SCIONIX

Application Note

^{6}LiI(Eu) thermal neutron scintillation detectors

Thermal neutron detection via nuclear reaction :

$$^{6}_{3}\mathrm{Li} + ^{1}_{0}\mathrm{n} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{3}_{1}\mathrm{H} + Q \; (Q = 4.78\ \mathrm{MeV})$$

Since the Helium atom and the triton are both particles with a limited range in the scintillator, a thermal neutron interaction results in a peak in the pulse height spectrum.

Density	4,1 g/cc
Emission wavelength	440 nm
Effective decay time	1.4 µs (neutrons and gammas)
High neutron peak position	> 3.6 MeV
Photoelectron yield	30-35% of NaI(Tl)
6-Li enrichment	> 96%

LiI(Eu) crystal under daylight

LiI(Eu) crystal under UV light

- 3 mm LiI(Eu) stops 90% of thermal neutrons
- Rugged crystal (> 20°C temperature change per hour allowed)
- Excellent neutron / gamma discrimination (neutron peak > 3.6 MeV)
- Neutron peak resolution < 7% FWHM (PMT readout)

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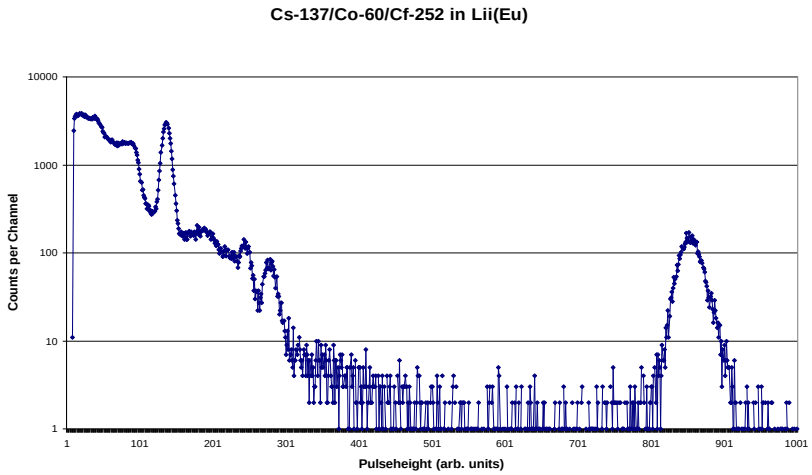
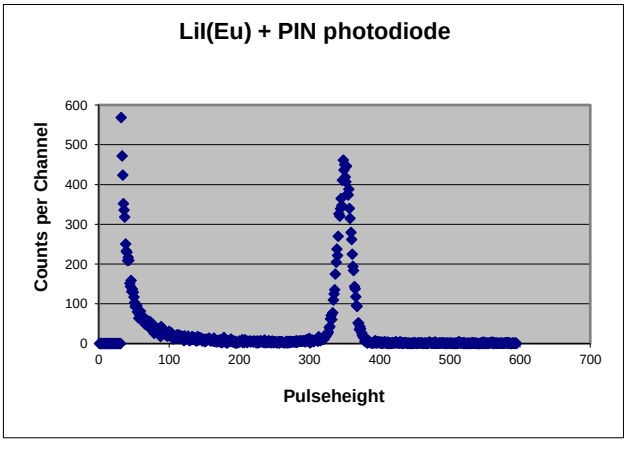


Pulse height spectrum showing the presence of the thermal neutron peak relative to the Cs-137 and Co-60 interactions. The thermal neutron peak is located at 4 MeV. The spectrum shows an excellent neutron / gamma separation.

LiI(Eu) detectors can be manufactured in many different geometries. Since the decay time for neutrons is essentially different from other scintillation crystals, it is possible to combine LiI(Eu) crystals to other scintillators in phoswhich geometries. By means of digital pulse shape discrimination techniques neutron and gamma interaction can be separated.

Photodiode readout

It is possible to read out LiI(Eu) crystals using PIN photodiodes. Such a detector is rugged and is operated at low voltage. The same properties for PMT readout apply



See for example REF. IEEE Trans. Nucl. Sci., vol. 55, no. 3, pp. 1413-1419, 2008.

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