



Run2B Closeout

Andrei Nomerotski 2/5/2004

Outline

- **Scope of Closeout**
 - ◆ Finalize and document R&D activities
 - ◆ Closeout for L0 is very relevant to new L0 design
- **Sensors**
 - ◆ Long term tests
- **Hybrids**
 - ◆ Verification of new grounding scheme
- **L0 Modules & CF support structure**
 - ◆ CF support structure
 - ◆ Electrical tests of L0 modules
- **L2-5 Modules & Staves**
 - ◆ Tests of electrical stave
- **Summary**

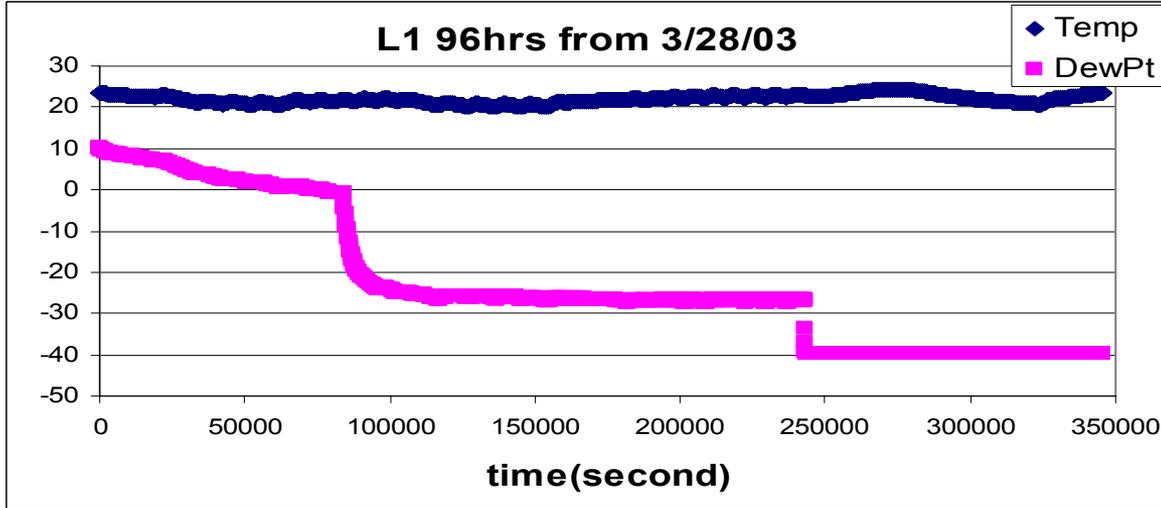


Sensors closeout

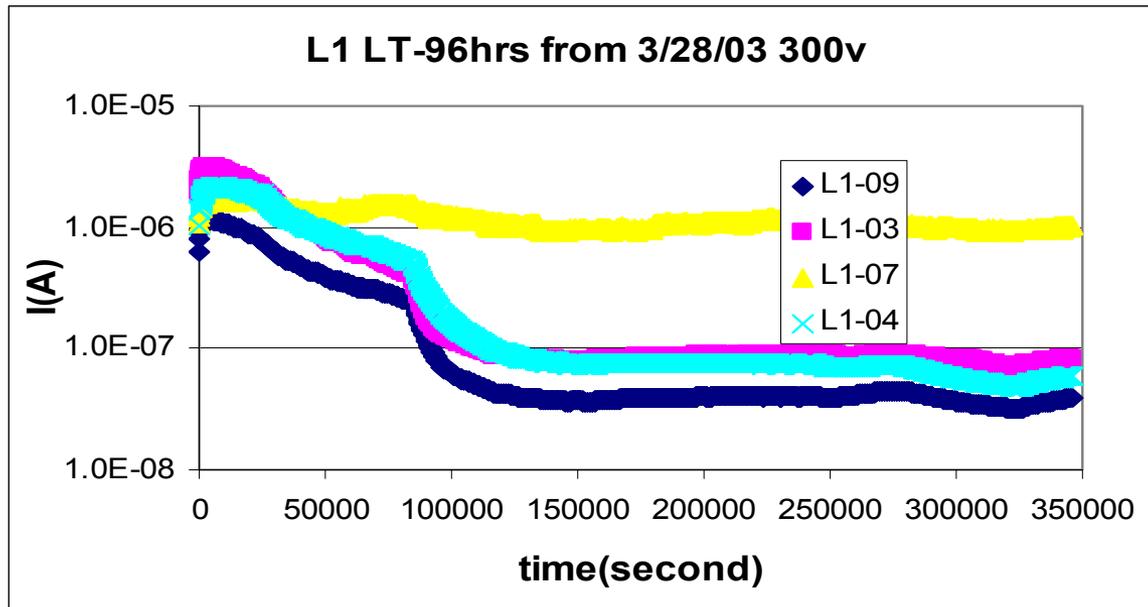
- Originally ordered 2735 L2-5 sensors from Hamamatsu
- Received 792 production sensors
 - ▲ Already had 100 prototype sensors
 - ◆ All received batches were partly tested
 - ◆ ~ 40 used for L2-5 module/stave assembly
 - ◆ ~ 40 used for long term studies
- Long term studies
 - ◆ Temperature and humidity effects
 - ◆ Effects of material on surface
 - ◆ Gluing effects
 - ◆ Guard ring bonding



Long Term Tests



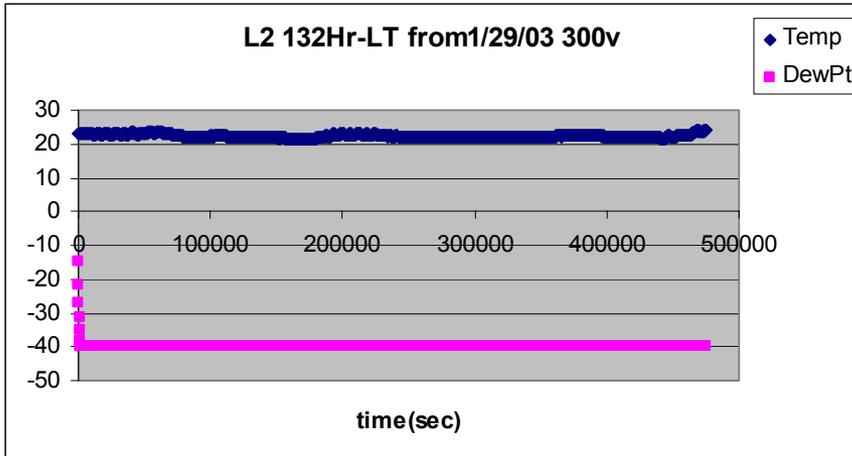
Examples of variation with temperature and humidity



