γ-ray Imaging by Using Shadow Hologram and its Tomographic Effect

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Shadow holography has been studied as one of the methods of γ-ray imaging. This method consists of the processes to obtain holograms by means of recording the shadow on X-ray film and to reconstruct images using the laser optical system. In order to obtain shadow holograms of γ-ray sources the positive or the negative zone plate is generally used in place of collimator. However image quality of these reconstructed images is not satisfied sufficiently for a lager size of γ-ray source, because of undiffractive component (DC component) of laser beam through a hologram. In this report the method of decreasing undiffractive component is discussed for the purpose of improving reconstructed images. (Experiment) Shadow hologram obtained with on-axis Fresnel zone plate shows the hamonic analyzed pattern of γ-ray source, so the lower frequency components are recorded at the neighborhood of center and higher components at further out of center. Therefore the hologram of object with lower frequency components is formed as the pattern having many informations at the neighborhood of center. For avoiding to lose the informations of lower components, we tried to use γ-ray filter (Copper plate) on the on-axis positive zone plate by which saturation of film density was avoided and hologram pattern of lower components became more clear. The relation between film density of holograms and image quality of reconstructed images was discussed. (Result and discussion) Using γ-ray filter, DC component by the first open zone was decreased and lower components were enhanced. This method using γ-ray filter and positive zone plate could improve image quality of reconstructed images for the objects with lower components. Also tomographic effect was studied by this method and good results could be obtained.

A New Collimator of Ring Time Modulated Multipule-Pinhole Coded Aperture

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A method of obtaining tomographic image from a single exposure to the gamma ray emitted by an object is multiple-pinhole coded aperture imaging. One of problems is effectively of eliminating noise image out of focus in a final decoded image in focus. A new collimator of ring time modulated multipule-pinhole coded aperture was developed, the aperture of 12 of 24 holes were symmetrically arranged in a ring and rotated by a motor drive (2 rot./sec) at 6 cm radius from the center of the

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ring. By using our new collimator, Anger-camera and various phantoms containing 99 m-Tc, it was clearly fround that signal-noise ratio in this decoded image (tomographic image) was predominantly improved; the spatial resolution was worsened compared with that of a stationary multiple-pinhole coded aperture collimator. Nontheless, the worsened spatial resolution of the decoded tomographic image was considerably improved by measuring densitometrically the decoded image and cutting off a noise-level.

Consideration of System Designs for Multicrystal Position Camera

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Several systems of fast positron camera for use of cyclotron produced positron emitters are discussed. The camera is composed of a pair of detectors in coincidence mode, each detector consisting of an array of a number of NaI (Tl) crystals and photomultiplier tubes. Both the systems using a hexagonal and a square array of the crystals are considered.

The hexagonal array of the crystals provides a more closely packed detector than that of the square array, but the system becomes complicated. Each photomultiplier tube views seven crystals, one of which is located at the central axis of the tube and fully viewed, and the others at the sides of the tube and half viewed. This arrangement requires two levels of discriminators for each photomultiplier tube to identify the crystal in which a coincidence event occurs.,

On the other hand, the square array of the crystals (MGH type) which provides a more simplified system at the sacrifice of the density of array is also discussed. In order to simplify the electronic system, a coincidence method is proposed in which the coincidence pairs are formed between columns (rows) in the photomultiplier tube array of both the detectors.

Symmetric and asymmetric detector constructions are also discussed, and theoretical spatial resolution and geometrical efficiency of these sytems to a point source are evaluated.

Physical Characteristics of Experimental Low-energy Di/Con Collimator —Comparison with Other Collimators—

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A new low-nergy diverging converging collimator was designed by author and constructed. The new collimator has about 4000 circular holes, 30 cm focal length from the converging face and

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