Status of Forward Pixel System Test

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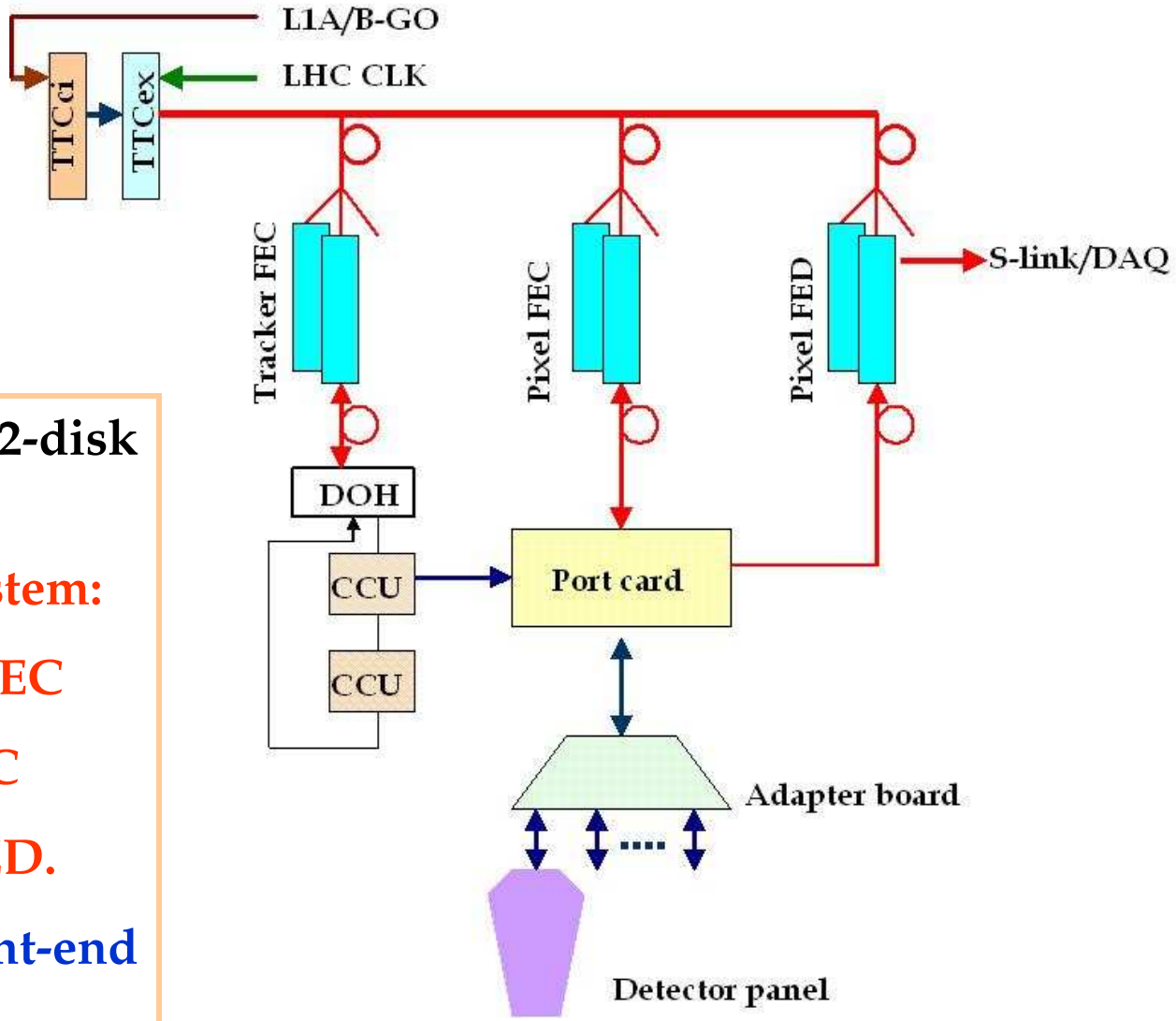
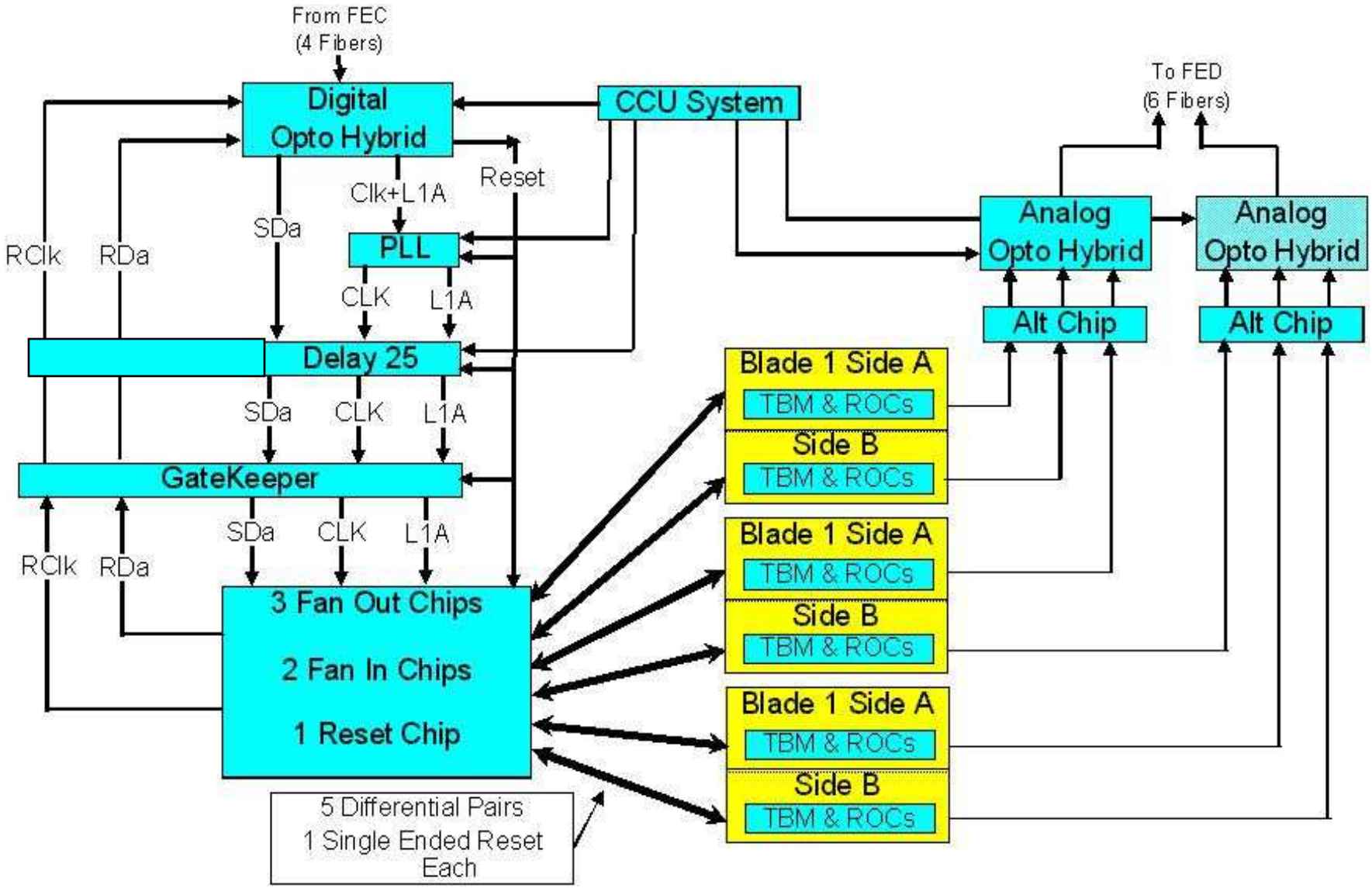
Forward Pixel DAQ Overview

