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Development of a High-Sensitive and Low-Cost Imaging Gamma-Ray Camera γI (Gamma Eye)

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We developed a Compton camera γI (Gamma Eye) using CsI (Tl) scintillators for measurement of arrival direction of gamma rays produced by radioactive cesium released into the environment from the Fukushima Dai-ichi Nuclear Power Plant accident due to the great east Japan earthquake and subsequent tsunamis in 2011.
The radiation exposure of residents remains extremely a serious problem in Japan. The capability of gamma-ray imaging with good angular resolution is a key feature for identification of radiation hotspots and effective decontamination operation. A detector using Compton kinematics is one of the best candidates. Some Compton cameras for such purpose are being developed so far.
However, they are not sufficient to cover a wide contamination area with the dose rate in air of < 1μSv/hour around the Fukushima Power Plant because of their low detection efficiency and/or very high cost. Thus we developed a novel Compton camera γI (Gamma Eye) with high sensitivity and low-cost. It consists of 2 arrays of detectors which act as a Compton scatterer and absorber. Energies deposited by Compton scattered electrons and subsequent photoelectric absorption measured by photomultipliers are used for image reconstruction. Each array consists of 8 large CsI (Tl) scintillator cubes, 3.5cm on a side, which are inexpensive and have good energy resolution. The 2 arrays are separated by 40cm to provide a 60-degree wide field of view as well as to keep position determination accuracy < 5 degree. The imaging capability was verified by test measurements in Fukushima Prefecture together with the laboratory tests.

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