- Humidity is important
- One of the sensors has big but stable current



Long Term Tests

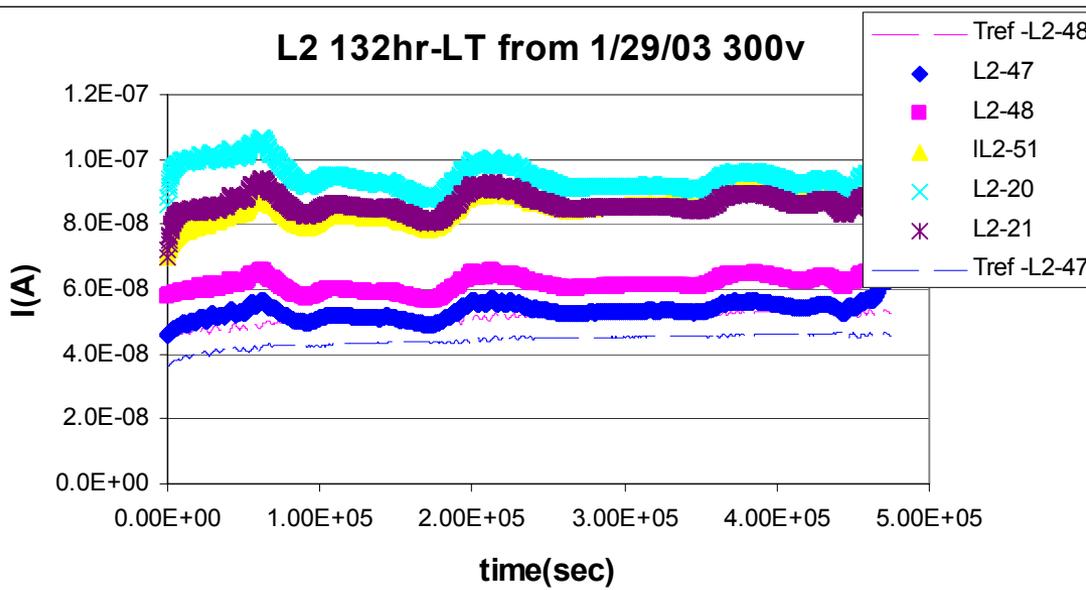


Current vs. Temperature

- Temperature is very important for IV
- The temp changed, so IV changed as well
- After temp correction curves look flat

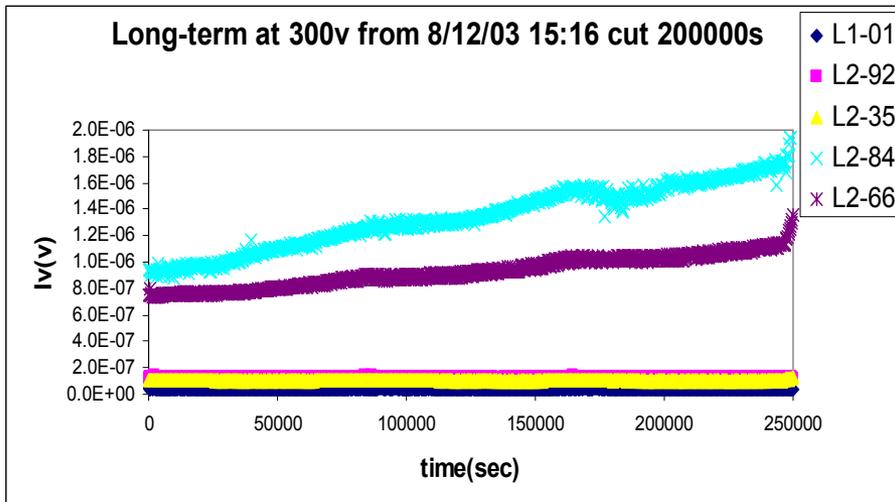
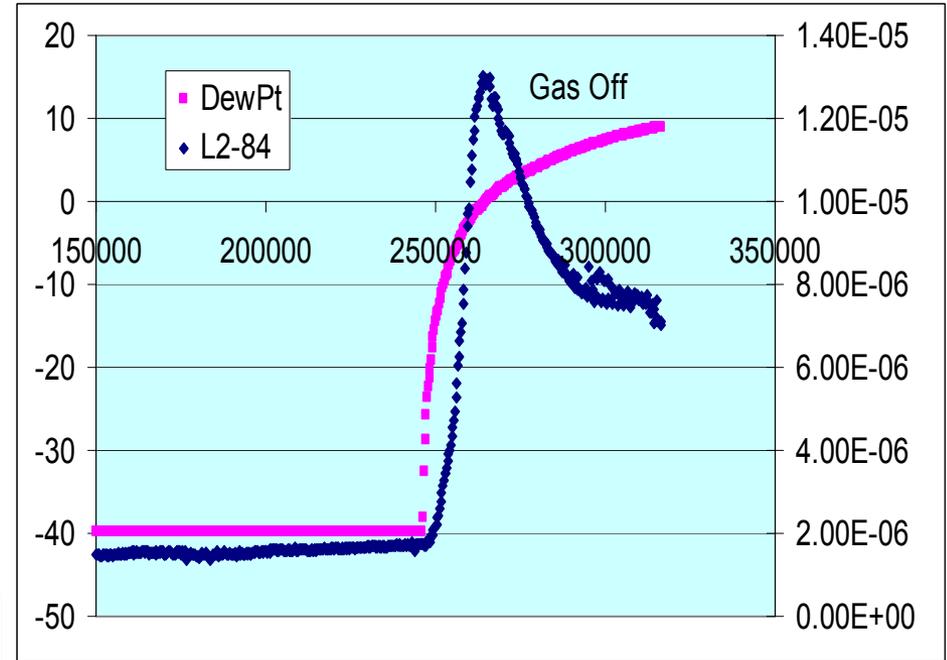
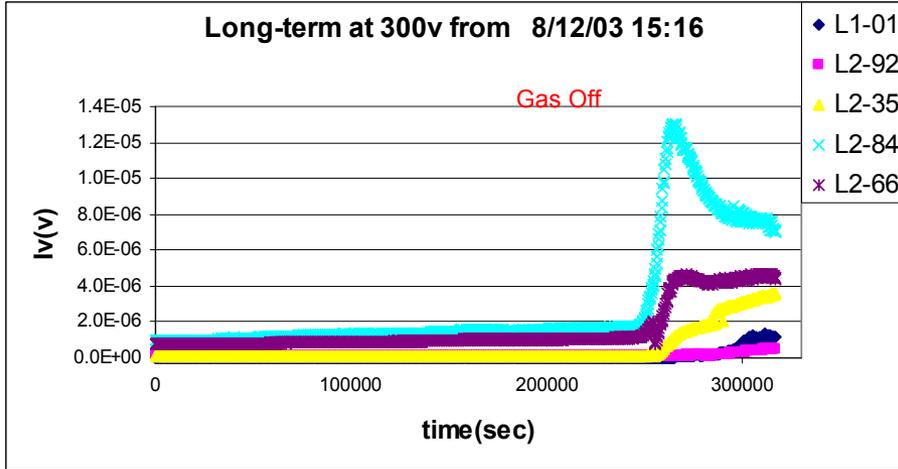
T correction:

$$I_m = I * (T_r / T_m) \times \exp(-E_g / 2k(1/T_r - 1/T_m))$$





Response to Humidity



- Sensors are sensitive to humidity
- Sensitivity varies among detectors.