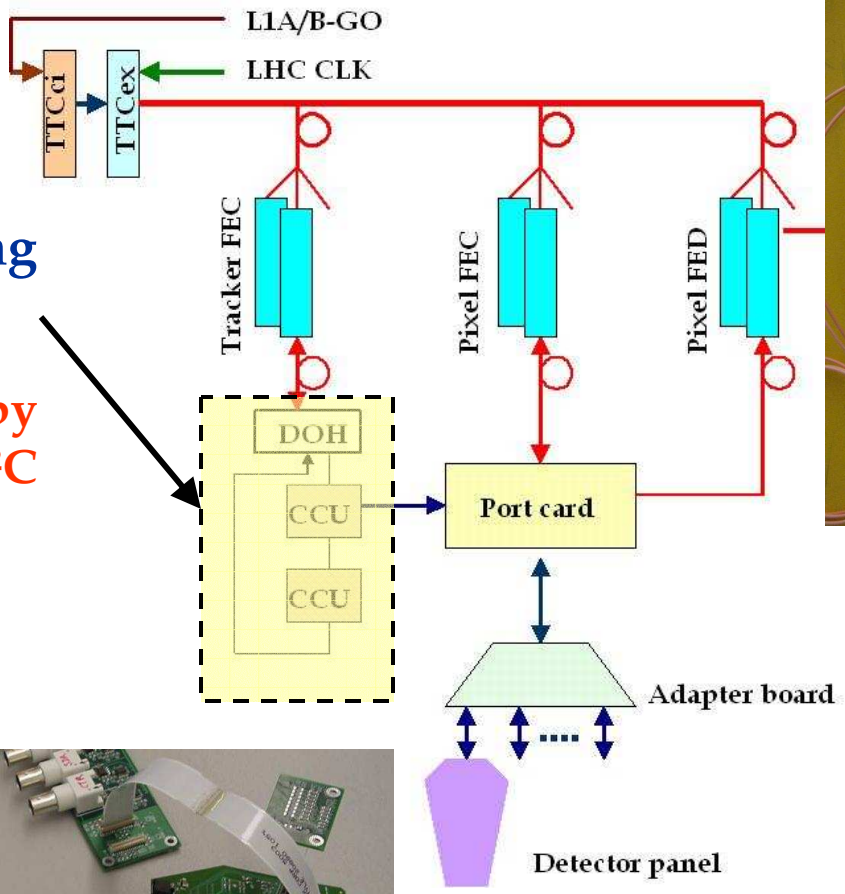


- ~ 20 M channels (2-disk configuration)
- Relative small system:
  - Half tracker FEC
  - Two Pixel FEC
  - Eight Pixel FED.
- Complicated front-end electronics.

Front-end Electronics

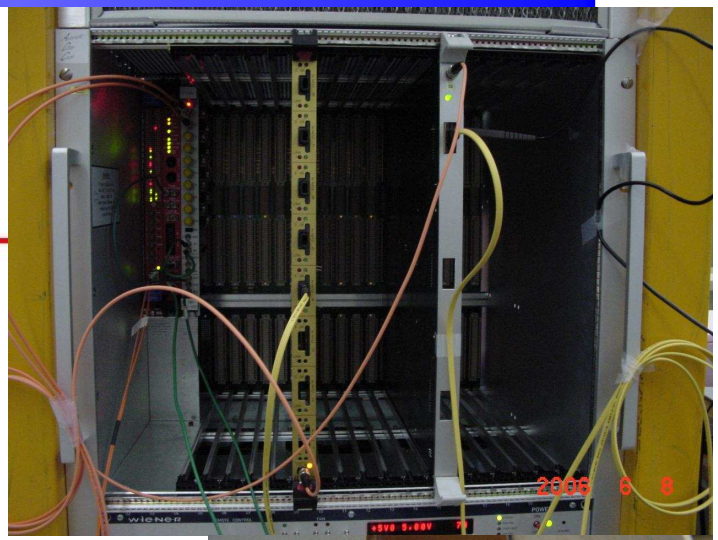


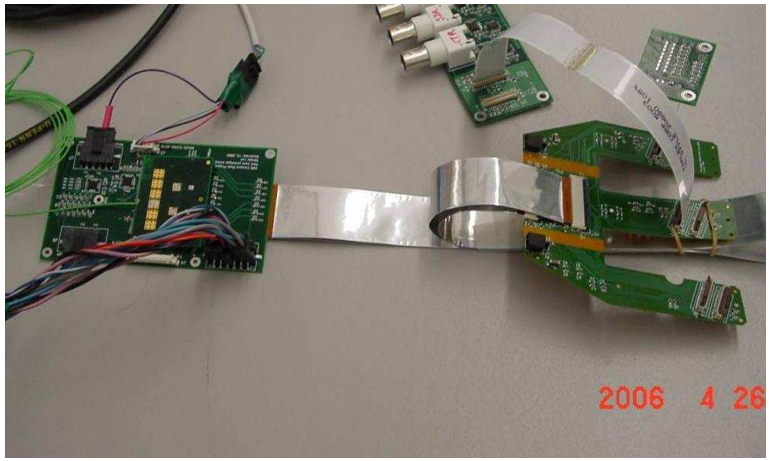
System Setup-June



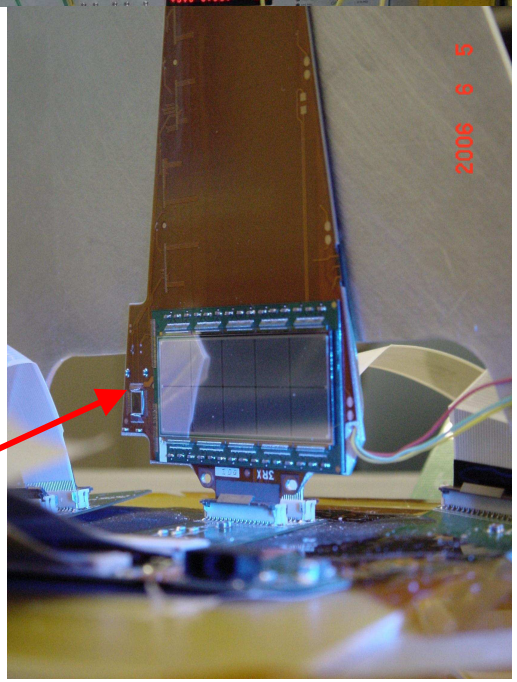
Major missing part!

