A new high resolution, eight element Silicon Drift Detector for μPIXE analysis at LIBAF

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Introduction

- The Lund Ion Beam Analysis Facility (LIBAF) has been upgraded with a high resolution, high count rate 8 x 80 mm^2 annular Silicon Drift Detector (SDD X-PIPS [1]) for PIXE analysis. The detector arrangement is a retrofit to the old liquid nitrogen cooled cryostat [2].
- Solid angle increased by tilting the normal of each of the elements towards the beam line axis. Solid angle covered by the elements increased by about 60% to 265 msr, compared to flat geometry.
- Resolution at 5.9 keV Mn K_α line at optimum conditions is 126 – 129 eV.
- Modified Mesytec MSCF16F unit [3,4] used as 16 channel spectroscopy amplifier, together with a multihit TDC module allows for the possibility to combine energy signals with timing information, building a software pile-up rejector.

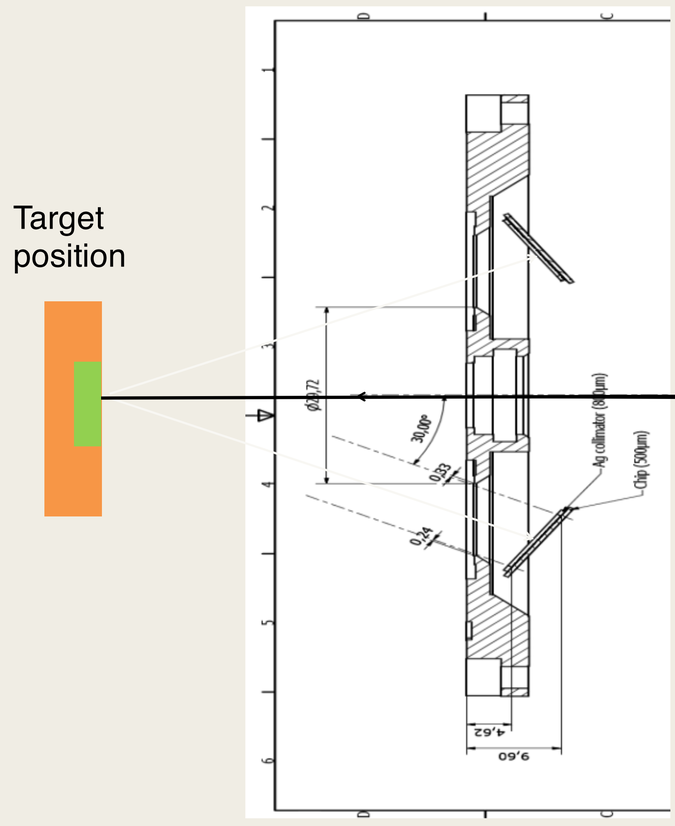
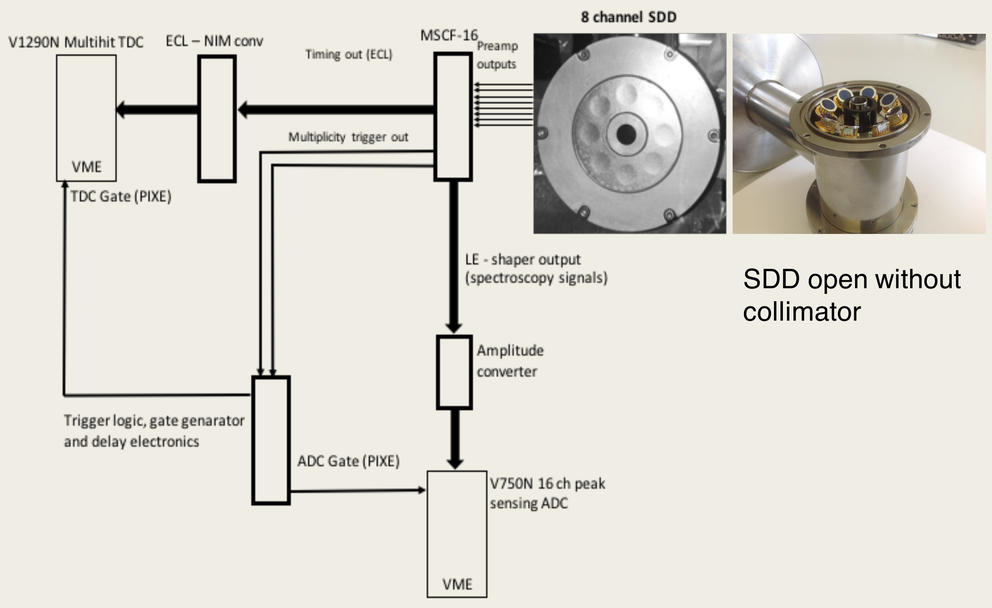


Fig. 3 Sample arrangement



SDD open without collimator

Fig. 1: Principal electronics layout (simplified) of spectroscopy and timing signals. MSCF-16: 16 channel spectroscopy amplifier with remote control, timing filter CFD/LE and a multiplicity discriminator trigger, but no built-in pile up rejection filters. This is instead implemented with a multihit TDC (CAEN V1290N) [3,4], where software cuts are made offline in the TDC-1D or in the 2D plot and data is resorted.

