

BrilLanCe[™]380 [LaBr₃(Ce)]¹ is a transparent scintillator material that offers the best energy resolution, fast emission and excellent linearity. It has higher light output than NaI(Tl) and also better energy resolution.

The FWHM (full width at half maximum) for 1" diameter by 1" long, 2" diameter by 2" long and 3" diameter by 3" long crystals has been measured at 2.8%, 2.6% and 2.9% respectively. The energy spectrum for the 3" by 3" is shown in Figure 1. The material's superior energy resolution is most pronounced at energies above 100 keV when compared with NaI(Tl).

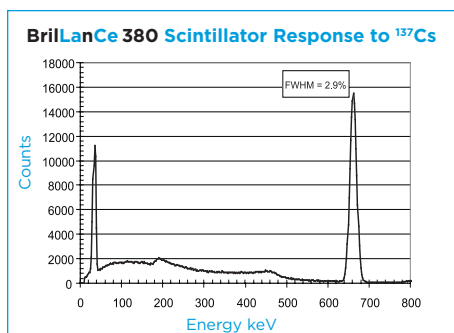


Figure 1. Pulse height spectrum

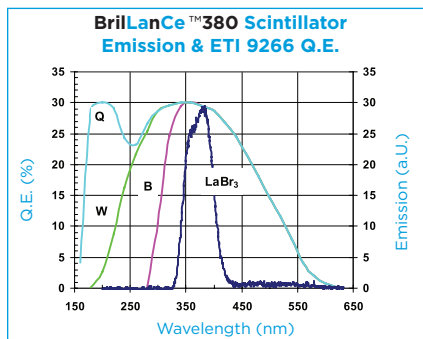


Figure 2. Scintillation emission spectrum of the BrilLanCe 380 crystal and Quantum Efficiency of a bi-alkali ET19266 PMT with (B)Borosilicate, (W)UV glass, and (Q)Quartz face plates (Q.E. data courtesy of Electron Tubes, Inc.)

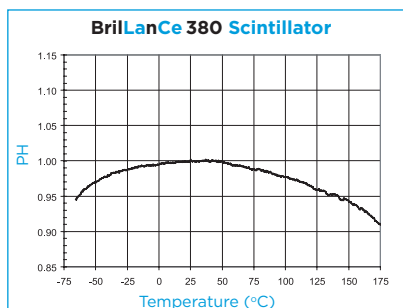


Figure 3. Temperature response. (The curve is for 12μs. The curve for 1μs is identical.)

The emission of scintillation light (Figure 2) is well within the wavelength range of standard photomultiplier tubes (PMTs) with borosilicate glass face plates (Curve B), which makes these standard PMTs suitable.

The light yield as a function of temperature was measured with ¹³⁷Cs excitation at two amplifier shaping times of 1μs and 12μs. The temperature of the PMT was maintained constant while the temperature of the scintillator was varied from -65°C to +175°C. Results are shown in Figure 3. This data indicates that around room temperature from 0°C to +55°C the light output of the BrilLanCe 380 crystal changes less than 1%, and the light output changes less than 5% in the range of -65°C to +140°C.

Properties

Density [g/cm ³]	5.08
Melting point [K]	1116
Thermal expansion coefficient [10 ⁻⁶ /°C]	8 along C-axis
Cleavage plane	<100>
Hygroscopic	yes
Wavelength of emission max [nm]	380
Refractive index @ emission max.	-1.9
Primary decay time [μs]	0.016
Light yield [photons/keVγ]	63
Photoelectron yield [% of NaI(Tl)] (for γ-rays)	165

BrilLanCe™380 Scintillation Material

Absorption Efficiency of BrilLanCe 380 [LaBr₃(Ce)]

