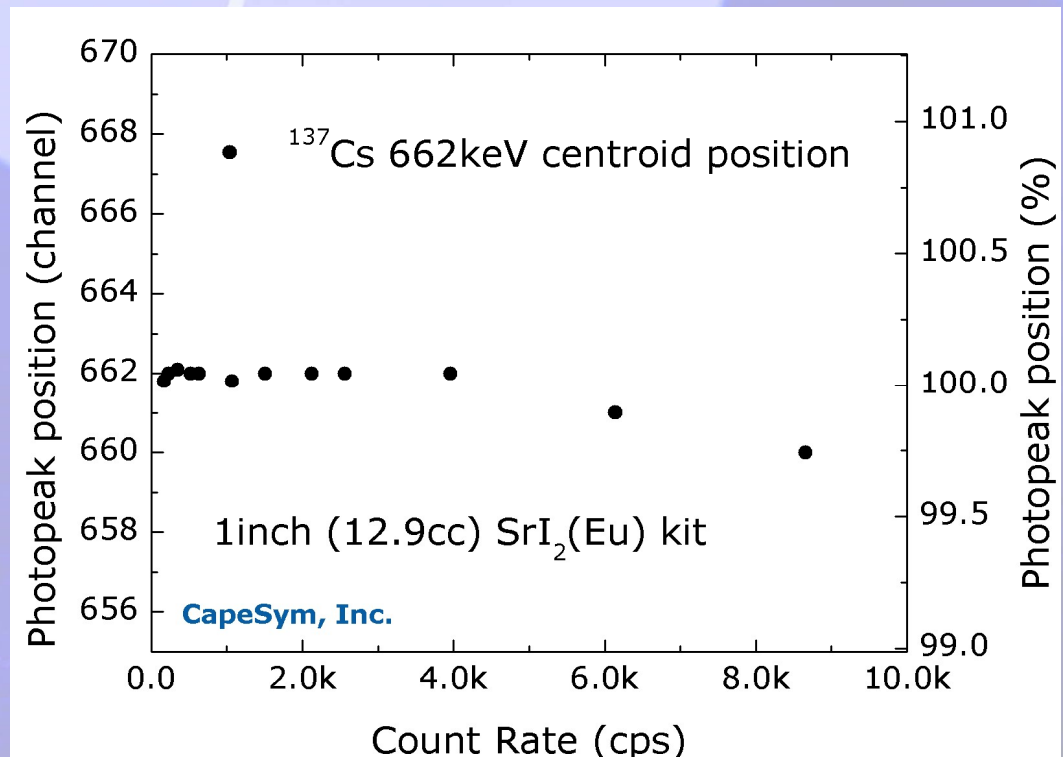


For digital data acquisition and analysis usbBase from Bridgeport Instruments is used. The usbBase consists of an eMorpho multi-channel analyzer and an integrated high voltage generator and divider to power the PMT. More information available at <http://www.bridgeportinstruments.com>

