Positron Camera at NIRS

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A positron camera system was constructed for imaging short-lived positron emitters produced by a cyclotron. It consists of a delay-line gamma camera and a focal detector. The image detector has a field of view of 33 cm in diameter and the focal detector having an effective field of 24 cm in diameter is placed in a plane at 70 cm distant from the image detector on the detector axis. The focal detector is a multicrystal type that consists of a hexagonal array of 61 small Nal(Tl) crystals viewed by a hexagonal array of 19 photomultipliers. Each photomultiplier (51 mm in diameter) views seven crystals each of which is 25 mm in diameter by 38 mm long. The position of the crystal in which a scintillation event occurs is determined from the photomultiplier array through fast logic circuits.

In the system, one of the serious problems is the performance of the image detector at high count rate. A coarse focusing collimator is attached to the image detector to reduce non-coincidence count in it and to improve high count rate capability. The collimator has a focal distance of 1 m and its transparency is 35.4%. Analog computation for tomography provides an image focused in an arbitrary plane between the two detectors. In a preliminary test, lateral resolution of the camera was less than 1 cm.

γ-Ray Imaging by Shadow Pattern (2)

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Use of holography for imaging of γ-ray which was reported by H.H. Barrett in 1972, has been marked as a new γ-ray imaging. Generally in optical fields hologram was very used for record and processing of image by coherent wave such as laser beam. But γ-ray is incoherent and do not condense by optical lenses. So it was needed that the hologram of incoherent sources was formed without optical lenses.

The method of recording shadow of zone plate with Fresnel diffraction pattern was used for obtaining an incoherent hologram. By this method fundamental of an incoherent hologram and practicabilities for γ-ray imaging were discussed.

In our system the scinticamera Pho-Gamma Ⅲ was used as a detector, but hereafter use of the film with better resolution was studing. Also, images were reconstructed using the laser beam (He-Ne laser, 6328 A, 1 mW). Zone plates were consisted with coaxial lead rings, one was 10 open zones and another 3 open zones. In this study later was used frequently, because the resolution of the detector was not very good. Sensitibity of zone plate type collimators was compared with a pinhole collimator. This result showed that the aperture area was more several hundreds times than the pinhole, but that sensitibity proportioned to solid angle of γ-ray source to aperture part. Therefore countrates were several ten times more.

Using Tc-99 m as γ-ray source, characters H, T and X were tried and these reconstructive images were obtained. Yet, good reconstructive images do not obtained, but this method had high sensitibity and area of view was considerably wide. Also optical path in reconstructive process was shortened by using concave lens. So that it was considered that these reconstructive system might be compacted in one simple set.

The Three Dimensional Scanner Using a Coaxial Ge(Li) Detector

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A three dimensional scanner using a coaxial Ge(Li) detector is being developed. The scanner is equipped with a parallel truncated cone-type collimator or a multichannel focused collimator by which information of source depth is transformed into the radial distance of incident position of radiations on the front surface of the detector. The incident position of radiations is then located by the pulse-shape analysis of signals from the detector. The scanner can thus be used for the multiplane tomography yielding four to six pictures at a time.

In this report will be presented: 1) selection of electronic circuits and their combination for the pulse-shape discrimination, 2) fundamental problems on collimation, 3) effects of scattered gamma-ray, 4) advantage and disadvantage of using a Ge(Li) detector for this purpose, 5) performance in the clinical applications.