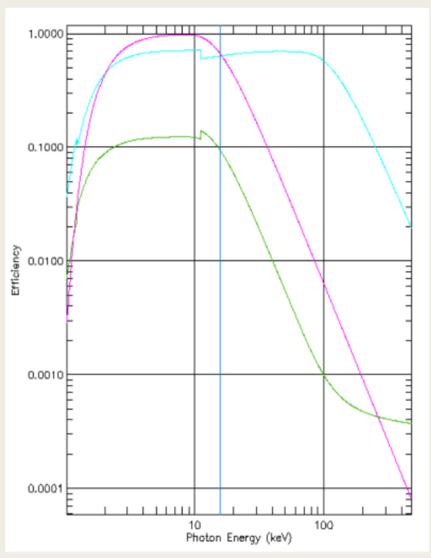


Fig. 2: Efficiency of new SDD (pink) compared with previous HPGe (turquoise). Green is ratio times 0.1

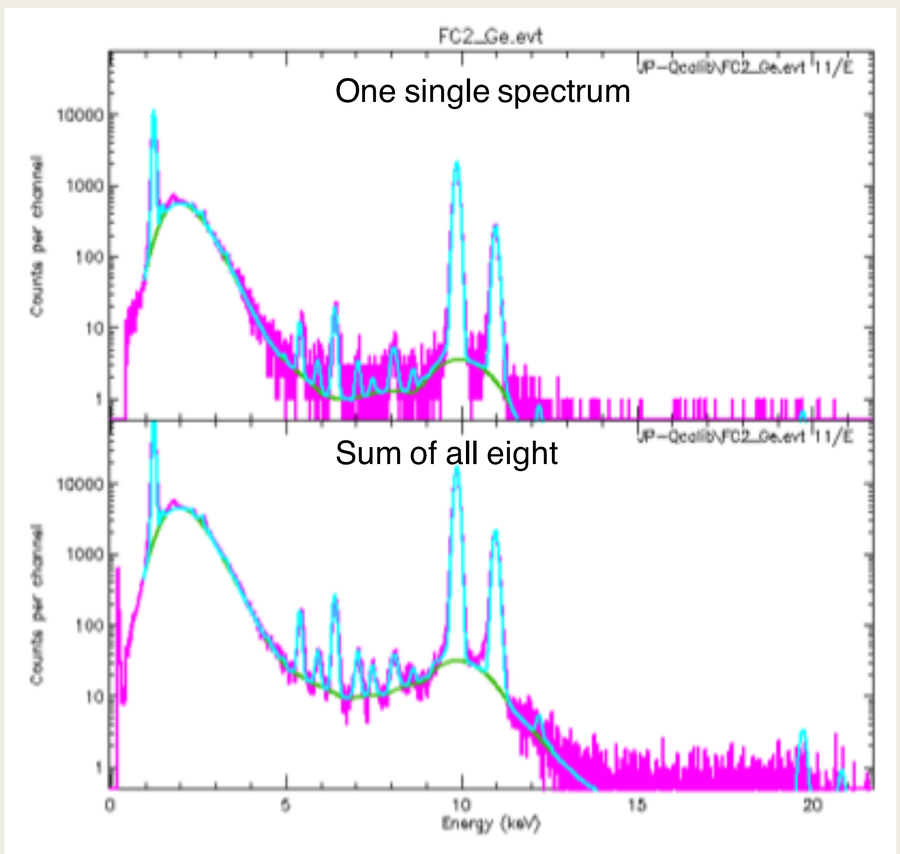


Fig. 5: Spectra from one single detector element and the sum of all eight. All spectra identical and can be summed together directly. A lot of the small peaks are lifted up above the background.

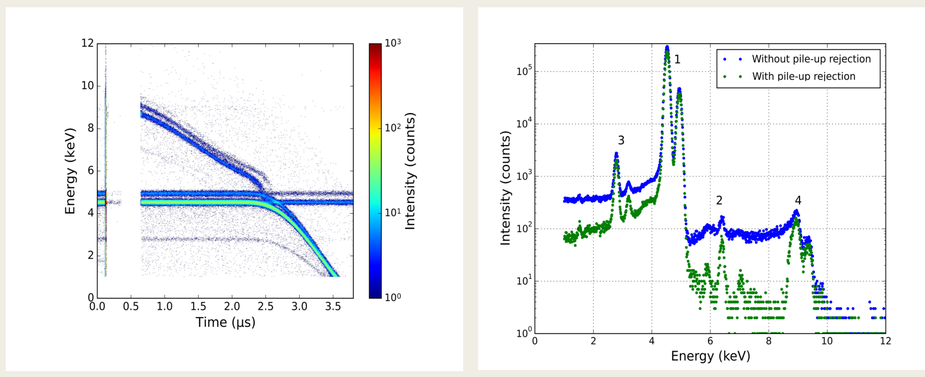


Fig. 4: Left: 2D plot of energy spectrum vs time. Right: PIXE spectrum from thick Ti target. Filter effect can clearly be seen. Green is with and blue without pile-up rejection.

Summary

- 8 channel SDD has been successfully implemented
- High count rate - keeping the resolution, p/b 1/10000
- High energy resolution (126 eV), directly sum all eight channels
- Short shaping time (0.25 μs)

References:
[1] CA Canberra Industries, Inc. 800 Research Parkway, Meriden, CT 06450, U.S.A.
[2] A. Shariff, et al. Nucl. Instr. Meth. B 219–220 (2004) 494–498
[3] M. Elfman, et al. Nucl. Instr. Meth. B 371 (2016) 148–152.
[4] Mesytec GmbH & Co. KG, Wernher-von-Braun-Str. 1, 85640 Putzbrunn, Germany, (<http://www.mesytec.com>).

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