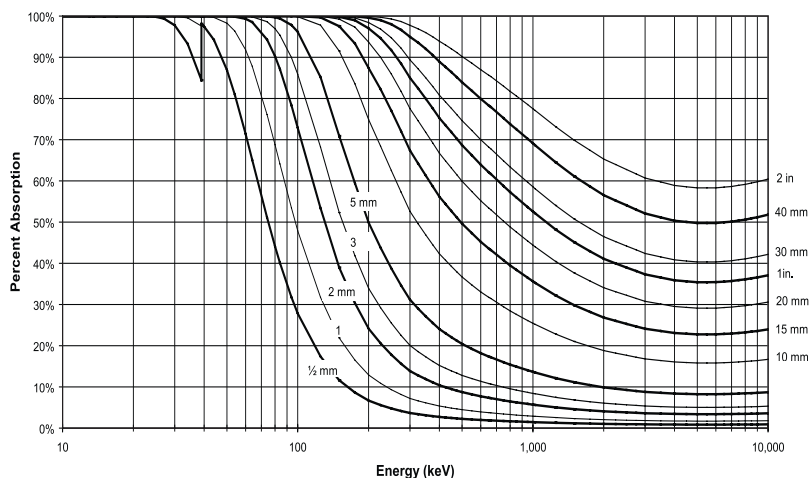


Figure 4. Gamma and X-ray absorption efficiency for various thicknesses of BrilLanCe 380 material. Data compiled by C. M. Rozsa (presented in Saint-Gobain Crystals' brochure "Efficiency for Selected Scintillators.")

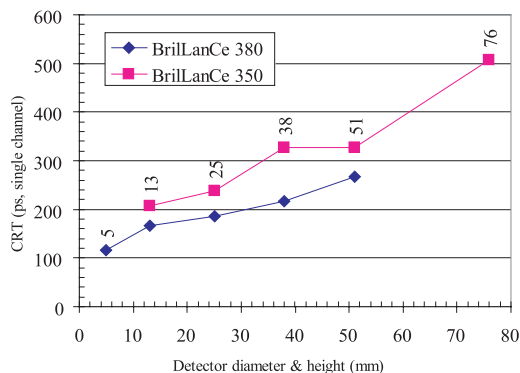
Refer to technical note "**BrilLanCe Scintillators Performance Summary**" for additional information on the following topics:

- Energy Resolution versus Energy
- Response versus Temperature
- Response versus Rate
- Coincidence Resolving Time
- Background
- Radiation Hardness
- Mechanically Robust

Users with questions about application details or with any residual concerns about ruggedness are invited to contact our office.

Representative coincidence resolving times (CRT) are shown below for various sizes of BrilLanCe 350 and BrilLanCe 380 detectors. The data was taken using two Photonis XP20Y0 PMTs gated on 511keV from ²²Na. The PMT serving as the STOP channel was coupled to the crystal to be measured and the other PMT was coupled to a dedicated START crystal, a 4x4x5mm BrilLanCe 380 crystal. Figure 5a shows that BrilLanCe 380 detectors have somewhat better timing than BrilLanCe 350.

Figure 5a. Coincidence Resolving Time (CRT) of BrilLanCe detectors as a function of the crystals' longest dimension measured with fast timing PMTs that have plano-concave face plates.



We also see the dependence on crystal size, slowing as crystals and light transit times become larger. Figure 5b shows the single channel CRT measured for a few geometries using a standard PMT with plano-plano face plate. This is an important point because it is possible to maintain the optimum performance of BrilLanCe crystals with standard PMTs. Note that the CRT does depend critically on the PMT; for example, the XP2060 38mm PMT gives much poorer performance than the larger PMTs.²

Figure 5b. Timing with BrilLanCe 380 Integrated Detector

Size (mm)*	CRT** (ns)	PMT Size (mm)	PMT*** Type
25x25	1.08	38	XP2060
38x38	0.36	51	R6231
51x51	0.45	56	XP5500
76x76	0.49	76	XP5300

* Diameter and length or right cylinder crystal.

** CRT is the single channel Coincidence Resolving Time.

*** These are standard PMTs with plano-plano phot cathode face plates.

¹ E. V. D. van Loef, P. Dorenbos, C. W. E. van Eijk, H.U. Gudel, K.W. Kraemer; *Applied Physics Letters*, 79, pp 1573-1575 (2001).

² Refer to Saint-Gobain Technical Note "BrilLanCe Scintillators: Performance Summary."

Protected under patents US7067816B2, US7250609B2, EP1257612B1*, EP1516078B1, - ZL03813659.7, UA75066C2

*This original patent was granted to Stichting Voor de Technische Wetenschappen. Inventors are P. Dorenbos, C. W. E. van Eijk, H.U. Gudel, K.W. Kraemer, E. V. D. van Loef. Technology is licensed to Saint-Gobain Cristaux & Detecteurs.



is a registered trademark of Saint-Gobain Ceramics & Plastics, Inc

Manufacturer reserves the right to alter specifications.

©2004-2016 Saint-Gobain Ceramics & Plastics, Inc. All rights reserved.

(08-16)

SAINT-GOBAIN

Saint-Gobain Crystals

www.crystals.saint-gobain.com