HYBRID PIXEL DETECTOR AND C8P1 ALGORITHM DEALING WITH CHARGE SHARING

Charge sharing in a hybrid pixel detector occurs when the charge generated in X-ray photon interaction with a sensor is collected by more than one pixel. Charge sharing effect may significantly impair the detector energy resolution and result in counting extra events or missing some of the events. Therefore, the charge sharing effect must be dealt with by a dedicated readout IC or processed off-chip [1-4]. The common aim of algorithms dealing with charge sharing is to reconstruct the signal as if the total charge deposited by a single photon would be processed in a single channel. It is also necessary to assign an event to a pixel in a group, preferably to the one with the largest charge deposition.

The C8P1 algorithm [5], the first task is realised by summing signals from the pixels which contribute to the photon detection. The second one involves a decision logic which compares information from the neighbouring pixels.

CORRECTIONS OF GAINS AND DC OFFSETS MISMATCH

The correction procedures are based on the extraction of the analog parameters such as offsets, and gains. The first step of the trimming process involves the DC offsets at the discriminator inputs correction. Then the CSA gains are trimmed (providing gain uniformity in the 'fast' processing path for precise signal reconstruction from 4 neighbours), and finally, the 5H SLOW gains undergoes a similar correction procedure (providing gain uniformity in the 'slow' processing path for precise signal comparison). The readout channel configurations for trimming are presented below.

SIMULATION RESULTS — GAIN AND DC OFFSET SPREAD INFLUENCE ON C8P1

The Q parameter was defined to compare quantitatively the maps of counts registered in the SPC and C8P1 modes. Where n is the mean number of detected hits, 0 is the standard deviation of the number of detected hits, p is the number of pixels in which the number of counts falls in the range [900; 1100], p n is the total number of pixels. The Q factor is used to evaluate the simulated detector performance in the presence of random noise and analog parameters spread. The quality factor Q, calculated for a typical detector parameters in Fig. 6 (Gain spread = 5%, DC offset spread = 40 e−, noise = 100 e−, THR = 4 keV) equals Q=0.866 and Q=0.999, for the SPC and C8P1 modes respectively.

COMPARISON WITH EXPERIMENTS

References: