

"Stereo Compton cameras" for 3-D localization of radioactive isotopes

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The Compton camera is a viable and convenient tool used to visualize the distribution of radioactive isotopes that emit gamma rays. After the nuclear disaster at the Fukushima Daiichi power plant in 2011, a large amount of radioactive isotopes (e.g. ^{134}Cs , ^{137}Cs) was released and widely dispersed, thus making the removal thereof is still an urgent task. In response, we are proposing a portable Compton camera weighing only 1.9 kg and measuring just 15 cm³ in size. The camera consists of Ce:GAGG scintillators coupled with large-area MPPC arrays. In this report, we present the detailed optimization of the detector design as based on Geant4 simulation. We show that the detection efficiency for 662 keV gamma rays can be as high as 0.54%, or more than 10 times higher than that of other cameras being tested in Fukushima, along with a moderate angular resolution of 8.1° (FWHM). We also propose a new concept of the "stereo" measurement of gamma rays by using two Compton cameras, thus enabling the 3-D positional measurement of radioactive isotopes for the first time. We will present a brief simulation of this innovative approach and discuss expected performance and applications in the near future.

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