(emulated by commercial I^2C controller)





Production TBM



Changes of Setup (Since June)

- Preproduction panel (same as the ones used in 07 FPixel Detector).
- Production adapter board; geographical addressing of hub addresses.
- Use CEAN power supply modules to provide LV/HV powers over final power supply cables (~ 40 m).
- Temperature control of the front-end electronics and detector panels.

  Can cool the whole system down to -10 degrees.
- Temperature control of the optical receiver on the FED board.
- Integrated the new TTC optical splitter.

Results - Power Load

- Low voltages; regulated to be within 10-20 mV of set values, variations is within 15 mV.
- Constantly monitoring current load of the detector panel.

  Observation: digital turn-on current could be as high as 0.75 A for a panel with a 2x4 plaquette, which drops to about 0.3 A after an initialization (type DACs used in bench tests).
- Checked ROC voltage regulation: tested digital voltage from 2.3 V up to 2.9 V; test analog voltage from 1.4 up to 1.9 V.
- Studied effects on panels when vary loads present.

  In FPix, six panels share same power line; with a switch network to change load.

Results – Analog Signal

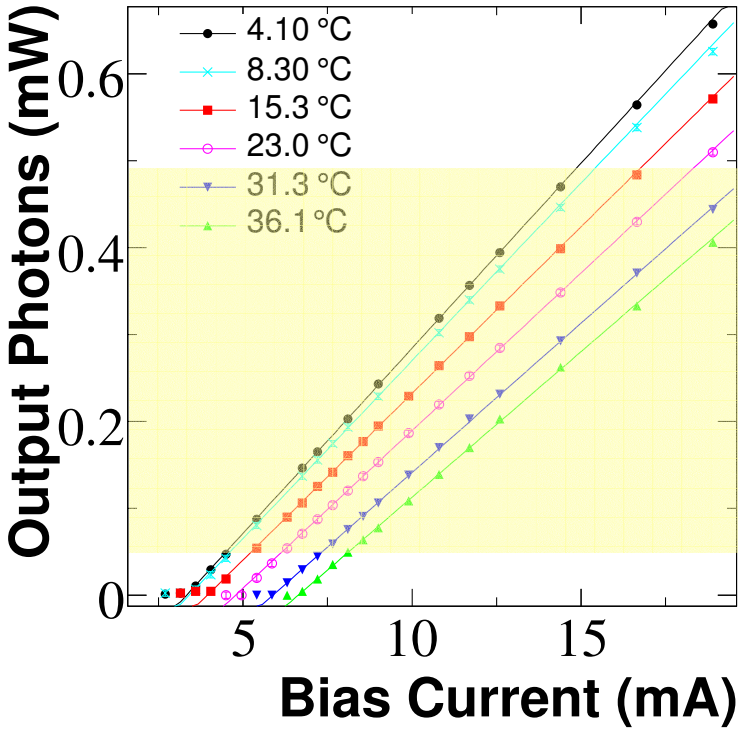
Signal from TBM

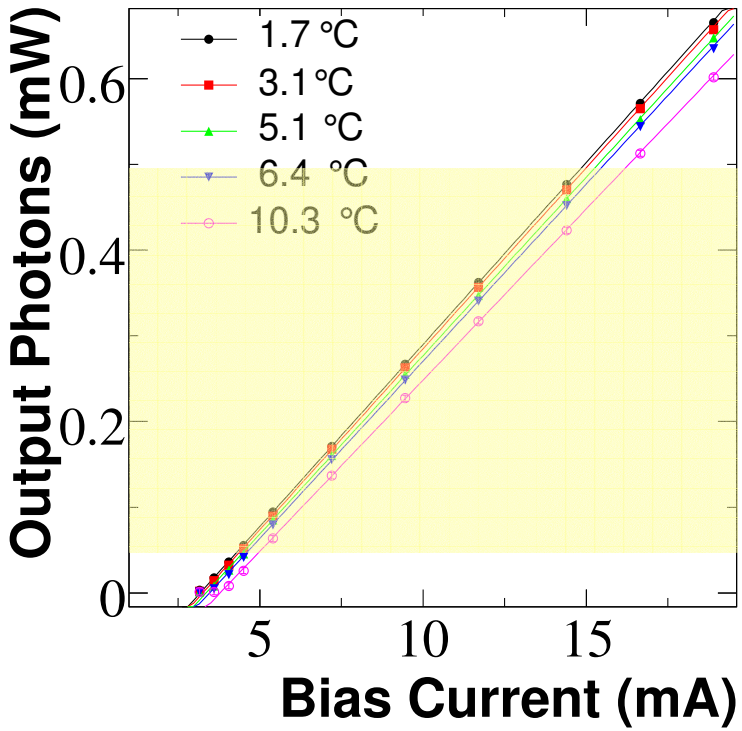
- **AOH: electrical/optical conversion, signal black level (in FED) is associated with bias current. Temperature sensitive.**
- **FED:**

  optical receiver: photodiode, amplifier (gain, DC offsets). Also temperature sensitive (seen by PSI before).

  Single channel offset adjustment.