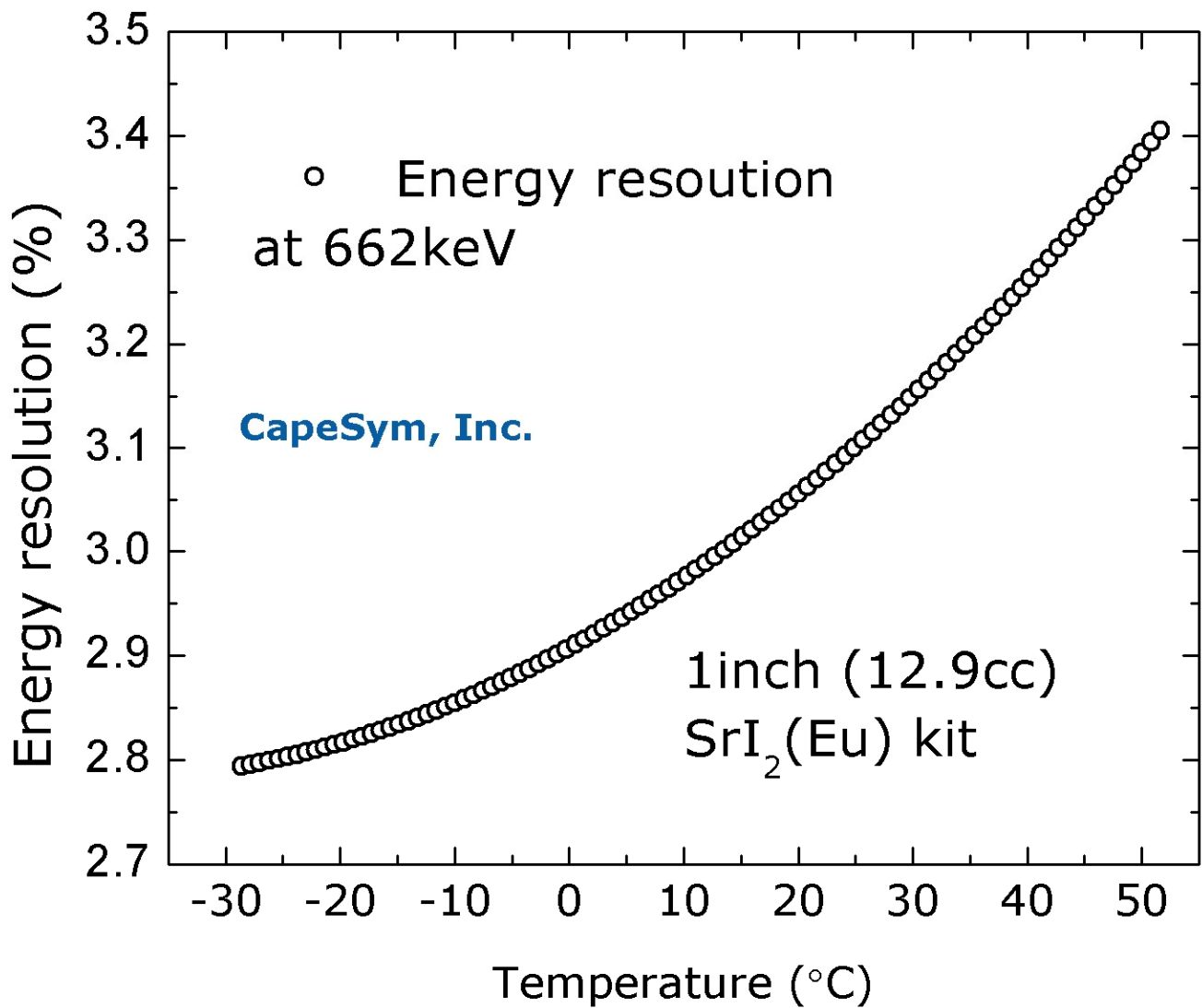
SrI₂(Eu) developer's kit is a perfect solution for high-sensitivity radiation detection up 10,000 counts per second.



Decay time of SrI₂(Eu) crystals is size and shape dependent and ranges from 1 to 3μs on average. Typically integration time 15 to 25μs is required to achieve optimum energy resolution.



Our kit is fully functional in the temperature range from -30°C to $+50^{\circ}\text{C}$ and can tolerate temperature changes with a ramp rate up to $10^{\circ}\text{C}/\text{hour}$. Performance of every kit delivered to the customer is measured in a broad temperature range to ensure reliability and quality of performance.



The coldest place on Earth is currently located in Antarctica, at the Russian Antarctic station Vostok. On July 21, 1983, this station recorded a temperature of -89.2°C (-128.6°F). This is the lowest naturally occurring temperature ever recorded on Earth. The standard measuring conditions for temperature are in the air, 1.5 meters above the ground, and shielded from direct sunlight. The highest reliably recorded temperature on Earth is 54.0°C (129.2°F), it was recorded both in Death Valley, California on 20 June 2013, and in Mitribah, Kuwait on 21 July 2016. (from wikipedia.org)

