Moreover, by using position-sensitive solid-state photodetectors to measure the depth of interaction in the crystal, off-axis penetration effects can be nearly eliminated (Figure 4).

Scintillators with different decay times

By coupling scintillation crystals with significantly different light decay times such as BGO (300 nsec) and GSO (60 nsec),[111] or CsF (2.5 nsec) and BaF_2 (80% at 620 nsec and 20% at 0.8 nsec),[26] it is possible to determine the crystal of interaction by an analysis of the PMT pulse shape. However, multiple crystal interactions cause the slower detector to be chosen, even if both are involved.

To provide depth of interaction information as well as finer linear sampling, it has been recently proposed to use concentric rings of scintillation crystals having different light decay time.[112]

Advanced tomographs

Table 3 describes some advanced positron tomographs with an image resolution finer than 7 mm.

Table 3. Comparison[a] of positron tomographs with spatial resolutions finer than 7 mm fwhm

Institution	MGH Boston	NIRS Japan	CTI Knoxville	LBL Berkeley	Univ Penn
References	71-74	65,64	66	63	81,82
Detector Material	BGO	BGO	BGO	BGO	NaI(Tl)
Number of Rings	1	1	1-4	1	1
Number of Crystals	360	128	512[b]	600	6
Detector Ring Diam (cm)	46	26.5	100	60	85[c]
Patient Port Diam (cm)	28	13.5	65	30	50
Crystal Width (mm)	4	4	5.6	3	–
Crystal C-C Spacing (mm)	4.0	6.5	6.1	3.15	–
In-plane Resolution (mm)[d]	4.8	3	5	2.6[e]	6.5
Axial Resolution (mm)	10	5	18	5	13

[a] Count rate capabilities are not available and cannot be compared.
[b] per ring
[c] hexagonal
[d] FWHM of reconstructed point spread function near center of system
[e] A resolution of 2.4 mm is expected for the complete system.

Table 4 lists the three major contributions to spatial resolution at the center of a 60 cm diameter detector ring comprised of 3 mm wide BGO crystals, assuming that multiple crystal interactions are rejected. For positron emitters of low emission