Bond & Glue Studies

- Studied effect of gluing and bonding
 - ◆ Glued objects to the silicon surface
 - ◆ Bonded bias and guard ring with different number of bonds
- All it matters at higher humidity
 - ◆ When DewPt is lower than 5 c, gluing and GR bonds have no visible effect on sensor current.
 - ◆ When DewPt is higher than 5-8 c, Current of some glued sensors (L2-866 148 149) increased with DewPt, some (L2-842 and 850) had no change.
 - ◆ When the dew point is higher than 5-8 c, guard-bias bonded sensors (L2-850, 866) had much bigger I than bias only. But for low dew point they had almost the same current, and the current did not change with dew point.
- When the humidity decreased to low values the current of sensors returned to normal
 - ◆ So sensors do not appear to be damaged.



Hybrid closeout

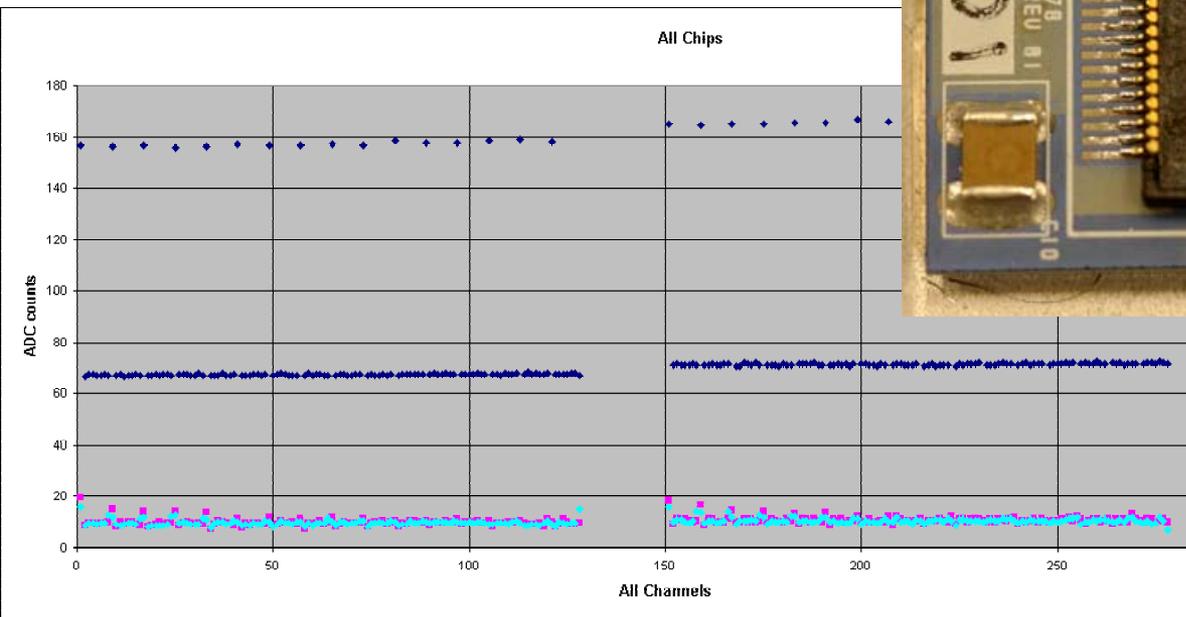
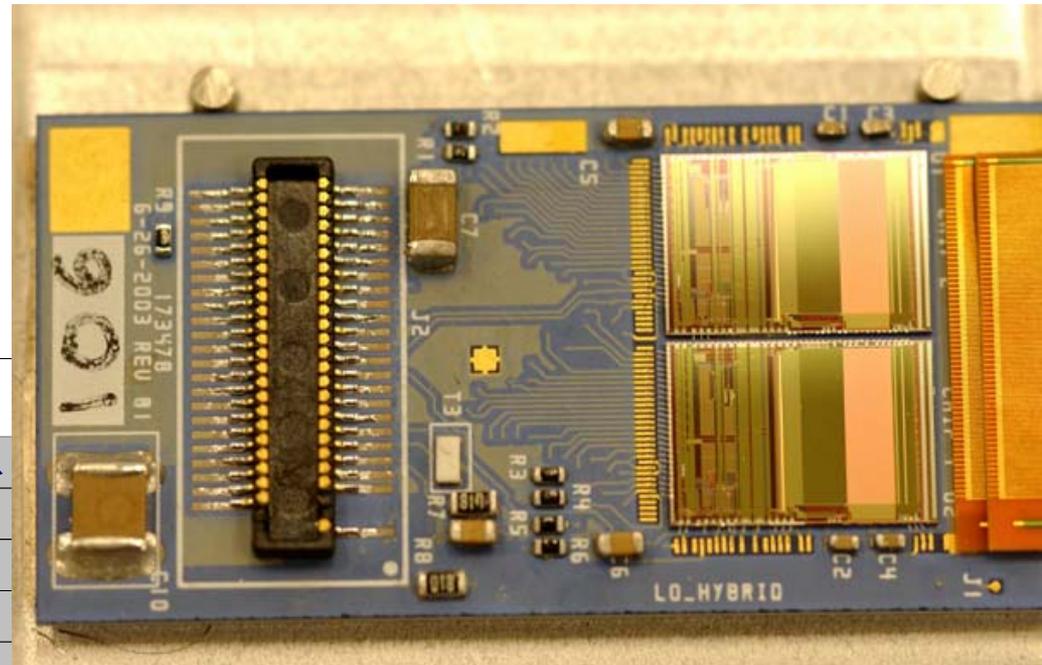
- Received new L2-5 hybrids from 3 vendors
 - ◆ Tested all batches mechanically
 - ▲ Flatness was a primary concern
 - ◆ Tested a few hybrids electrically
- Amitron and CPT were within specs, Halcyon failed to meet the flatness spec by far
- Orders are closed, closeout for L2-5 hybrids complete

- Received 25 new L0 hybrids from Amitron
 - ◆ New grounding scheme
 - ◆ Extensively tested - will be used for new Layer 0 without changes
 - ◆ See results next slides



New LO hybrids

- Assembled and tested 12 new LO hybrids
 - ◆ Used latest revision of SVX - SVX4.2B
 - ◆ Used 1.5 mm profile MOLEX connector planned for new Layer0
- Results are very good
 - ◆ Noise 1 ADC count
 - ◆ Flat pedestals
 - ◆ Plot below shows
 - ▲ Calinjects
 - ▲ Total & differential noise





