6 - 1 Development of A Position Sensitive CsI(Tl) Crystal Array

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The thallium-doped cesium iodide (CsI(Tl)) scintillator is widely used in the fields of nuclear physics, nuclear medicine, safety inspection, for the characteristics of high density, high luminous efficiency, high radiation-hardness, low cost, etc. As shown in Fig. 1, a position-sensitive CsI(Tl) crystal array, with the pixels size of 2.0 mm × 2.0 mm and the whole cross section size including the light reflective material of 49.9 mm × 51.2 mm, coupled with the multi-anode position sensitive photomultiplier tube (PS-PMT), Hamamatsu H8500C, has been developed at the Institute of Modern Physics. The thickness of light reflective material between the pixels is 0.3 mm. An effective and economical readout circuit based on discretized positioning circuit (DPC) bridge was designed for the 64-channel multi-anode flat panel PSPMT[4].

Fig. 1 (color online) The CsI(Tl) crystal array with pixels of 2.0 mm × 2.0 mm.

Fig. 2 (color online) Horizontal (a) and vertical (b) slices of a flood field irradiation image with 2.0 mm × 2.0 mm pixel array.

Fig. 3 Two-dimensional images of a flood field irradiation with 2.0 mm × 2.0 mm pixel array.

The horizontal and vertical position resolutions are 0.86 and 0.80 mm respectively. The results show that the low cost CsI(Tl) crystal array could be applied in the fields of medical imaging and high-resolution gamma camera (Figs. 2 and 3).
6 - 2 Ion Pulse Ionization Chamber for Online Measurements of the Radon Activity Concentration

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Radon and its decay daughters are one of the main sources of natural radiation to humans and the second leading cause of lung cancer after smoking\cite{1}. In this paper, a new multi-wire impulse ionization chamber type intended for continuous airborne radon activity measurements is described.

To reduce the measurement uncertainty and the limited statistics of the count rate, a low-level radon reference chamber with specific measurement equipment was set up. Internal structure diagram of detector is shown in Fig. 1. It is composed of three parallel printed boards and the sensitive volume of 13.25 L which is formed by multiple wire electrodes and the circular boards. The electrode wires by according the shape of two Archimedean spirals\cite{2} are 1 mm copper round rods which are gold-plated to reduce corrosion effects which are separated into two parallel electrodes with a high voltage (HV) and collection ground (signal readout). The ionization chamber is required to work in air environment to on-line measure the concentration of radon in air.

In order to avoid the electron adsorption effect caused by the ionization of negative electric gas\cite{3} to the chamber, the detector adopts the method of collecting ions, which makes signal to be the current impulse with a long rising time. Therefore, the signal of ions produced by $\alpha$-decay in air is detected using the current amplifier LCA 200. Fig. 2 shows the signal of detector on the oscilloscope. The signal has a long pulse width about 4 ms and its risetime is 2 ms. The counter rate under different high voltage shown in Fig. 3, the counting rate will be tendency to plateau region after the voltage at $-400\ \text{V}$. Therefore, the measurement of air radioactivity on the choice of high voltage should combine the characteristic of counter rate flat curve.

References

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