Contribution ID: **29** Type: **Oral Presentation**

One dimensional detector for X-Ray diffraction with superior energy resolution based on silicon strip detector technology

Tuesday 13 September 2011 10:00 (20 minutes)

1-D position sensitive X-ray detectors based on silicon strip detector technology have become a standard for x-ray diffraction instrumentation. They are widely used with laboratory equipment but also at powder XRD beam lines. As these devices have been proven to be very useful due to their measurement speed and angular resolution, the implementation of further improvements of their performance obviously needs to be investigated. The silicon strip detectors as applied in X-ray diffraction are primarily used as counting devices and the requirements concerning the spatial resolution, dynamic range, and count rate capability are of primary importance. However, there are several experimental conditions in which a good energy resolution is a highly demanded feature.
The energy resolution of silicon strip detectors is limited by the charge sharing effects in the sensor, by the noise of the front-end electronics, and as well as by base line fluctuations. All these effects have been analysed in detail and have resulted in the development of a new readout design. A front-end ASIC with a novel scheme of baseline restoration and novel interstrip logic circuitry has been designed. The interstrip logic is used to reject the events resulting in significant charge sharing between neighbouring strips. In expense of rejecting small fraction of photons entering the detector one can obtain single strip energy spectra mostly free of charge sharing effects.
In the paper we present the design consideration and measured performance of the detector being developed. The electronic noise of the system at room temperature is typically of 70 el rms for 18 mm long silicon strips and a peaking time of 1 microsec. The energy resolution including non-reducible charge sharing effects and electronic noise of 800 eV FWHM has been achieved. It will be shown that this energy resolution is sufficient to electronically suppress the Fe-fluorescence which commonly is a problem in X-ray diffraction on iron containing samples irradiated by the most generally used Cu-K radiation.

Preferred medium (Oral/poster)

Oral

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Session Classification: X-Ray and Gamma detectors

Track Classification: X-ray and Gamma-ray Detectors