

Environmental & Low-Background Monitoring

Trace-level activity measurement in soil, water, air, and foodstuffs demands scintillators that contribute almost nothing to the background count themselves. ScintIQ detectors based on **CeBr₃**, **Nal(Tl)**, and **SrI₂(Eu)** are configured specifically for this class of work: high light yield for good peak resolution, low intrinsic radioactivity, and enough energy resolution to separate closely spaced environmental nuclides without ambiguity.

CeBr₃

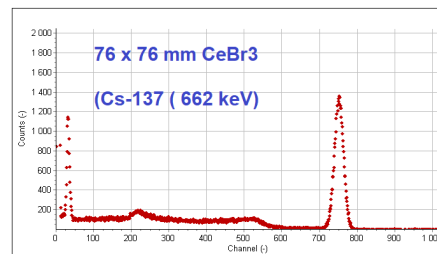
Nal(Tl)

SrI₂(Eu)

Trace Activity

Low Background

High Resolution



Measured: Cs-137 spectrum from a 76 x 76 mm CeBr₃ crystal, the 662 keV photopeak at 4 percent FWHM (CeBr₃ datasheet).

APPLICATION BRIEF · SCINTIQ CUSTOM SCINTILLATION DETECTORS · dc-62023201

The Measurement Challenge

Environmental gamma spectroscopy operates at the margins. Samples arrive with low specific activity, and the detector itself must not mask what you are trying to find. Any scintillator containing lanthanum carries a known contaminant: La-138, a naturally occurring radioactive isotope that produces a 1436 keV gamma line from its electron-capture branch and a 789 keV gamma line from its beta branch, which can overlap with environmental lines of interest. The same concern applies, at lower levels, to other materials with natural radioactive chains.

Resolution matters too. Common environmental nuclides cluster together in energy. Cs-137 is at 662 keV. Ba-133 peaks near 356 keV. Ra-226 and its daughters span several lines between 186 keV and 609 keV. A detector with poor resolution smears these into a single unresolved mound. A detector with intrinsic background adds phantom peaks that take statistical effort to subtract. The ideal material is bright, clean, and capable of separating lines only a few tens of keV apart.

Three ScintIQ materials cover this application well, each with its own place in the design space.

Recommended ScintlQ Materials

BEST RESOLUTION, ZERO LA-138

CeBr₃

CeBr₃ delivers 4% energy resolution at 662 keV against roughly 7% for NaI(Tl) at the same energy. Because it contains no lanthanum it carries no La-138 background, and its own Ac-227 contribution is 0.002 counts per second per cubic centimeter inside a 100 mm lead shield. Light output is approximately 60,000 photons per MeV, with a relative photoelectron yield of about 130 on a bialkali PMT (NaI(Tl) = 100), and the fast 18 to 25 ns decay constant supports high count-rate work. Density is 5.23 g/cm³. It is hygroscopic and requires hermetic encapsulation, which ScintlQ housings provide as standard. For laboratories or field stations where the La-138 interference of LaBr₃(Ce) is unacceptable, CeBr₃ is the preferred choice.

HIGH THROUGHPUT, PROVEN WORKHORSE

NaI(Tl)

NaI(Tl) remains the reference material for environmental counting. Its light yield (defined as 100 on the relative scale) is very high, density is 3.67 g/cm³, and emission peaks at 415 nm for straightforward PMT or SiPM coupling. Resolution at 662 keV is approximately 7%, adequate for most regulatory monitoring tasks. Large crystal sizes are achievable, which matters when sample geometry requires a wide detection solid angle. For standard gamma-spec counting of soil and water samples against established regulatory frameworks, NaI(Tl) offers the best combination of cost, availability, and validated methodology.

