LiCAF
for Neutron Detection

Eu or Ce doped $LiCaAlF_6$
(*Ce:LiCAF, **Eu:LiCAF)
are novel thermal-neutron scintilators.

*T. Yanagida et al., Opt. Mater., 32, 311 (2009).
**T. Yanagida et al., Opt. Mater., 33, 413 (2011).

Specific Features of LiCAF

- n/γ discrimination
  Low γ sensitivity
  PSD compatible (Ce:LiCAF)
- Non-hygroscopic
- Large size available
- Transparent
- High light yield (Eu:LiCAF)

Applications

- ^{3}He alternative detectors for:
  Homeland security
  Survey meter
  Neutron Diffraction
- Neutron imaging devices

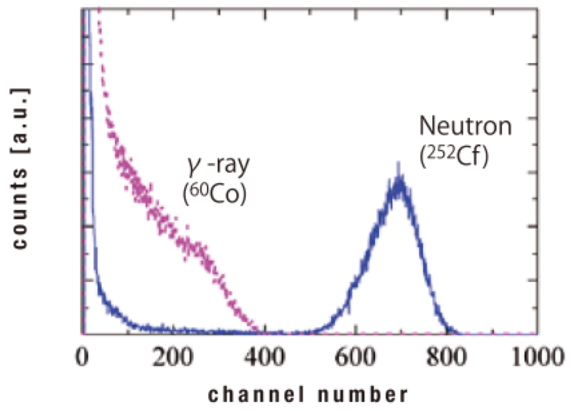
Available Size of LiCAF

Disk (4″ dia. x 10 mmt)

Array (2 × 2 × 4 mm^3, 20 × 20 pixels)

Available in various sizes, please contact us by e-mail.
(ff@tokuyama.co.jp)

Ce:LiCAF



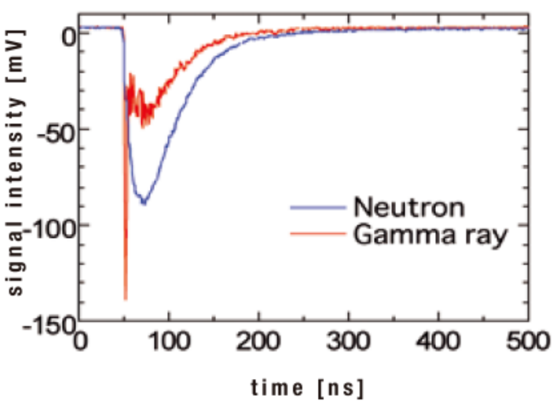
Low γ sensitivity and sufficient α/β ratio of Ce:LiCAF allows simple pulse height discrimination to reduce the γ background.

Fast response meets the requirement of high count rate operation and/or timing resolution.

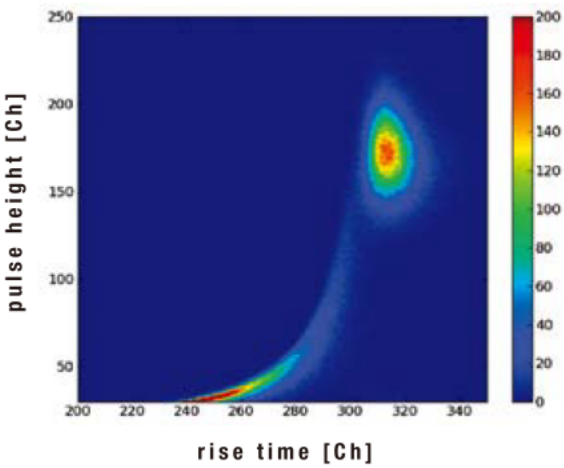
High transparency of the crystal makes possible a detector not only for thermal neutrons but also for epithermal neutron by the use of a thick scintillator.

