ESRF	**Experiment title: Calibration of a polarization-sensitive microstrip Ge detector**	**Experiment number**: MI-727
Beamline: ID15 A	**Date of experiment**: from: 04.05.05 to: 08.05.05	**Date of report**: 27.02.06
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Report:

Introduction

The x-ray spectroscopy program of the SPARC collaboration strongly relies on the availability of two-dimensional, energy dispersive strip detectors with their inherent advantages concerning spectroscopy and imaging capabilities as well as polarization sensitivity. Here we report on a performance test of a first prototype 2D μ-strip germanium detector developed at IKP Jülich. This germanium diode has on the front contact 128 strips on an area of 32 mm x 56 mm (pitch of 250 μm) and on the rear contact 48 strips (pitch of 1167 μm), respectively (for details compare [1]). For an accurate determination of the response characteristics of this detector (accuracy in position determination and polarization sensitivity) in-beam test measurements using monoenergetic polarized photons were needed.

Experiment

The measurements were performed at the European Synchrotron Radiation Facility (ESRF) in Grenoble. The detector was installed at the high energy beam line ID15A (see Fig. 1) where 98% linearly polarized synchrotron radiation at energies of 60 keV and 210 keV was provided for the experiment.

The beam size on the detector was close to 50 μm x 50 μm, ideally suited for this test purpose. For the experiment, each detector segment was connected to a separate electronic readout. This allowed us to register simultaneously for every segment the energy deposition and the hit probability as a function of the beam

position on the detector. For the latter purpose, the photon beam was scanned over the active detector area in steps of 50 μm. From this scanning technique detailed information on the effects of electronic cross talk and in particular of charge splitting for the different photon energies used is obtained. A further important aspect of this study was to utilize the detector as a Compton polarimeter and to investigate its polarization sensitivity.

Fig. 1 : the 2D micro-strip Ge(i) detector as installed at the beamline ID15A.

Results

Sample 2D images for Compton scattering of 210 keV photons are depicted in Fig. 2 as observed for different energies of the Compton scattered photons. Utilizing the kinematical relation between Compton scattering angle θ and the energy of the scattered photons, the various images displayed refer to the spatial intensity distributions related to different scattering angles (from almost 0 deg up to 180 deg). In the figure, an almost dipolar intensity pattern is observed close to scattering angles of 90 deg (cluster plot in the middle). This finding visualizes that for our initial energy of 210 keV, Compton scattering is most sensitive to the linear polarization at scattering angles close to 90 deg. To illustrate the excellent performance in more detail, we display in Fig. 3 the intensity distribution for 90 deg scattering along an arbitrarily chosen radius vector of 5 mm around the center of the image (position of the beam spot on the detector). The solid line displayed gives the result of the Klein-Nishina formula [3] for 100% linearly polarized light and a scattering angle of 90 deg. An excellent agreement between the data and the calculation must be stated.

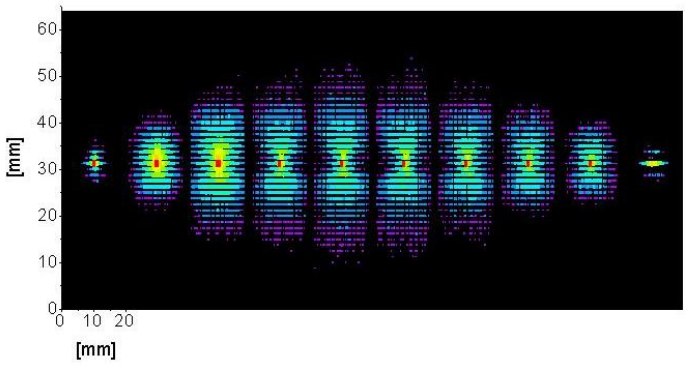

Fig. 2: Preliminary 2D images for Compton scattering of 210 keV photons (for details see text).

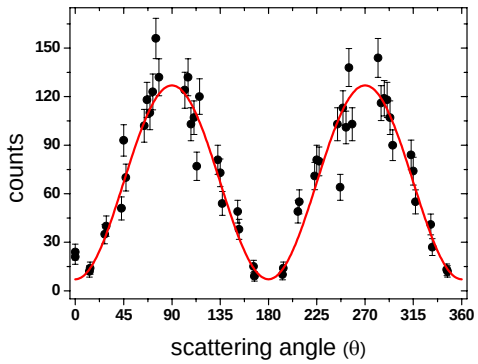

Fig. 3 : Intensity distribution for Compton scattering of 210 keV photons at 90 deg (for details see text).

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References

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