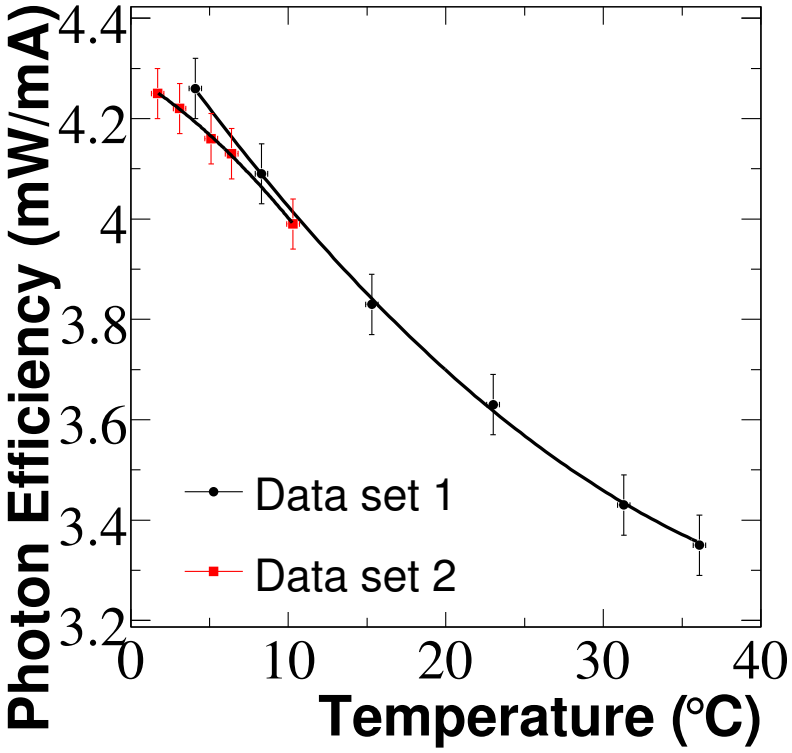
AOH – PL Curves

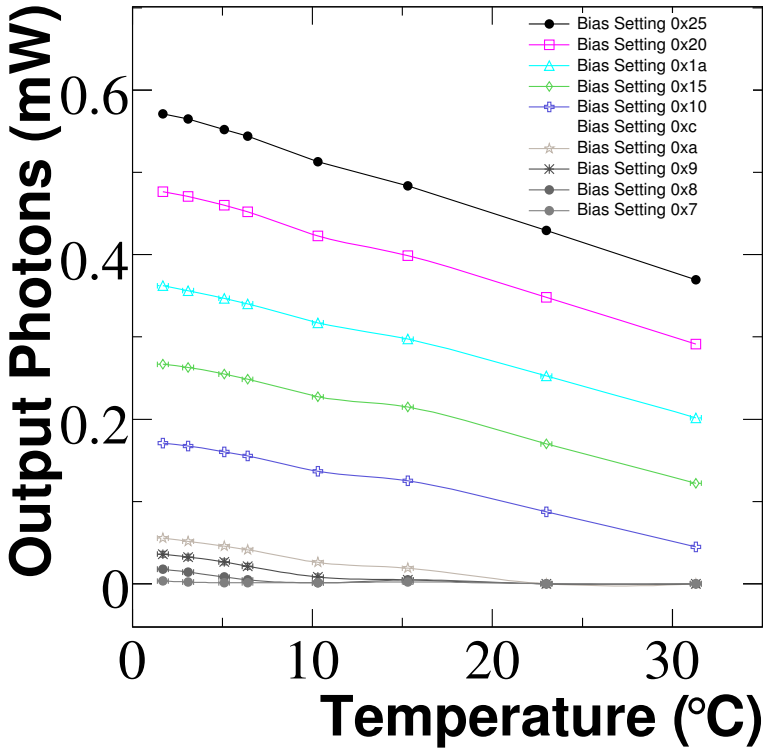




- **AOH output power vs. bias current @ different temperature.**
- **All temperatures are laser diode temperatures. (about 13 ºC higher than environment, same observation as strip tracker)**
- **Photon efficiency: slope of the linear fit to the shaded regions, which is the input range to the optical receiver on FED.**

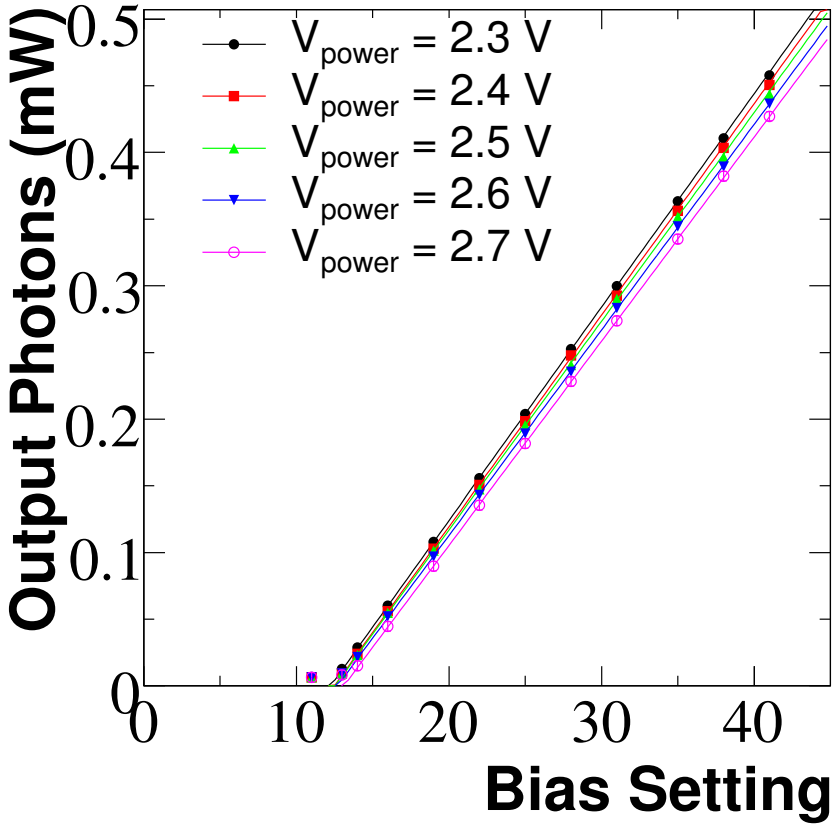
AOH-Temperature Variations

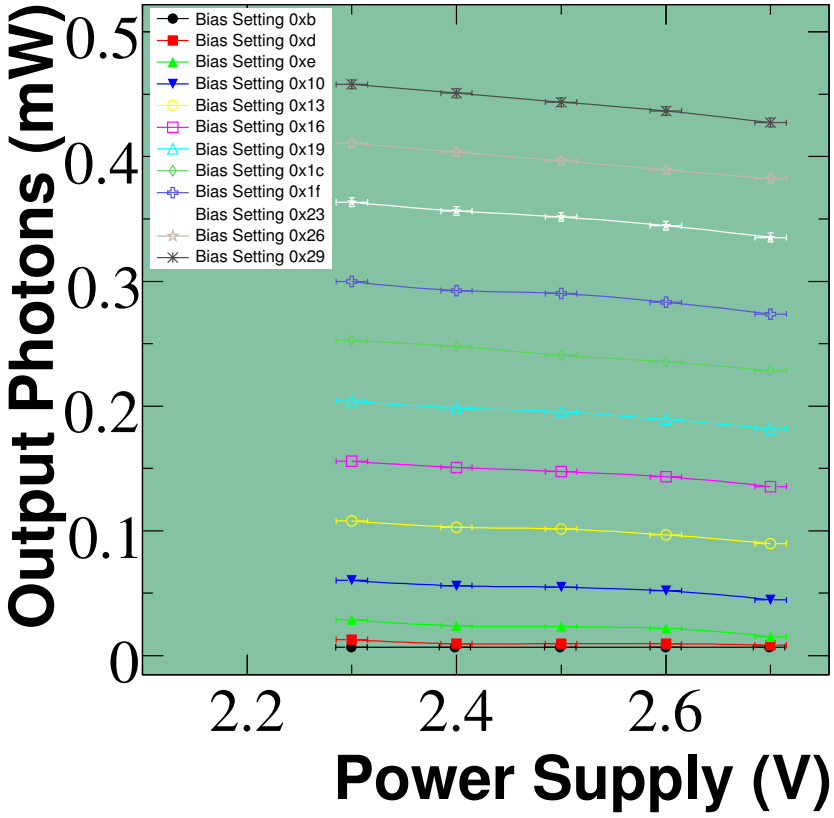




- **Photon efficiency: gain variation on the pixel signals.**
- **Output photon variation (same bias); base line shifting.**

