

# A Calibration Algorithm to Solve the Pixel's Inconsistency for the Imaging of the HEPS

Ye Ding, Jie Zhang, Wei Wei, Hangxu Li, Zhenjie Li, Peng Liu

The State Key Laboratory of Particle Detection and Electronics,  
Institute of High Energy Physics, CAS;

E-mail: dingye@ihep.ac.cn

## 1. INTRODUCTION



Fig. 1. HEPS-BPIX readout electronics system and one of its sensor module



HEPS is a readout electronics system based on the BPIX pixel array detector readout chip. The prototype of the detector consists of 16 sensor modules. In order to complete the function of the pixel detector, the readout system must set up the configuration of the BPIX readout system. Factors such as the process non-uniformity, the thresholds of the pixels are not completely consistent, and the thresholds of the pixels are not completely calibrated to make the inconsistent thresholds of the pixels reach a corresponding level. The readout system must configure the threshold of the pixels, meaning that 32 sets of different thresholds are needed for each pixel's threshold.

## 2. IMPLEMENTATION

### Calibration:

- (1) The inputs are 1kHz square waves starting at 60mV to 600mV stepping by 20mV to reach the count from 0 to the full count of pixel per seconds.
- (2) For a pixel, there are 32 different thresholds for one signal amplitude of inputs.
- (3) Taking the counts as the ordinate and the input amplitudes as the abscissa, this test can obtain 32 sets of curves each pixel.
- (4) To find the appropriate curve from the 32 curves through making the pixel curve be close to the average of whole pixels, and the threshold corresponding to the curve is the pixel's threshold.

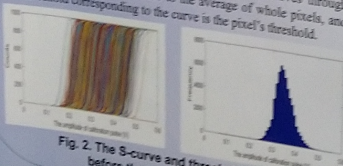


Fig. 2. The S-curve and threshold distribution before the inconsistent Calibration

## 3. RESULTS

- (1) The final S-curve spread and the threshold distribution of the array pixel detector is minimized.

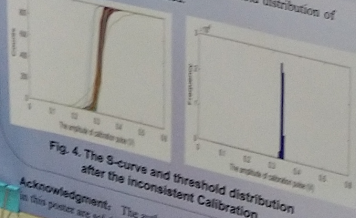


Fig. 4. The S-curve and threshold distribution after the inconsistent Calibration

**Acknowledgments:** The authors acknowledge the IHEP for providing funding and fundamental resource. This paper is solely the responsibility of the first author and do not necessarily represent IHEP and other.

If the pixel has a inappropriate threshold, it will cause bright noise and dark noise in the imaging. The lower threshold, and the latter is caused by the bright noise and appears during detecting the synchrotron ray).

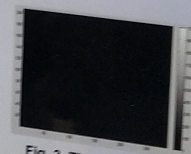


Fig. 3. The imaging with the bright noise before the inconsistent Calibration

Based on the calibration, the thresholds of the pixels are set separately according to the scanned S-curve. After excluding the inappropriate threshold curve, set the threshold to the minimum value of the bright noise, set the threshold to the maximum value of the dark noise, set the threshold to the minimum value of the plateau which can reach full count with the maximum value of the dark noise.

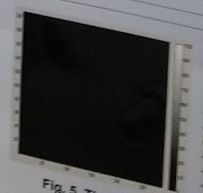


Fig. 5. The imaging without the dark noise after the inconsistent Calibration

- (2) Both the bright and dark noise are minimized. Although it affects the inconsistent thresholds, the inconsistent thresholds are the few and have no effect on the algorithm later.