Source : "Thermal neutron detection properties of Cerium doped $LiCaAlF_6$ single crystals", J. Iwanowska, et al., Nucl. Instr. and Meth. A, in press, doi:10.1016/j.nima.2010.09.182 (2011)

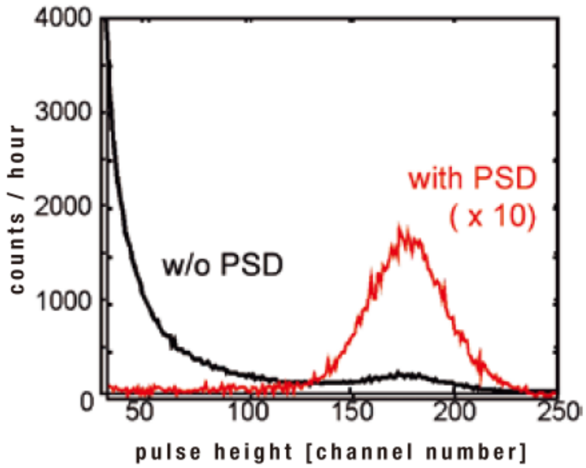
Gamma Suppression by Pulse Shape Discrimination



The pulse height spectra are separeted by the pulse shape discrimination using the rise time of the integrated signal pulse. In the separated neutron spectrum, the γ-ray events were effectively suppressed without the loss of neutron events. The pulse shape discrimination was confirmed to be useful to use the Ce:LiCAF neutron scintillators under the condition where massive high-energy γ-rays exist.

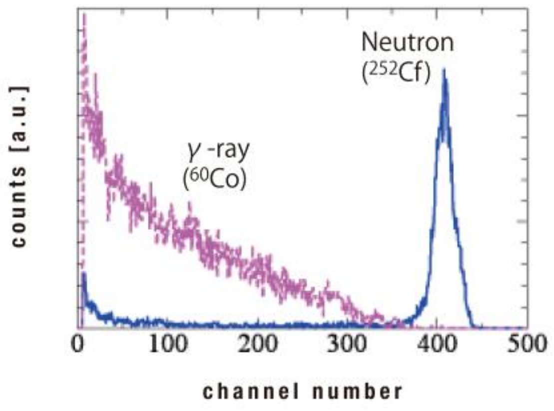


Two-dimensional plot of pulse height versus rise time



Pulse Height Spectra Under Strong γ Field
Source: "Neutron-gamma discrimination based on pulse shape discrimination in a $Ce:LiCaAlF_6$ scintillator"
A. Yamazaki, K. Watanabe, et al., Nucl. Instr. and Meth. A, 652 (2011) 435-438, doi:10.1016/j.nima.2011.02.064 (2011).

Eu:LiCAF



Eu:LiCAF, which possesses very bright scintillation at PMT-friendly wavelengths and is non-hygroscopic, is most suitable for neutron monitoring applications.

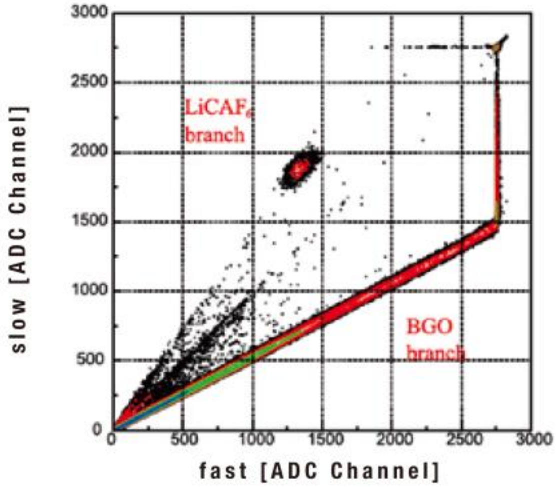
Furthermore, a phoswich-type detector consisting of Eu:LiCAF a and gamma-sensitive scintillator provides excellent η/γ discrimination.