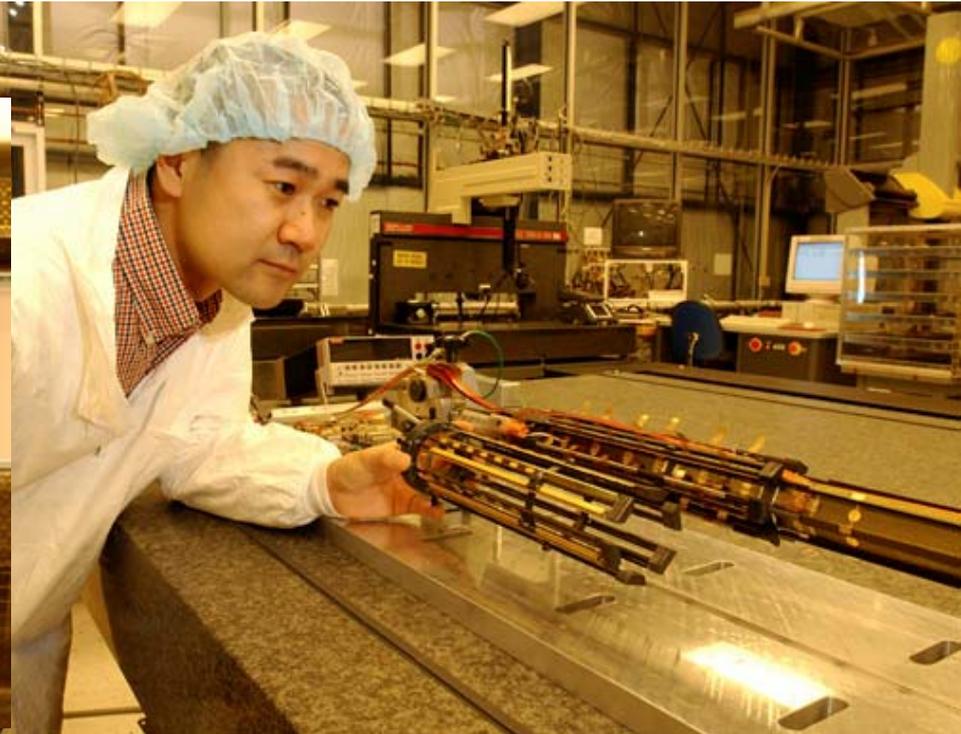
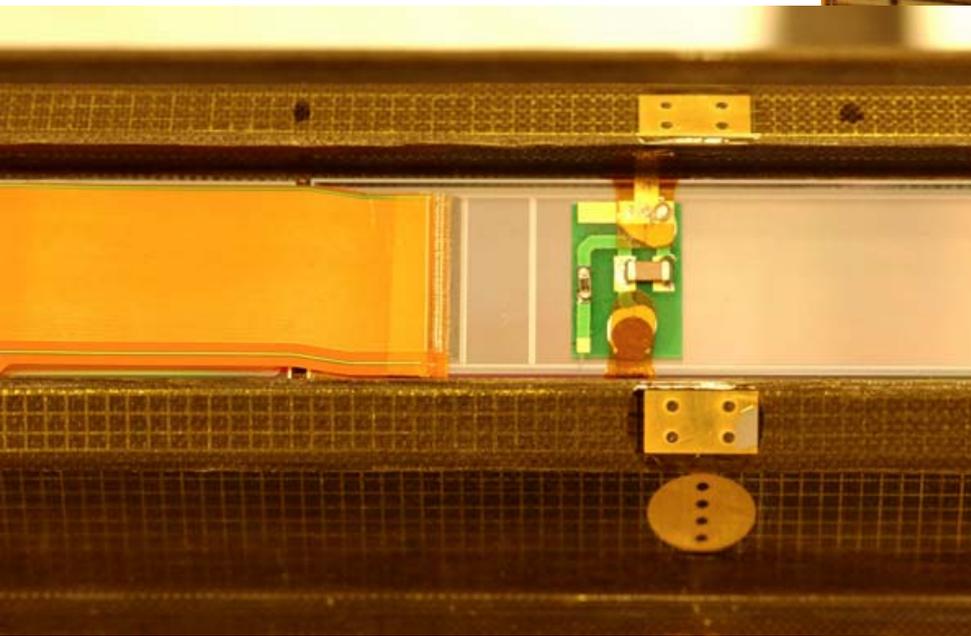
L0 closeout

- New Layer 0 will have very different design
- However the original Run2B Layer 0 allowed to prototype many aspects of the new design
 - ◆ CF support structure
 - ◆ Grounding/noise issues
 - ◆ Assembly issues
- Received the new support structure in December 2003
- By now mounted on the structure and tested four L0 modules
- Plan to report results at APS meeting in May 2004
- This work will continue and become eventually Layer 0 project activity



LO support structure

- Prepared by University of Washington
 - ◆ Implements new grounding approach : laminated ground mesh covering all surface
- Measured mechanically before module installation - OK





