12. PARTICLE DETECTORS

Updated 1992 by D.G. Coyne, R.W. Fast, R.D. Kephart, B. Mansoulie, H.F.W. Sadrozinski, H.G. Spieler, and C.L. Woody

This is an abridgement of the discussion given in the full *Review of Particle Properties* (the "full *Review*").

In this section we give various parameters for common detector components. The quoted numbers are usually based on typical devices, and should be regarded only as rough approximations for new designs. A more detailed discussion of detectors can be found in Ref. 1. In Table 12.1 are given typical spatial and temporal resolutions of common detectors.

Table 12.1: Typical detector characteristics.

Detector Type	Accuracy (rms)	Resolution Time	Dead Time
Bubble chamber	10 to 150 μm	1 ms	50 ms[a]
Streamer chamber	300 μm	2 μs	100 ms
Proportional chamber	$\geq$ 300 μm[a]	50 ns	200 ns
Drift chamber	50 to 300 μm	2 ns[a]	100 ns
Scintillator	—	150 ps	10 ns
Emulsion	1 μm	—	—
Silicon strip	$\frac{\text{pitch}}{3\text{ to }7}$[a]	[a]	[a]
Silicon pixel	2 μm[a]	[a]	[a]

[a] See full *Review* for qualifications and assumptions.

12.1. Plastic scintillators

The photon yield in the frequency range of practical photomultiplier tubes is ≈ 1 photon per 100 eV of charged particle ionization energy loss in plastic scintillator [2]. One must take into account the light collection efficiency ($\lesssim 10\%$ for typical 1-cm-thick scintillator), the attenuation length (1 to 4 m for typical scintillators [3]), and the quantum efficiency of the photomultiplier cathode ($\lesssim 25\%$ when folded with a typical scintillator emission spectrum).

12.2. Inorganic scintillators

Table 12.2 gives a partial list of commonly-used inorganic scintillators in high-energy and nuclear physics [4–11]. These scintillating crystals are generally used where high density and good energy resolution are required. In a crystal which contains nearly all of the energy deposited by an incident particle, the energy resolution is determined largely, but not totally, by the light output. The table gives the light output of the various materials relative to NaI, which has an intrinsic light output of about 40000 photons