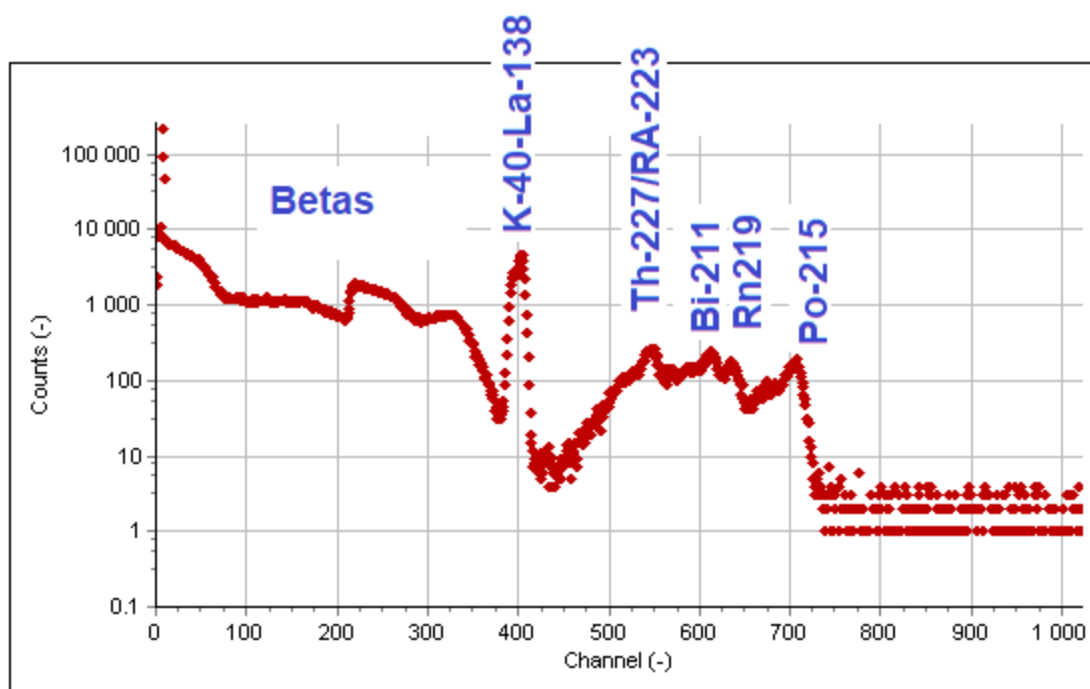
HIGHEST LIGHT YIELD, EXCELLENT RESOLUTION

SrI₂(Eu)

SrI₂(Eu) achieves energy resolution of about 3.5% at 662 keV (3.4% measured on a 38 x 38 mm crystal) with a relative photoelectron yield of 120 to 140 and a density of 4.6 g/cm³. Its slower decay (1-5 microseconds) makes it unsuitable for very high count rates, but for low-background counting applications where sample throughput is secondary to spectral clarity, SrI₂(Eu) separates lines that NaI(Tl) cannot resolve. It is hygroscopic and requires the same sealed housing approach as CeBr₃ and NaI(Tl). SrI₂(Eu) is the choice when the measurement question demands the best resolution available without lanthanum and without HPGe.

Table 1.

Property	CeBr ₃	NaI(Tl)	SrI ₂ (Eu)
Density (g/cm ³)	5.23	3.67	4.6
Emission peak (nm)	370	415	450
Decay constant	18-25 ns	0.23 us	1-5 us
Relative light yield (NaI = 100)	~130	100	120-140
Energy resolution at 662 keV	4%	~7%	~3.5%
Intrinsic radioactivity	No La-138; Ac-227 at 0.002 c/s/cm ³ (shielded)	None stated	None stated
Hygroscopic	Yes	Yes	Yes
Refractive index	2.09	1.85	1.85



■ **MEASURED** **Figure 1.** The intrinsic background of a LaBr₃(Ce) crystal, with the La-138 region and actinium-chain daughters labeled. This self-activity is exactly what CeBr₃ avoids by containing no lanthanum.

Typical Measurement Scenarios

ScintIQ environmental detectors are deployed across a range of monitoring contexts. Regulatory compliance surveys use NaI(Tl) because the methodology is established and large crystal sizes improve sensitivity for diffuse sources. Research programs measuring post-incident fallout and trace radionuclides at the limit of scintillator sensitivity use CeBr₃, where the cleaner spectrum reduces the uncertainty introduced by background subtraction; work at sub-becquerel-per-kilogram levels is HPGe territory. Separating closely spaced natural uranium and thorium series lines is where SrI₂(Eu) earns its place.

Common use cases for these detectors include:

- Soil and sediment gamma surveys for Cs-137 and naturally occurring radioactive materials (NORM)
- Water sampling for Ra isotopes, I-131, and other fission products
- Air filter analysis for particulate radioactivity after nuclear events or routine stack monitoring
- Food and agricultural commodity assay under international regulatory standards (Codex Alimentarius and EU food safety limits)
- Marine sediment and seawater surveys for oceanographic tracer studies
- Low-background laboratory counting systems using underground or shielded detector arrangements

Detector Configuration Notes

All three materials are hygroscopic and are supplied in hermetically sealed aluminum or stainless steel housings with optical coupling to the readout device. ScintIQ crystals are available with PMT or SiPM readout. SiPM readout suits compact field-deployable systems and low-voltage operation. PMT readout provides established performance and direct compatibility with existing spectroscopy electronics.

For underground or heavily shielded laboratory installations, radiopure construction options are available. Contact Berkeley Nucleonics for housing material specifications and low-background options. Crystal dimensions are configurable; state your geometric constraints and detection efficiency target when requesting a quote.

ScintIQ readout electronics

Berkeley Nucleonics offers matched MCA and preamplifier electronics including the bMCA (Ethernet and USB variants) and the TOPAZ-HR digital MCA. These integrate directly with ScintIQ detector assemblies for a complete measurement system.

Talk to an Engineer

Environmental monitoring applications vary widely in geometry, shielding, count rate, and required sensitivity. Berkeley Nucleonics engineers work with customers to specify crystal dimensions, housing materials, readout electronics, and calibration standards appropriate for the measurement objective.

Contact us at info@berkeleynucleonics.com or call 800-234-7858 to discuss your application.

Additional material and detector data sheets:

[CeBr3 Data Sheet](#) · [NaI\(Tl\) Data Sheet](#) · [SrI2\(Eu\) Data Sheet](#)

ScintIQ crystals are grown and finished with our long-standing scintillation partner in the Netherlands (Scionix Holland).

Berkeley Nucleonics Corp.

Test, Measurement and Nuclear Instrumentation since 1963
For details: info@berkeleynucleonics.com or 800-234-7858

Application Brief

ScintIQ Custom Scintillation Detectors | dc-62023201