New LO modules

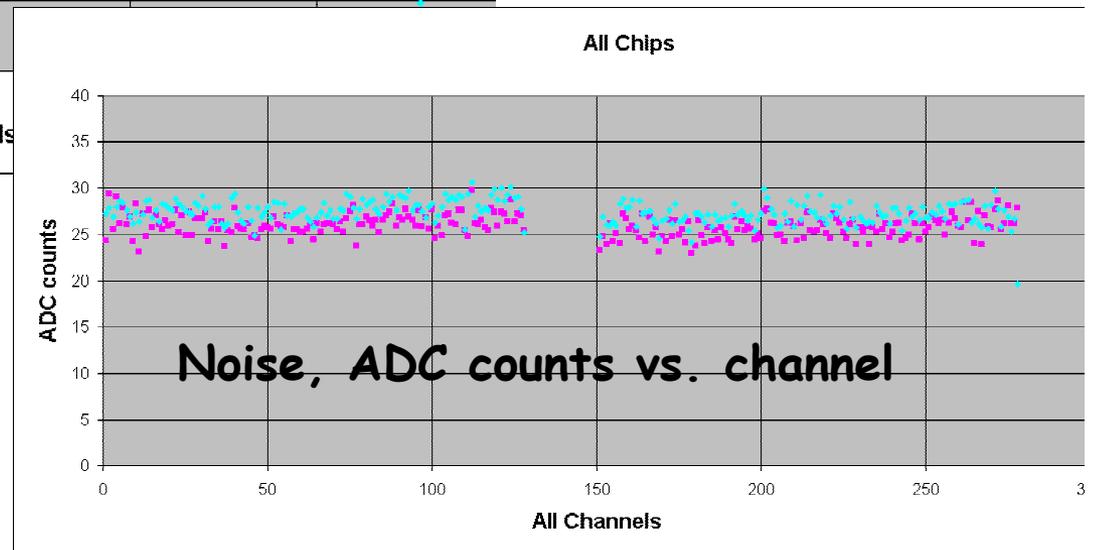
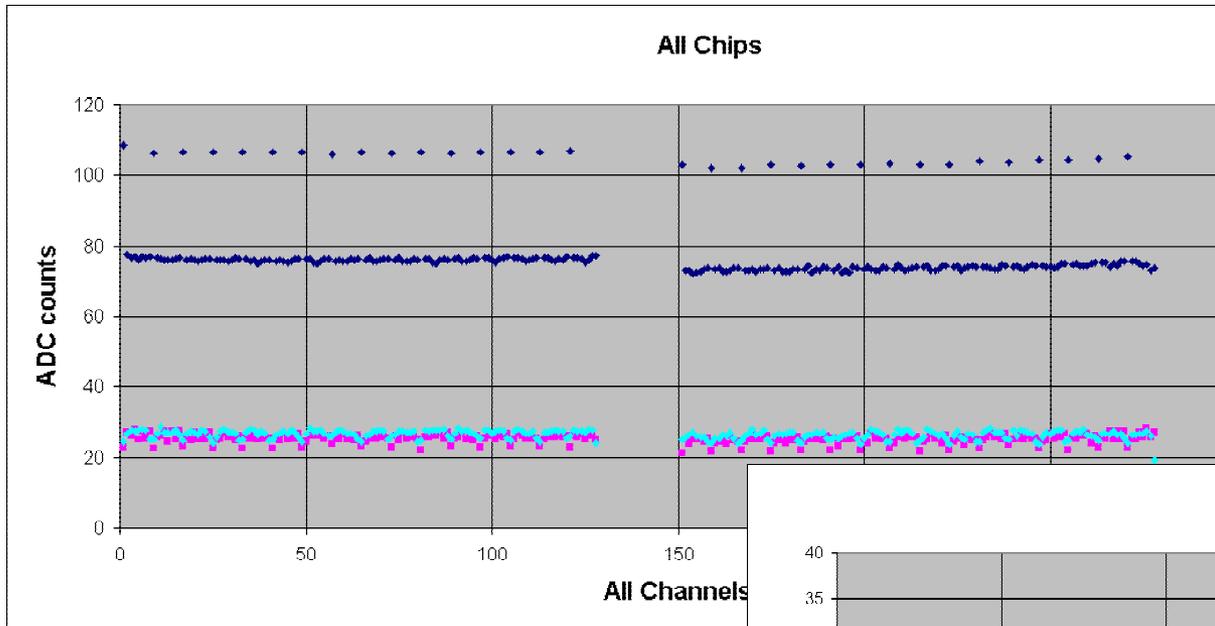
- Had 2 LO modules ready to be mounted
 - ◆ ELMA LO sensors
 - ◆ Rev.1 LO hybrids
 - ◆ Dyconex analog cables
 - ▲ longer than we need now
- Mounted on the support structure in layer OA (smaller R)
- See results of tests, next slide

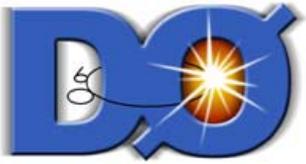
- Assembled 4 new LO modules
 - ◆ All same as above but Rev.2 hybrids
 - ◆ All modules have good performance
- Mounted two modules in layer B (larger R)
- Testing is in progress



L0 module with rev.2 hybrids

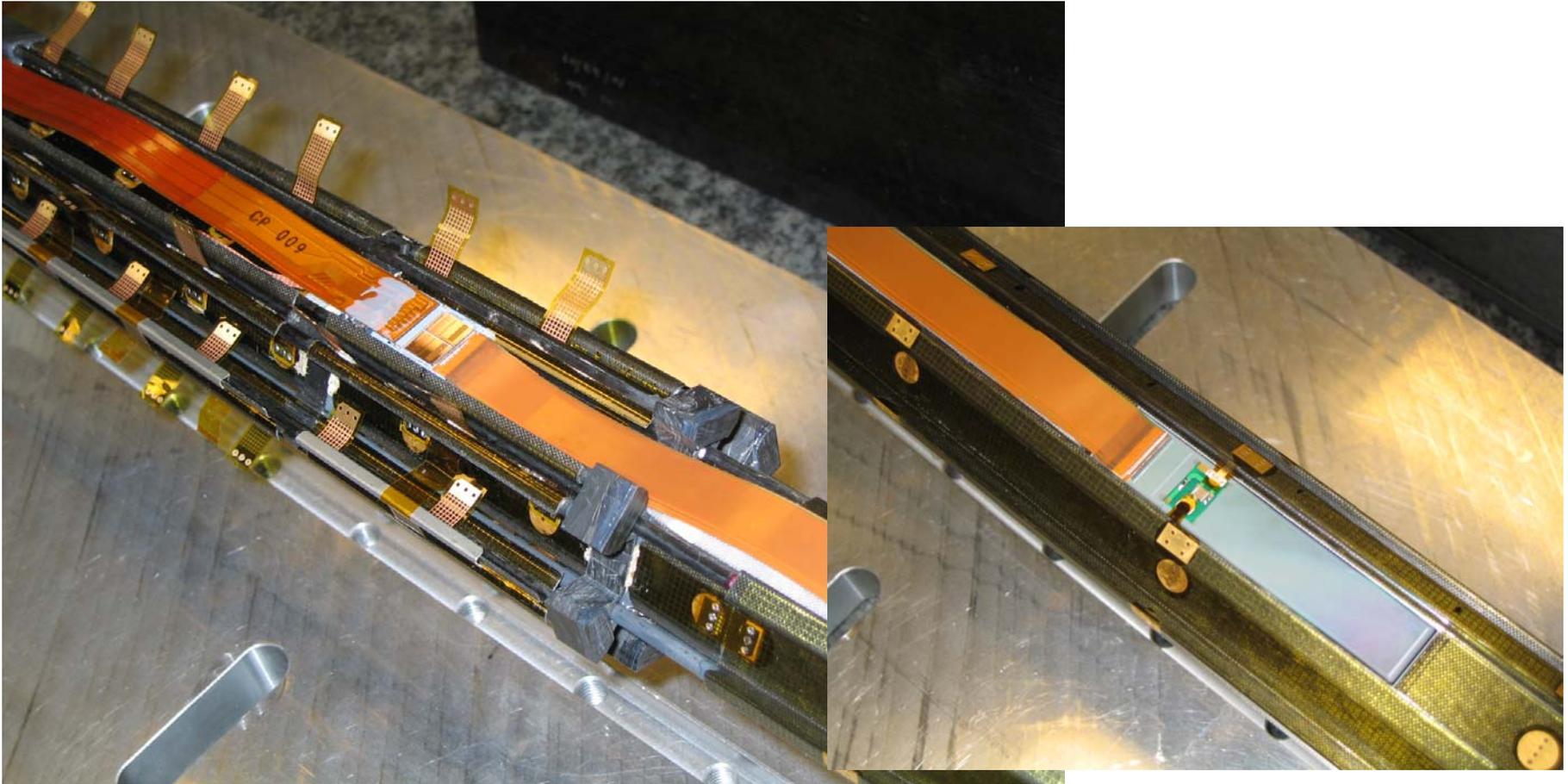
- Note that module is not in the Faraday cage