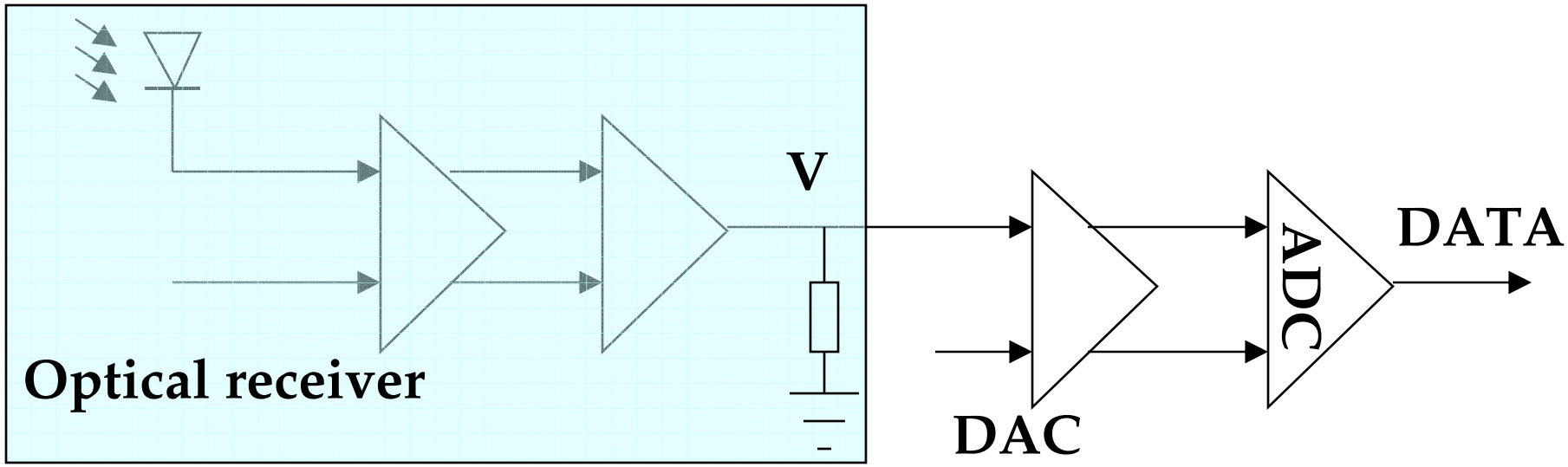
AOH – Power Supply





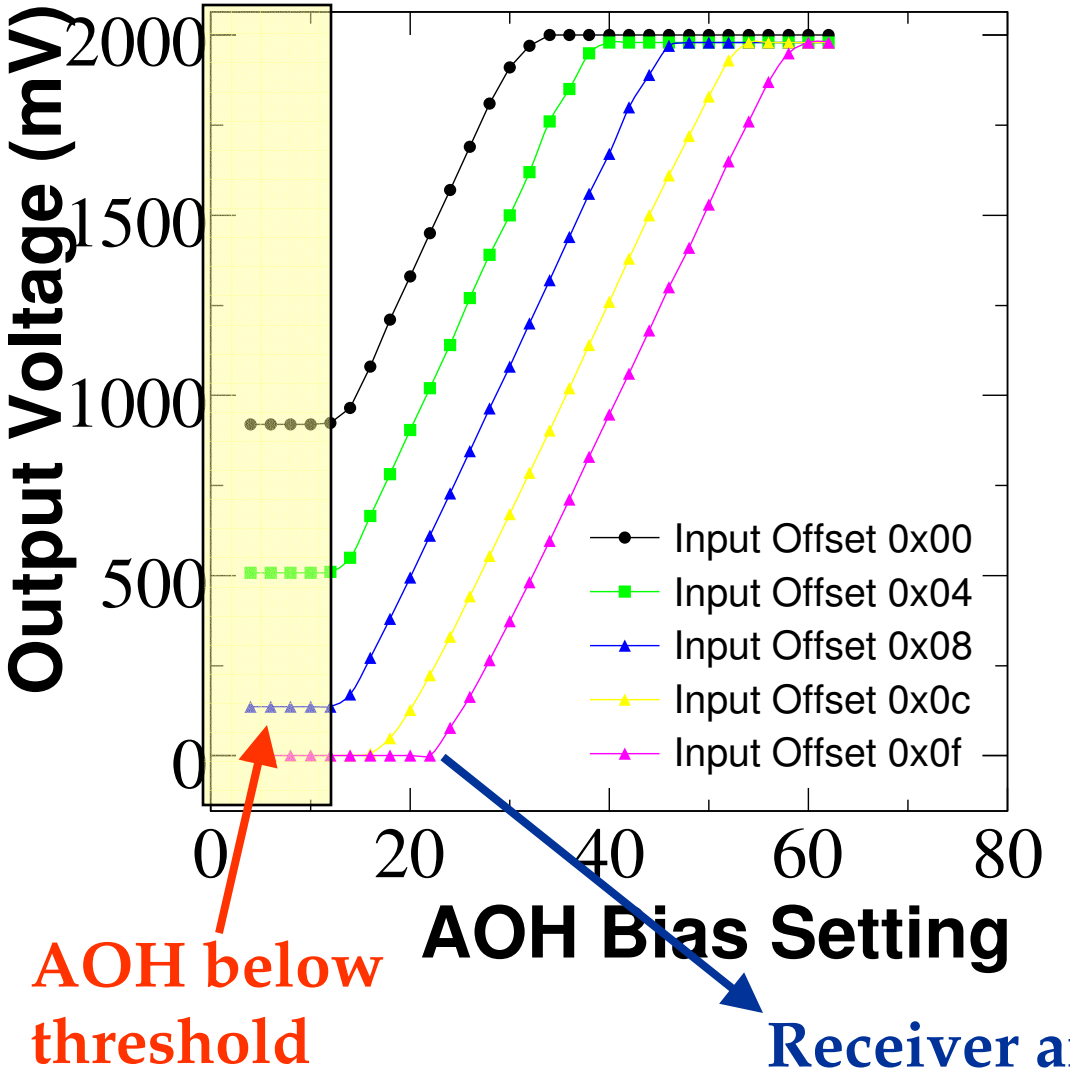
- **No voltage regulator for Linear Laser Driver (LLD) on the AOH. No voltage regulator on the used port card.**

