PNU Status BIC Meeting, Feb. 6 (2026), CKim

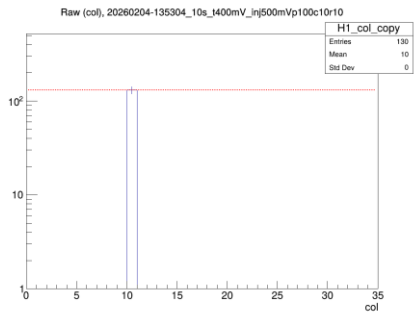
- **AstroPix_v3 study**
  - Tentative chip test process: separate to four independent levels
    a. Initialize: communicate with board and fw (astropix-fw → astep)
    b. Tests: power-up, noise scan, threshold scan, injection study, etc.
       b-1. Multiple DAQ running + output files generation (major point for time/memory/disk)
       b-2. Focus on writing speed: record output in raw binary format or ROOT (currently human readable)
    c. Analysis and scoring:
       c-1. Each test's criteria should be tuned w.r.t chip version
       c-2. If possible, will not produce human-readable output (e.g., csv, etc.) to avoid decoding time
    d. Cleanup: system reset for next run, sorting by score, summary report, upload to DB
  - Initial test items to be implemented
  - Injection study
    a. Injection routine is prepared: single pixel, column/row scan, and all pixels
    b. Optimal injection rate study
    c. Consistency check

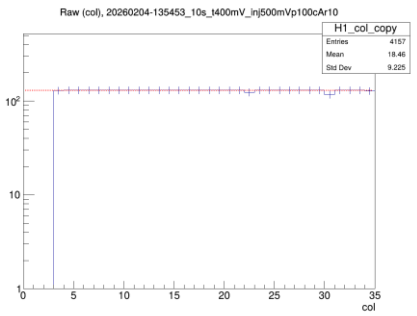
Initial test items

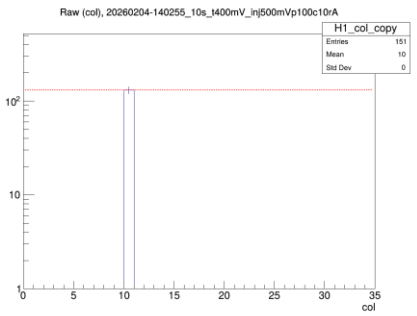
- **Initial test items plan to implement**
  - Communication check and Register R/W
    a. Board ↔ chip communication (to check if the chip is alive)
    b. Register map check: key register values write/readback
    c. Record: bias voltage, current, temperature, fw, entire register map
  - Basic performance: require parameters study and tune
    a. Noise scan: # of hot/dead pixels, generate occupancy map
    b. Injection scan: by using low and stable event rate
    c. Threshold scan: generate s-curves for multiple points
    d. Record: results plots generated by ROOT
  - Stability
    a. Generate 2D hit map in “standard” setup (e.g., bias -200V, threshold 200 mV, runtime 30s, etc)
    b. Repeat at least 3 times and check consistency
    c. Record: hit maps

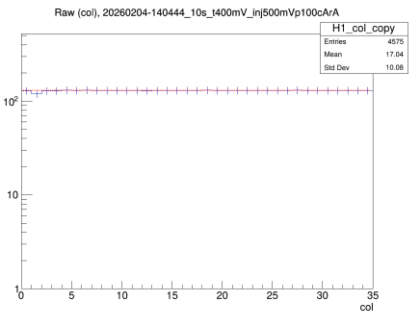
Injection study (1/3)

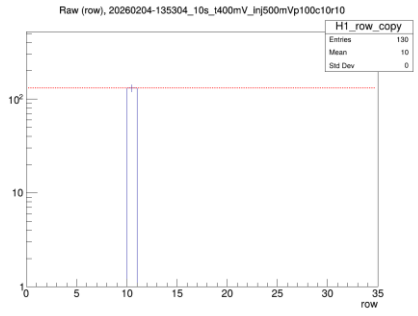
- **Test routine prepared**
  - Based on astropix-fw + astropix-python
    a. Capable of single pixel, column scan, row scan, and all pixels
    b. Conditions: -150V (bias), 400 mV (threshold), 500 mV (inj_voltage), 100 (inj_period, ~13 Hz), 10 s (runtime)