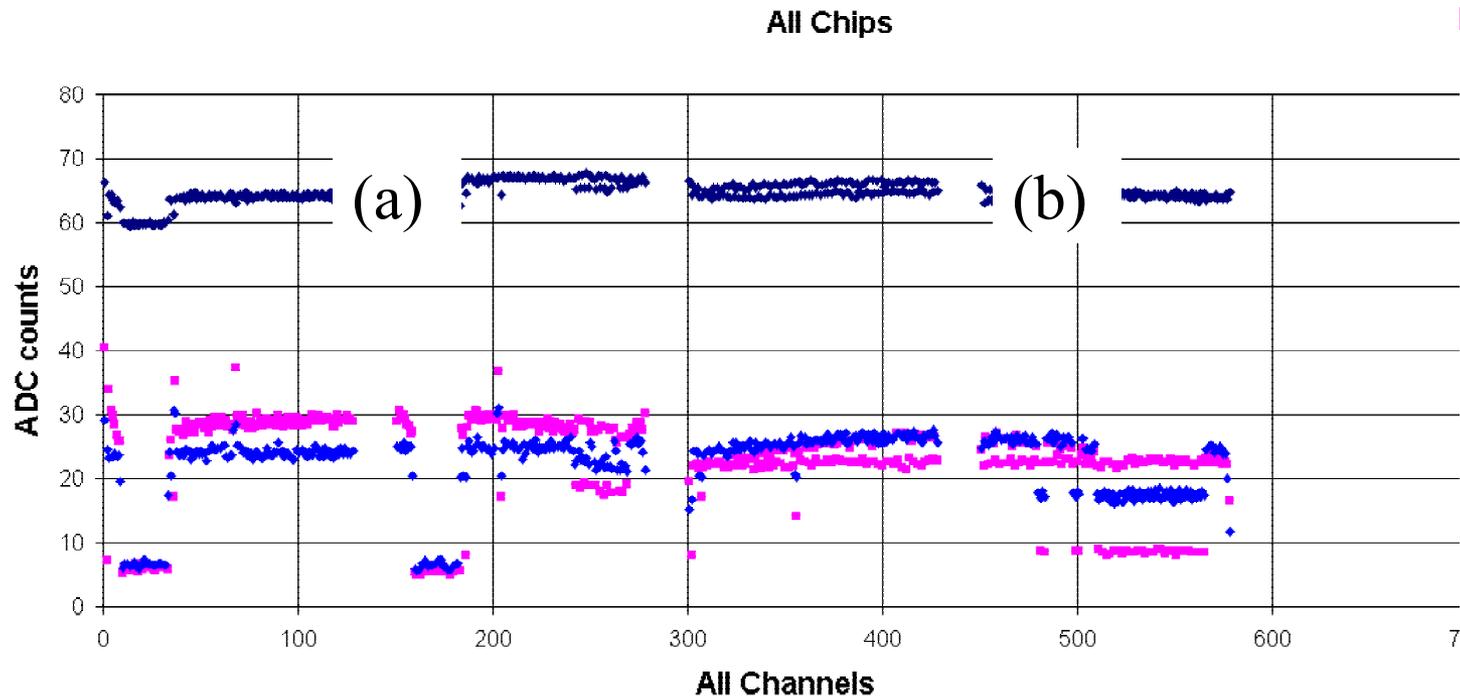
LO module on the structure

- Two modules are installed on the sector-A





LO modules on the CF structure



- Noise practically the same as before – proof of principle for the new grounding approach
 - ◆ No Faraday cage - in fact no shield at all (!)
- Took data at 20V (plot above) and 60V and different chip settings
- temperature stable @~35°C (no cooling now - may need cooling later)



Even odd effect



- For one module see that even - odd pedestals are split by 1-2 counts

- ◆ Small effect (in fact see it only because SVX4 is so good!)
- ◆ Present in analog cable closer to structure
- ◆ Will study more (as function of distance etc)