Analog Signal Path on FED



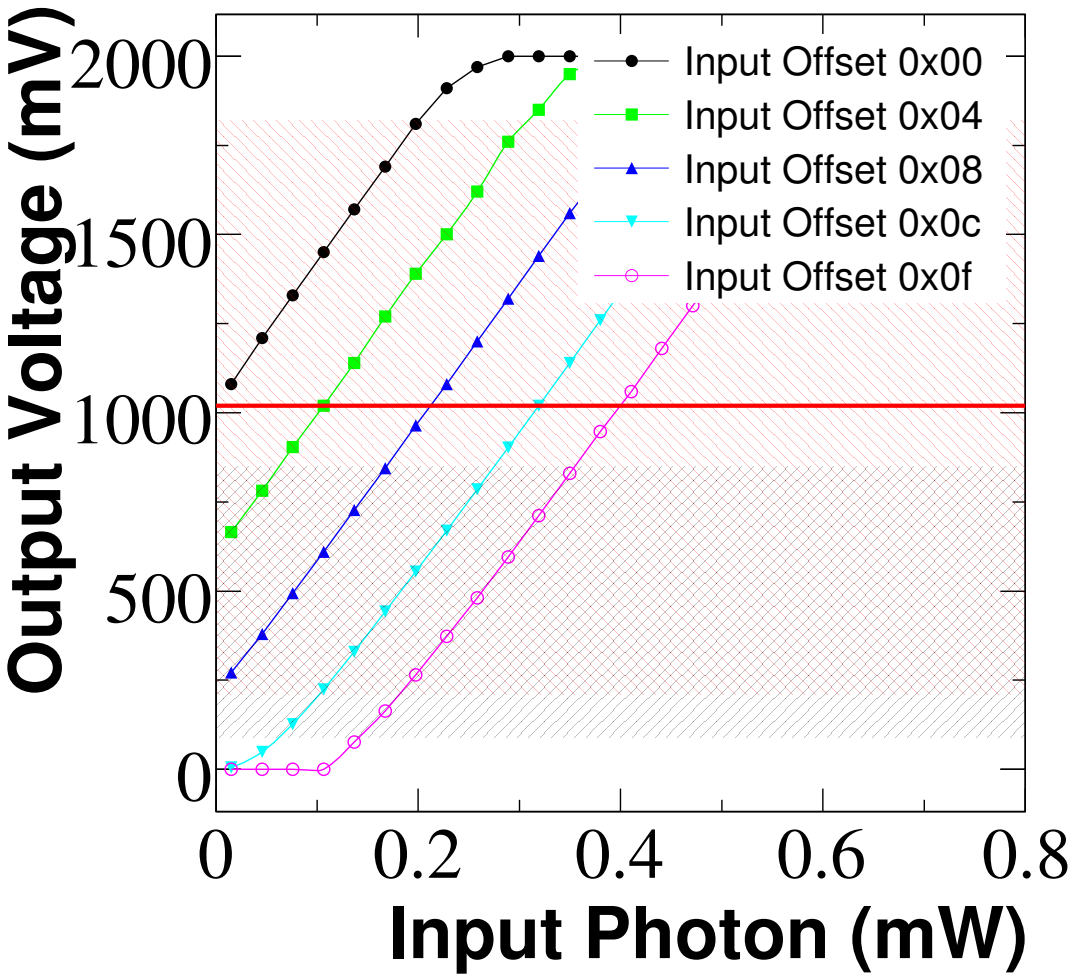
- **Using AOH to provide a optical signal, measured single-ended signal (V) and ADC counts with different input/output offset settings**

Amplifier on the Optical Receiver



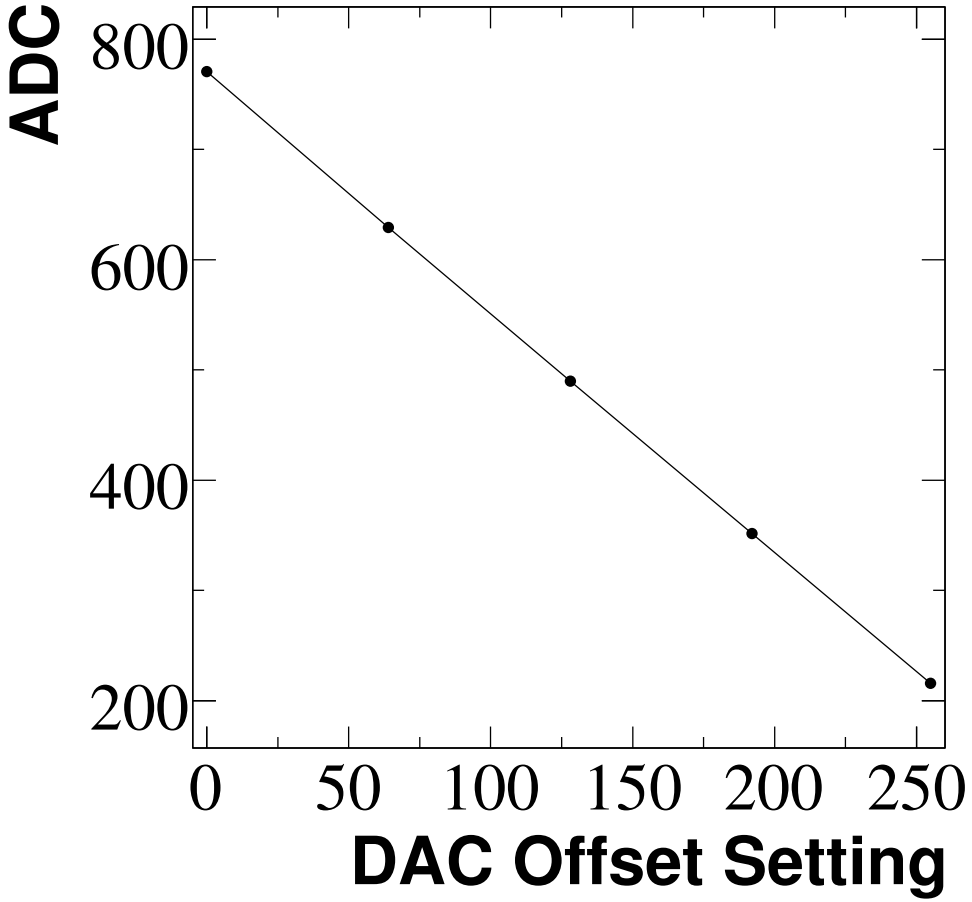
- **Amplifier gain: ~ 40**
- **Input range: ± 300 μA.**
- **16 input offset settings, sink maximum 375 μA current.**
- **4 output offset setting (0, 1, 2, and 3), add DC maximum ~ 7.5 mA current.**
- **Left:**
  - **Output offset 0**

ADC Counts



- Same figure, (converted AOH bias setting to photon power)
- Red shaded region: ± 200 μA input current to amplifier (best linearity)
- Black shaded region: voltage fitting into ADC range.
- DAC setting (0xff), output offset of optical receiver (0x0). Is DAC setting decrease DC level?

