Experiment title: Charge Collection and Depth Sensing Investigation on CZT Drift Strip Detectors		Experiment number: MI-1022
Beamline: ID15A	**Date of experiment:** from: 6 May 2010 to: 10 May 2010	**Date of report:** 23 August 2012
Shifts: 12	**Local contact(s):** Irfan Kuvvetli	*Received at ESRF:*

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Report:

DTU Space developed CZT drift strip detectors [1-3] were evaluated at the ESRF ID 15A beam with its very fine collimations (50 µm, 150 keV up to ~500 keV) [4]. The detectors were operated in side illumination configuration, the so-called Photon Transverse Field (PTF) configuration. With these measurements, we demonstrated that these detectors have high efficiency due to large effective thickness, high energy resolution due to the small electron drift lengths and can achieve sub mm position resolutions using the so-called Depth of Interaction Technology (DOI). The depth resolution was found to be 100 um FWHM @150keV and 200 um FWHM@500keV. The measured position resolutions were analysed with a model which includes the contribution due to the electronic noise of the detector and the smearing of the position resolution due to the range of the photo/Compton electron in the detector. The polarization of the monochromatized photon beam was also taken into account. Figure 1 shows two plots comparing experimental data of the obtained position resolution with the model for Compton and Photo electric events, respectively. Whereas the agreement is acceptable for the Photo electric events there is a clear discrepancy between data and model for Compton events at higher energies. At present this discrepantioncy is not weel understood. However, the most important conclusion is the DTU Space developed CZT drift strip detectors could be operated at high photon energies (> 500 keV) with good efficiency, good energy resolution and excellent position resolution.

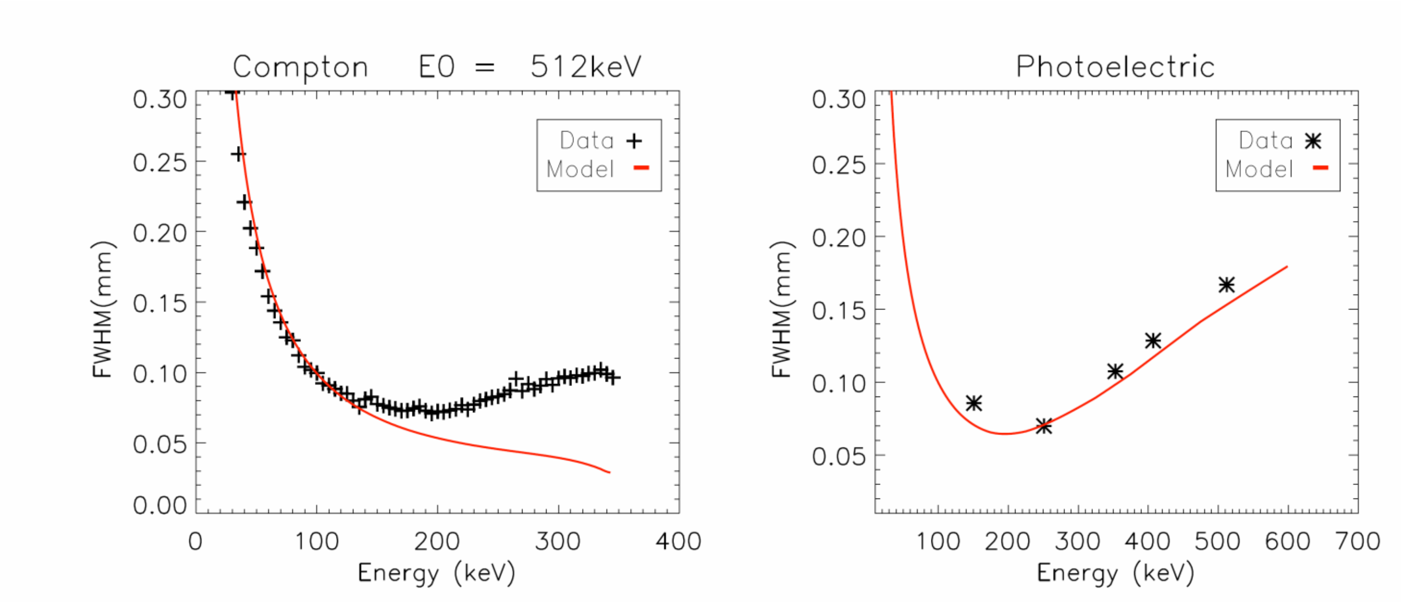

Figure 1: Measured data and model of DTU Space CZT detector's resolution function of energy (data form linear polarized 512 keV, 50 um x 50 um beam). Left: Position resolution obtained using Compton recoil electron. Right: Position resolution obtained using Photoelectron.

The outcome of the ESRF measurements were used to start an ESA indepented R&D project '3DCZT high resolution detector development'. The main goal of the project is to develop and build a full 3D CZT detector module with two orthogonal sets of strips combined with DOI technique. We plan to characterize the prototype 3D CZT detector at the ESRF ID15A beam determing the achievable 3D position resolution as well as the spectral performance.

References

[1] M.A.J. van Pamelen and C. Budtz-Jørgensen, Nucl. Instr. and Meth., A 403, pp 390-398, 1997.

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[3] Kuvvetli, I. et.,al., Nuc. Inst. & Meth., A, 624(2), 486-491, 2010

[4] Kuvvetli, I.; Budtz-Jørgensen, C., IEEE Nuclear Science Symposium Conference Record NSS '11 (R7-2), 2010