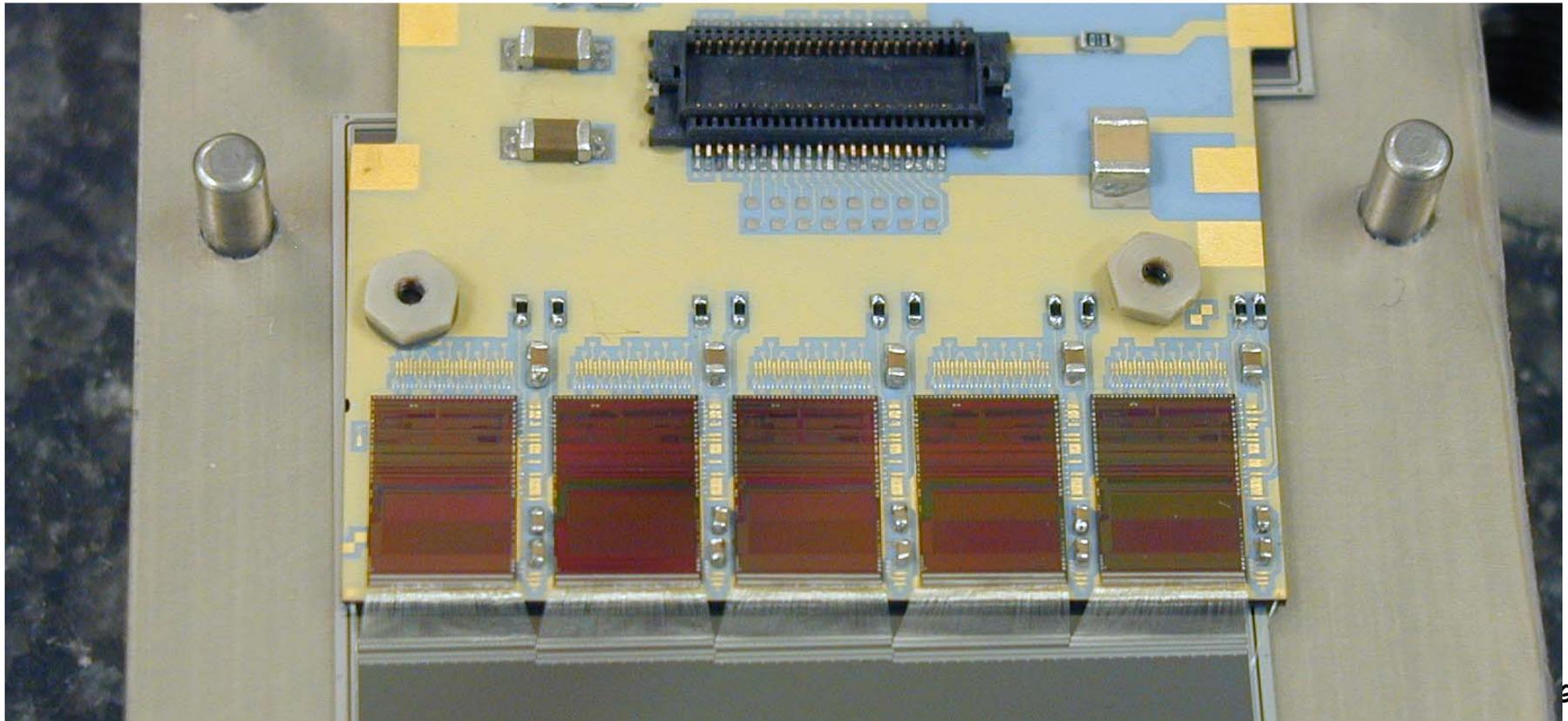
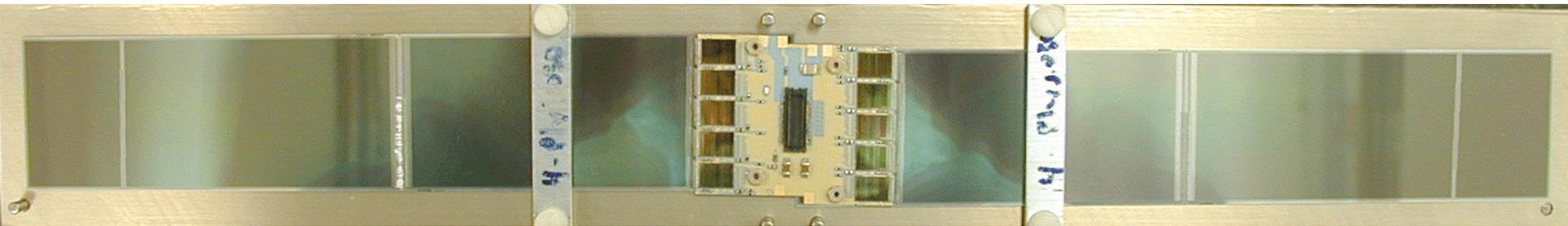


L2-5 module/stave closeout

- Stave includes 4 types of modules
 - ◆ axial 10-10, axial 20-20
 - ◆ stereo 10-10, stereo 20-20
- Assembled 12 L2-5 modules
 - ◆ 6 modules work ok
 - ◆ 2 have problems
 - ◆ 4 need testing
- Assembled one electrical grade stave
- Stave tested both in the standalone mode and with full chain readout



L2 Stereo 20-20 Module

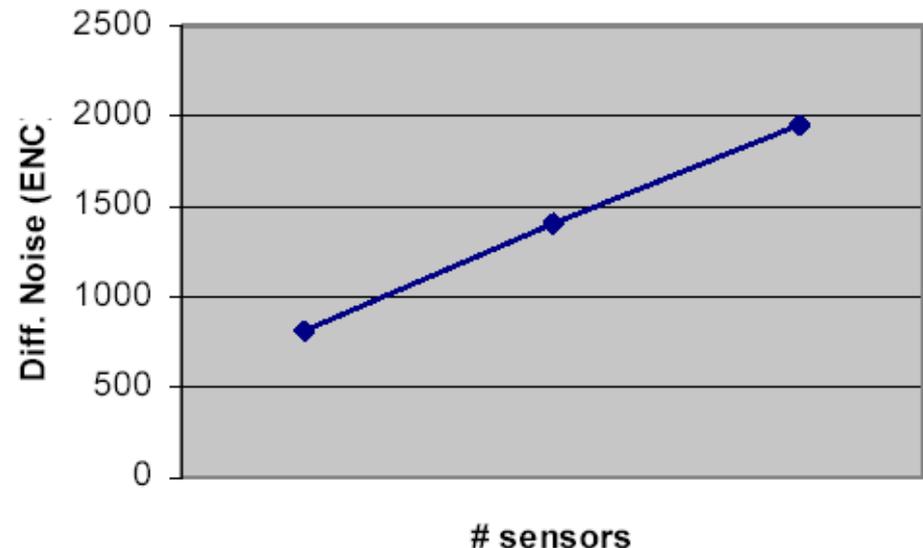




L2-5 module noise performance

- Measure ENC = 800 e + 600 e /sensor
- Expected ENC = 500 e + 40 e /pf
 - ◆ Agrees with measurement assuming
 - ▲ Setup noise of 600 e
 - ▲ 1.5 pf/cm of capacitive load
 - ▲ Negligible contributions from other sources of noise
- Signal/Noise (preliminary)
 - ◆ Assume MIP = 22000 e
 - ◆ 20-20 modules S/N = 11
 - ▲ S/N = 12 in TDR
 - ◆ 10-10 modules S/N = 16