Source : "Basic study of Europium doped $LiCaAlF_6$ scintillator and its capability for thermal neutron imaging application ", T. Yanagida, et al., Opt. Mater. ,33, 1243-1247 (2011).

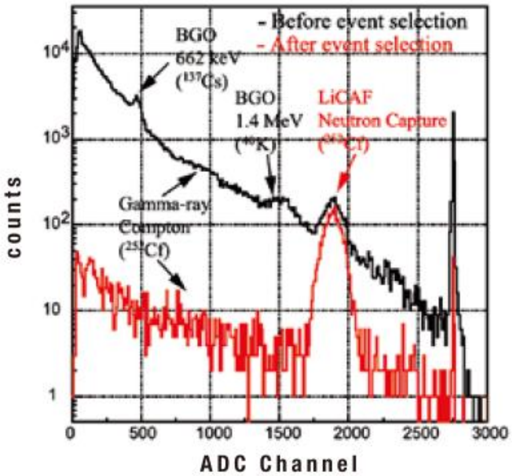
Phoswich Detector for Neutron Astrophysics

Eu:LiCAF was used for PoGoLite (Polarized Gamma-ray Observer) project with the aim to measure polarization of soft gamma rays. Since neutrons are most significant background, Eu:LiCAF scintillator was equipped to measure the neutron flux.

Phoswich detector consisting of Eu:LiCAF and BGO demonstrated excellent n/γ discrimination during ground testing and this detector was used in the pathfinder flight of PoGoLite experiment with a large Swedish balloon which was launched from Esrange Space Center. Atmospheric neutrons were successfully observed in July, 2011.



"fast"-"slow" diagram for ^{252}Cf and ^{137}Cs.



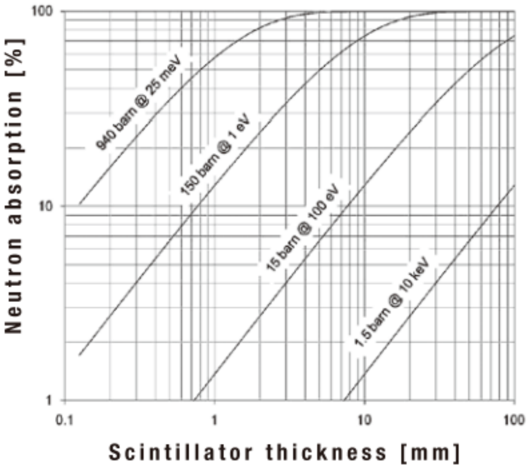
Neutron events selection by phoswich detector.
Source: "A Thermal-Neutron Detector with a Phoswich System of $LiCaAlF_6$ and BGO Crystal Scintillators onboard PoGOLite", H. Takahashi et al., IEEE NSS MIC Conference record, 32-37 (2011).

Physical and Scintillation Properties of LiCAF

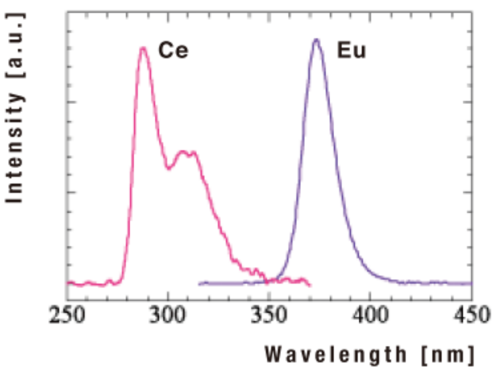
^{6}Li content : 9.1 x 10^{21} atoms/cm^3
Density : 2.99 g/cm^3
Effective Z : 15

	(Ce:LiCAF)	(Eu:LiCAF)
Light yield (photons/neutron)	~5,000	~40,000
Decay constant (nsec)	40	1,600
Luminescence wavelength (nm)	280 - 320	360 - 390
Transparency (at 10 mm thickness)	> 90%	> 90%

Values are not for specifications



Neutron Absorption of LiCAF



Luminescence spectra of LiCAF

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