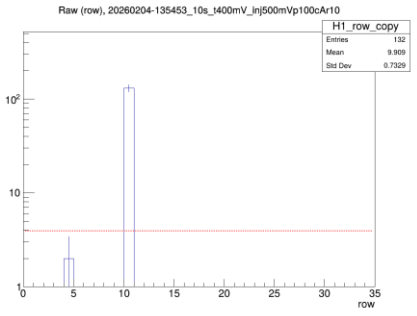


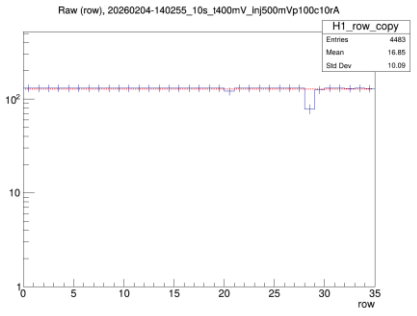


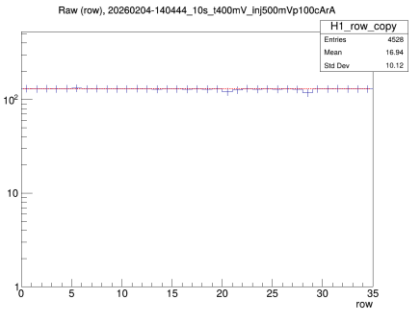












Injection study (2/3)

- **Rate capability of single pixel (c10, r10)**
  - Official info vs. Measurement

a. Spec: 4 Hz/pixel (arXiv:2511.05639)

→ This limit seems like operational condition, rather than the physical/technical one

b. Parameters relevant to event rate being injected (astropix-python):

b-1. Inj_period (0, 255)

b-2. clkdiv (1, 65535): default 300

b-3. Judging from data, $f_{inj} = \frac{f_{sysclk}}{256 \cdot clkdiv \cdot (inj\_period + 1)}$, f_{sysclk} = 100 MHz, given by Nexys-video

c. Conditions: single pixel injection (c10, r10), -150V (bias), 400 mV (threshold), 500 mV (inj_voltage), 10 s (runtime)

d. Repeated same measurements for 3 different chips (w102s08, s10, s12): consistent

inj_period	clkdiv	n_lines	n_readout	File size (kB) (* csv decoded)	Contamination	Rate (Hz)
0	300	65,144	1,666	3,742	?	?
10		2,495	1,247	141	N	~125
100		259	239	15	N	~13
162		159	79	9	N	8.0
255		101	50	6	N	5.1

Injection study (3/3)

- **Rate capability of all pixels**
  - Scanned inj_period and clkdiv
    a. Data starting to be contaminated (truncated packet, corrupted row/col consistency, readout overlap, etc.), if the inj_period is lower than 162 (event rate is higher than 8.0 Hz)
    b. For chip performance test purpose,
       b-1. 7 ~ 7.5 Hz injection rate
       b-2. A few tenth seconds of runtime
    c. If necessary, clkdiv can be utilized for extremely high/slow event rate
    d. Tentative test procedure: default (7 Hz + 30s) + precision (only when the status looks suspicious)

inj_period	clkdiv	n_lines	n_readout	File size (kB) (* csv decoded)	Contamination	Rate (Hz)
100	300	9,096	259	498	Y (substantial)	~13
129		7,065	201	386	Y (substantial)	~10
162		5,682	161	310	Y (slightly)	8.0
255		3,885	114	210	N	5.1
	600	1,821	52	98	? (not checked)	2.6
	150	7,141	205	389	? (not checked)	10.1

LAST SLIDE