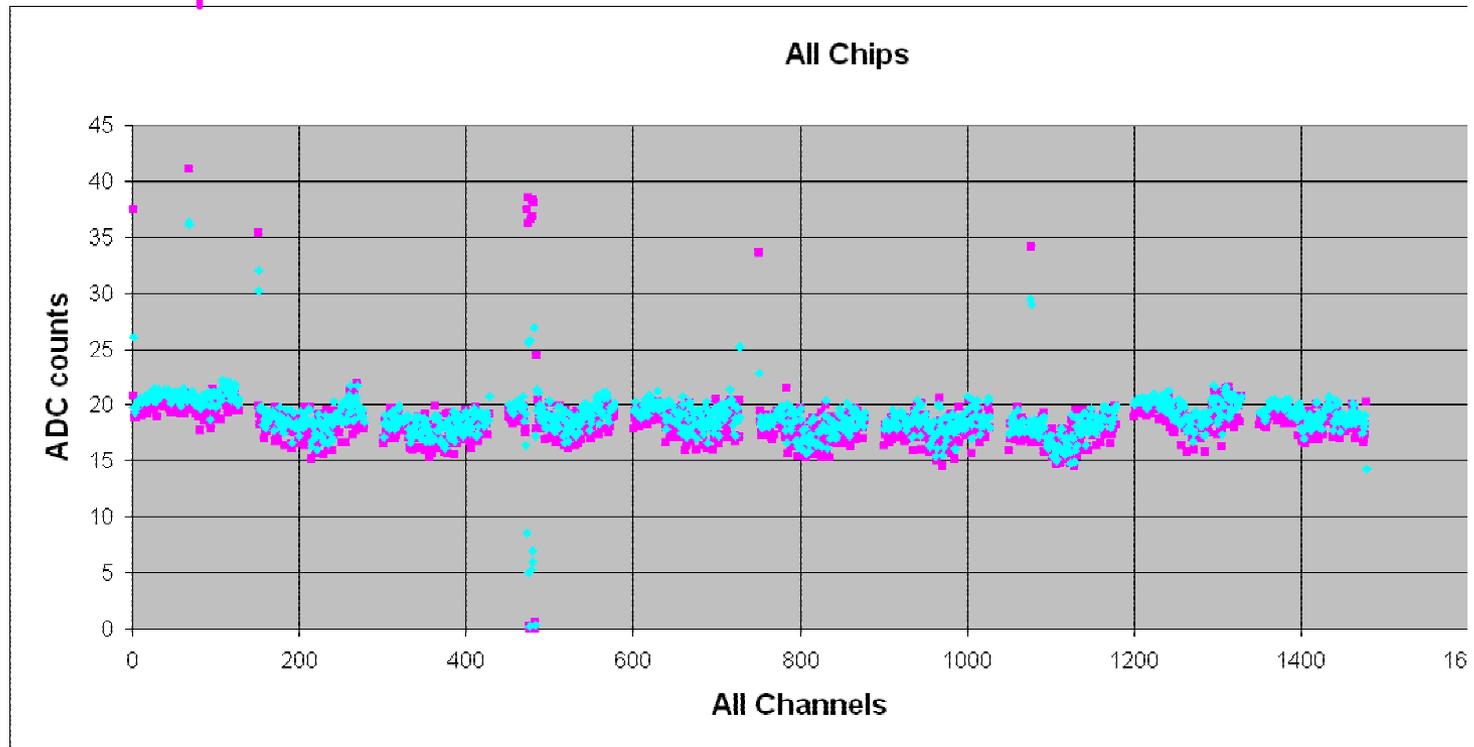
Differential noise vs # sensors





L2-5 module performance

- L2S 10-10 module
 - ◆ Non irradiated sensors fully depleted @ 80 V bias
 - ◆ All chips bonded to sensor



Differential noise [ADC counts x 10]
Total noise [ADC counts x 10]



Electrical stove

- Has 4 working modules
- Dry gas enclosure

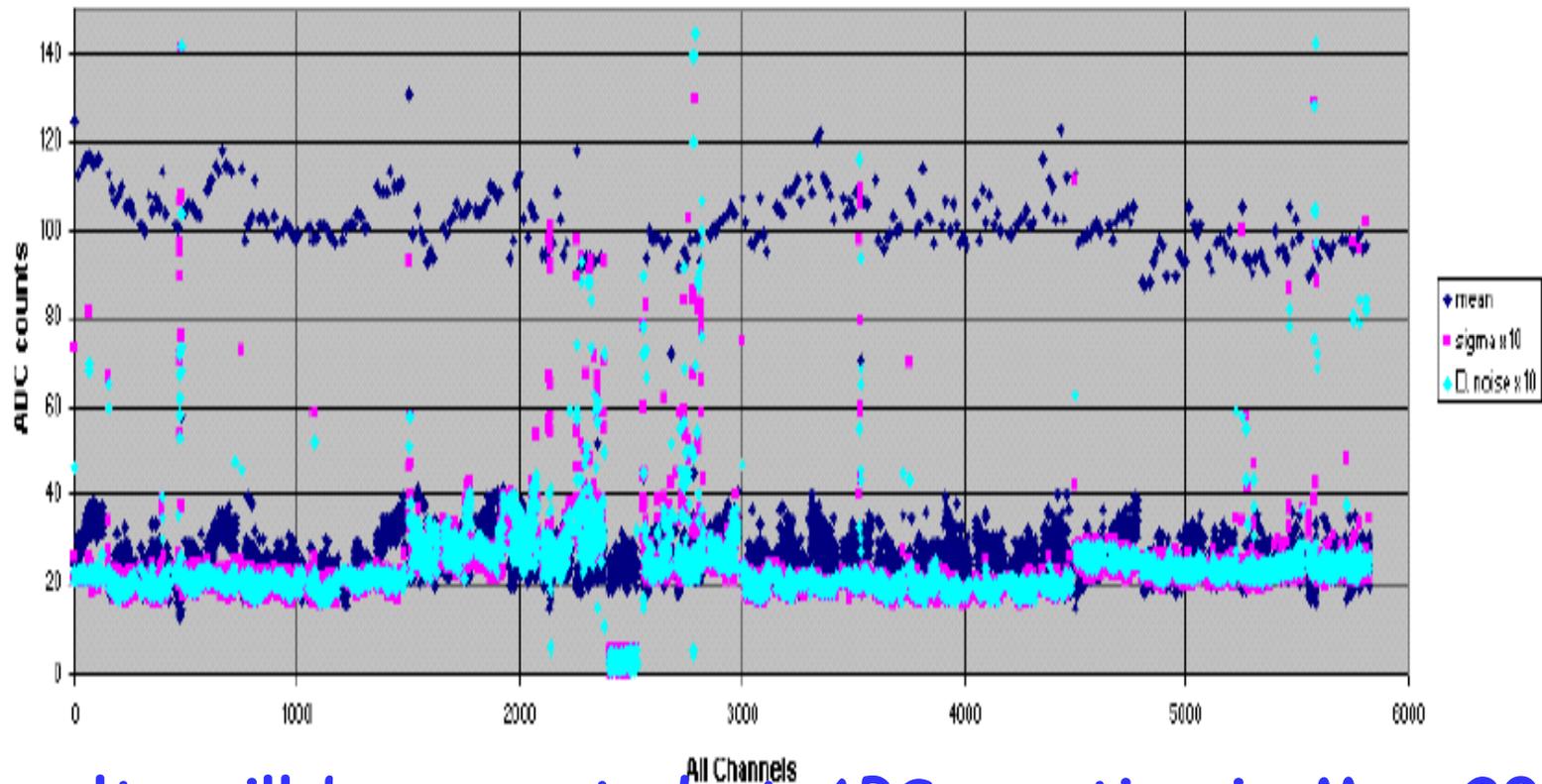




Tests of Electrical stave

- No surprises - all modules behave in the stave as they behaved before

Stave 001, bias voltage 100V



- Results will be reported at APS meeting in May 2004
- Thinking if we need more staves, may be not



Summary

- We are on track for Run2B closeout
 - ◆ Sensor/Hybrids/L2-5 module closeouts complete
- Closeout for original Run2B Layer 0 produces very useful information for the new Layer 0 project
- LO and stave results will be reported at the APS meeting

- We are within budget for the closeout