Table 7.3.5.1. *Characteristics of some PSDs*

1D = one dimensional; 2D = two dimensional; *F*/ = flat; *C*/ = 1D curved; *X* = single crystal.

	Gas Resistance encoding 1D	Gas Resistance encoding 2D	Gas Multi-electrode 1D	Gas Multi-electrode 2D	Scintillation Anger camera 1D	Scintillation Anger camera 2D
Location	*F*/ MURR (USA)	*F*/ ORNL (USA)	*F*/ ILL (France) *C*/ CENG (France)	*F*/ ILL (France) *C*/ ILL (France)	*F*/ Jülich (FRG)	*F*/ ANL (USA)
Instrument reference	Powder (1)	SANS (2)	*F*/ Liquids (3) *C*/ Powder (4)	*F*/ SANS (3,5) *C*/ *X* (3)	Powder (6)	*X* (7)
Detection area (mm)	$l = 610$ (Ø = 25.4)	650×650	*F*/ $l = 162.5$ ($h = 70$) *C*/ $l = 2096$ or 80° ($h = 70$)	*F*/ 640×640 *C*/ 1300×80 or $64° \times 4°$	$l = 744$ ($h = 20$)	300×300
Cell size or pixel (mm)		10×10	*F*/ 2.54 *C*/ 2.62 or 0.1°	*F*/ 5×5 *C*/ 2.54×5	0.7	0.3×0.3
Resolution (mm)	2.5	10×10	*F*/ 3.2 *C*/ 2.6	*F*/ 5×5 *C*/ 3×6.6	2.5	2.7×2.7
Efficiency (%)	70 (1.3 Å)	90 (4.75 Å)	*F*/ 90 (0.7 Å) *C*/ 52 (2.5 Å)	*F*/ 75 (11 Å) *C*/ 85 (1.5 Å)	70 (1.2 Å)	80 (1.8 Å)

MURR: Missouri University Research Reactor, Columbia, Missouri, USA.
ORNL: Oak Ridge National Laboratory, Tennessee, USA.
ILL: Institut Laue–Langevin, Grenoble, France.
ANL: Argonne National Laboratory, Argonne, Illinois, USA.
CENG: Centre d'Etudes Nucléaires de Grenoble, Grenoble, France.

References: (1) Berliner, Mildner, Sudol & Taub (1983); (2) Abele, Allin, Clay, Fowler & Kopp (1981); (3) Institut Laue–Langevin (1988); (4) Roudaut (1983); (5) Ibel (1976); (6) Schaefer, Naday & Will (1983); (7) Strauss, Brenner, Chou, Schultz & Roche (1983).

7.3.6. Characteristics of detection systems

We shall present and comment on some characteristics of detectors plus electronic chains in operational conditions.

(*a*) *Intrinsic background* (*i.e.* with the reactor or neutron source shut down). The intrinsic background level is about 6 counts h^{-1} for an ^{3}He, 3 bar (1 bar = 10^5 Pa) detector (Ø 50 mm, *L* 100 mm) in operational conditions. Of course, it is very important to protect the low-level part of the amplifier from the discriminator and trigger by separating these two stages very carefully, and from electric and electronic parasites by using good ground connections. Additional parasitic effects might be produced by (i) high-voltage flashes in the detector or in dirty or deficient plugs, (ii) microphony, and (iii) particle emission by the detector walls (*e.g.* uranium impurities in aluminium, or activation).

(*b*) γ *discrimination*. The γ discrimination of an ^{3}He detector is said to be 10^{-8}. From our own experience, we can say that a pure ^{3}He detector is insensitive to a γ dose up to 10 mGy h^{-1} (1 rem h^{-1}). However, additional gases increase the γ-detection efficiency (Fischer, Radeka & Boie, 1983). For a good scintillator, the γ discrimination is of the order of 10^{-4} (Kurz & Schelten, 1983).

(*c*) *Stability*. Under good conditions, the gas-detector stability has been verified to be better than 3×10^{-4}/day and 10^{-3}/month. The stability of operational scintillators is probably about 10^{-3}/day but it is known to drift over longer periods of time.

(*d*) *Dead time and non-linear effects due to the count rate*. The gas detector has a dead time of 1–10 µs depending on the duration of the analogue pulse, which is fixed by the detector plus adapted electronic chain. The scintillator has a dead time about 10 times shorter, *i.e.* 0.2 to 1 µs. A rule of thumb is to keep the total dead time to less than 10% of the counting time, which fixes the maximum counting rate. This limits the effects of non-linearity of the dead time as a function of the counting rate. Non-linear effects in gas detectors are complex and due to (i) the distortion of the electrostatic field near the anode by the space charge, (ii) the decrease of the high voltage at the anode produced at high counting rates by the increased ionic current passing through the high-impedance filter, and (iii) the possible shift of the zero level of the charge preamplifier.

(*e*) *TOF requirements*. In a TOF experiment, it is important to know exactly the time and place of each neutron capture. The thickness of the detector must be as small as possible in relation to the total flight path (scintillators are roughly 10 times thinner than gas detectors). The delay between the neutron capture and the logic pulse given by the amplifier gives an additional error. Again, the scintillator is about 10 times faster.

 references