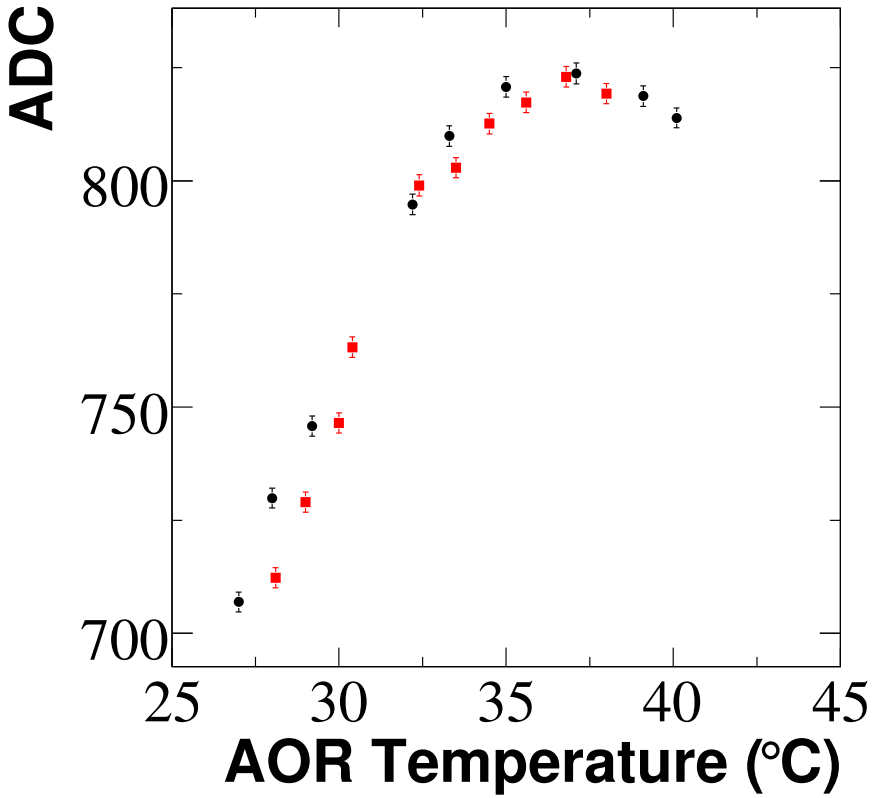
ADC Counts

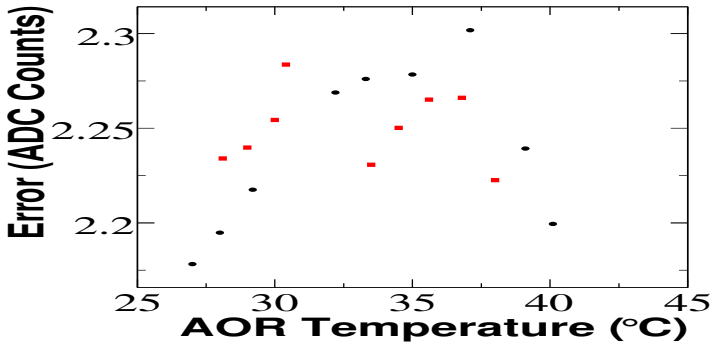


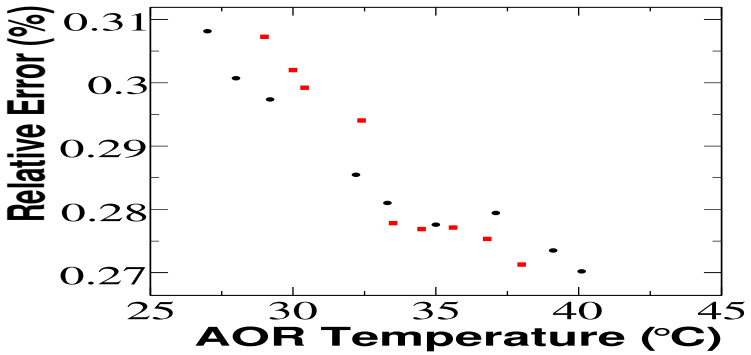
- One DAC setting, ~ - 2.2 ADC counts. (?)
- One input offset, ~ 180 ADC counts.
- One output offset, ~550 ADC counts.
- One mV (single-ended voltage) is ~ two ADC counts.

Is there a gain factor of 2 before sending signal to ADC?

