

A NaI (Tl) - Ge (Li) coincidence gamma polarimeter

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Considerable improvement of the energy resolution over NaI (Tl) - NaI (Tl) coincidence Compton polarimeters while essentially retaining other properties, was obtained by replacing the detector that is used as a Compton scatterer by a coaxial Ge (Li) detector. A 34 cm³ Ge (Li) detector and a 38 mm diam. x 38 mm NaI (Tl) integral scintillation detector, coupled to a fast-slow coincidence system, were used in the measurements. Sum spectra were recorded in a 256-channel analyzer. The ratio of the detection efficiency in the full-energy peak of the system to the efficiency of the Ge (Li) detector was found to be 0.11, 0.175, and 0.18 for the 662, 1173, and 1332 keV gamma rays. The polarimetric sensitivity was determined by using beams of polarized photons obtained in Compton scattering. For photons of a medium energy of 700 keV the polarimetric sensitivity was found to be 0.33, i.e., 82% of the maximum value calculated for the Compton scattering of 700 keV photons. The energy resolution of the system was found to be 31, 42, and 45 keV for 662, 1173, and 1332 keV gamma rays. Some improvement of these results is possible. The system is expected to give a still better performance at higher energies, when a larger fraction of the photon energy is imparted to the recoiling electron inside the Ge (Li) detector.