Characterization and Signal readout from the new linear silicon drift detector for soft x-ray studies

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Currently Astronomy people are trying answer fundamental questions about the motion of matter orbiting close to the event horizon of a black hole, and the state of matter in neutron stars. In practice, these scientific objectives will be achieved through high-resolution X-ray timing, i.e. through the measurement of X-ray photometric time series and spectra from a range of astrophysical compact objects (neutron stars, Galactic black holes and extra-Galactic black holes in AGNs). These measurements require no imaging capability, but instead a 10 m2 class instrument, in combination with good spectral resolution.

To measure the X-ray energy and timings, recently people have developed the Large area silicon detectors. The working principle of the detector is drift based X-ray detection. The charge generated by the absorption of an X-ray photon is collected in the middle plane of the detector and then it is drifted towards the read-out anodes on one edge of the detector. A series of cathodes on both sides of the detector maintain the electric field. The read out at anode gives the X-position. The y-position is calculated based on the drift time of electrons to anodes. So, practically it is 1.5-dimension detector.

In order to achieve accurate X-ray interaction position and energy resolution, our goal is to design a detector which has 2-dimension readout. The detector will work on principle of electron and hole drift. The primary component of this detector will be a silicon detector based on the drift readout technique, which can provide very good energy resolution and timing capabilities. Custom built multi-linear SDD is planned to be design which gives accurate positioning and better resolution compared to available detectors. The Design of detector will be discussed during conference.

Most radiation detectors require pulse (or signal) processing electronics so that energy or time information involved with radiation interactions can be properly extracted. We are working on different techniques of pulse height analysis like Wilkinson ADC technique, Pulse width modulation technique, Digital pulse processing technique and pulse height measurement using peak detector & successive approximation ADC. Above said pulse processing methods were implemented on hardware and tested with x-ray SDD detector (silicon drift detector-SDD). Performance of processing techniques is compared based on achieved spectral resolution, count rate handling, power consumption and total hardware component requirement. Each technique has its own advantage and disadvantages, the design details and evaluation results will be discussed during conference.