Temperature Sensitivity – Optical Receiver



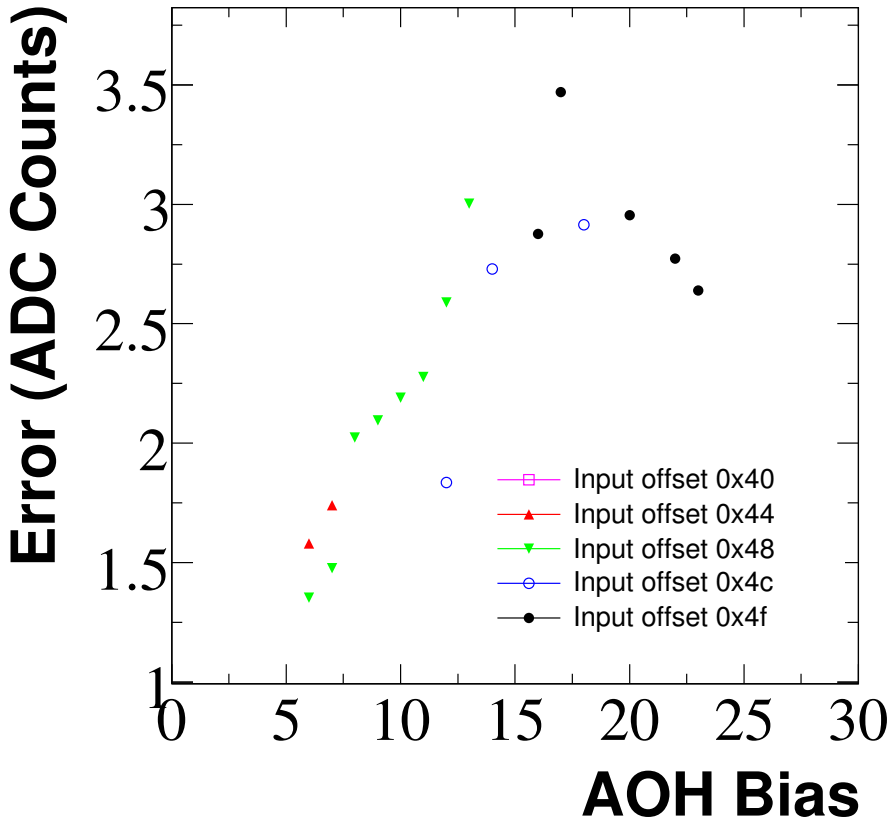


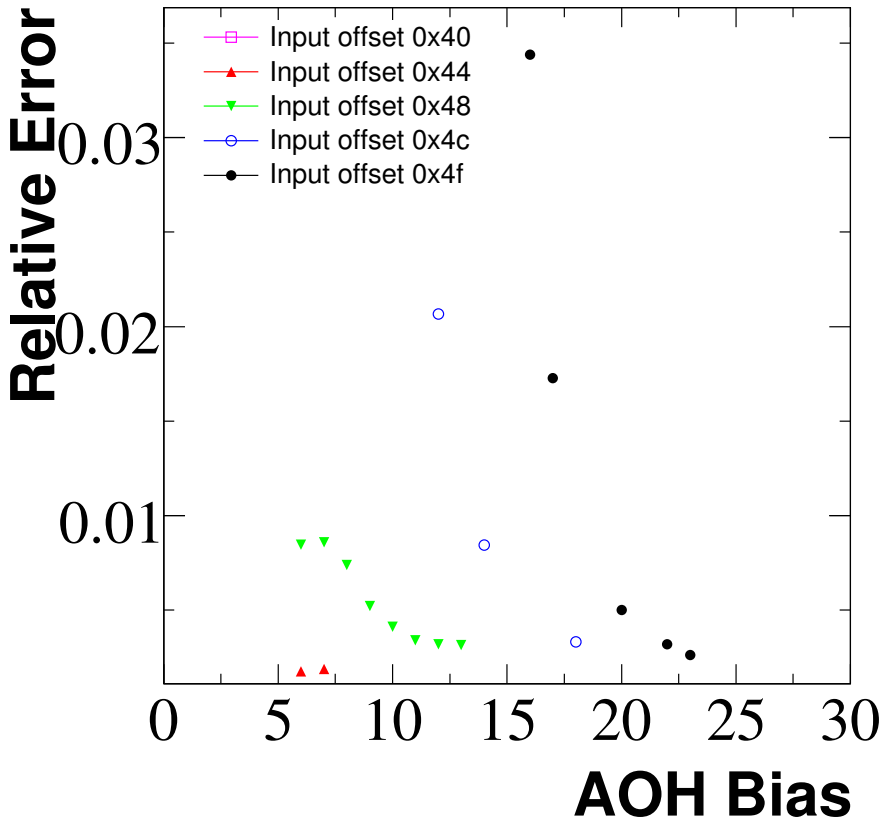


- Checked temperature variation of optical receiver (at two different days).

- AOH at 20 degrees, bias setting (0x1a); optical receiver 0x4c; FED DAC offset 0x0.

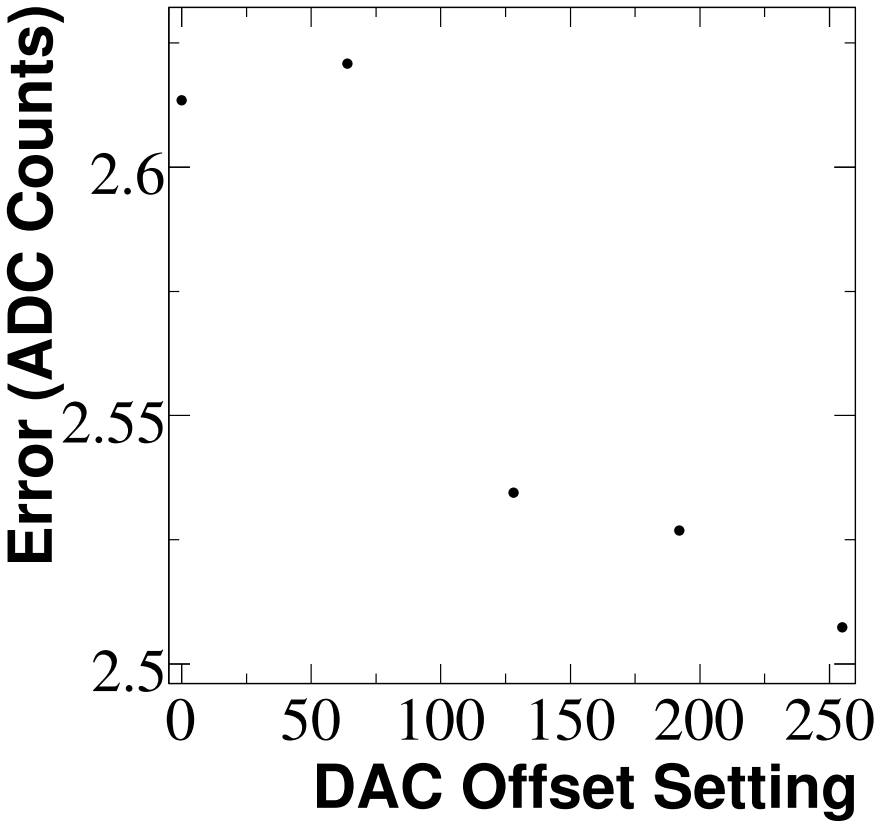
System Noise

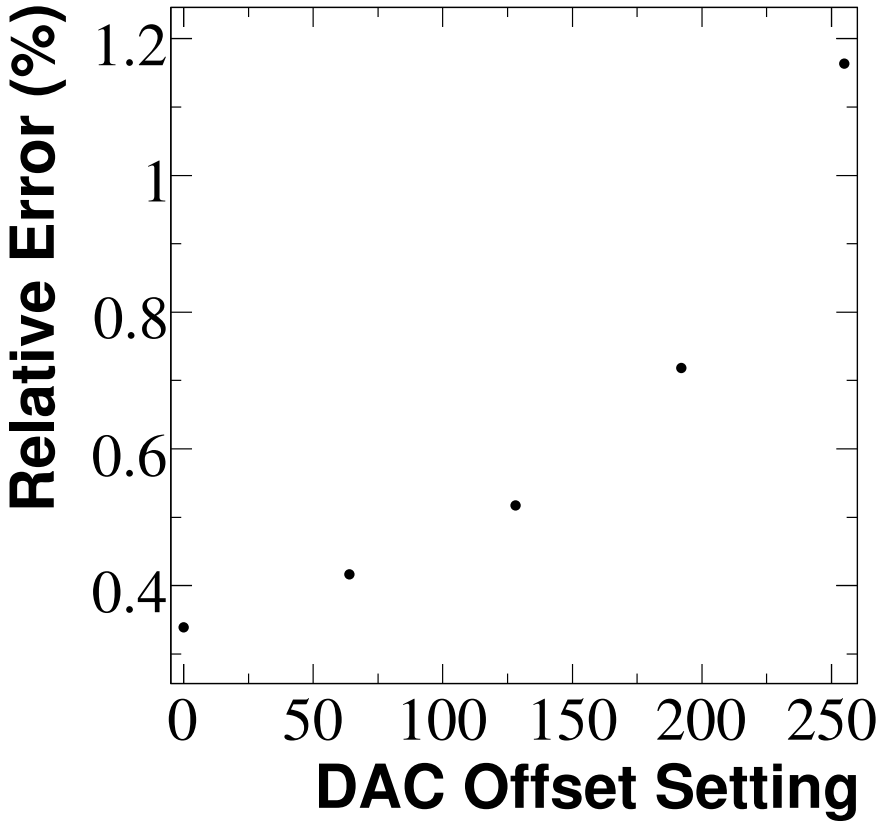




- AOH @ ~ -5 degrees; AOR about 34 degrees; optical receiver output offset (0x0); FED DAC setting (0x0).
- Every data point is average of 4000 transparent events, taken with 20 s.

System Noise (II)





- **AOH @ about ~ 33 degrees, bias setting (0x1a); optical receiver @ about 34 degrees, setting 0x 4c.**

Summary & Outlook

- **Pixel DAQ system is a very quite: system noise could be below 2 ADC counts.**

  However, depends on
- **How mechanically stable FED optical connector is.**
- **How well we can control the temperature of AOH.**
- **How well we can control the temperature of the FED optical receiver.**
- **Current understanding of the system enable us to really operate it in stable condition; will concentrate on the pixel data.**
- **Digital links: reliable ways to determine relative phase among digital signals, etc.**
- **Planning a procedure of commissioning 07 FPix detector in September.**