

PXL Electronics

Status update for HFT TC meeting on
May 11, 2010 at LBNL

Outline

- FY10 Tasks
- Status of Tasks
- Schedule

PXL Milestones

Plan “B”

- ~~2010-Q1 – Phase 2 sensors delivered to LBNL.~~
- 2011-Q2 – Receive prototype final sensor.
- 2012-Q2 – Install prototype detector at STAR.
- 2012-Q4 – Receive production sensors.
- 2013-Q4 – Install PXL detector.

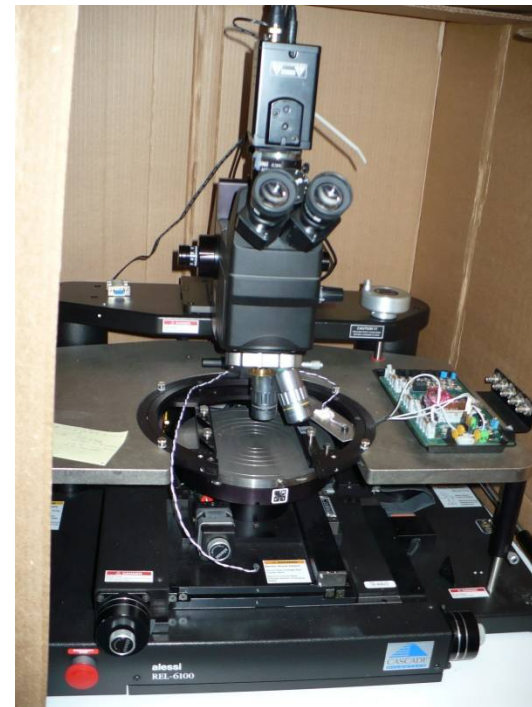
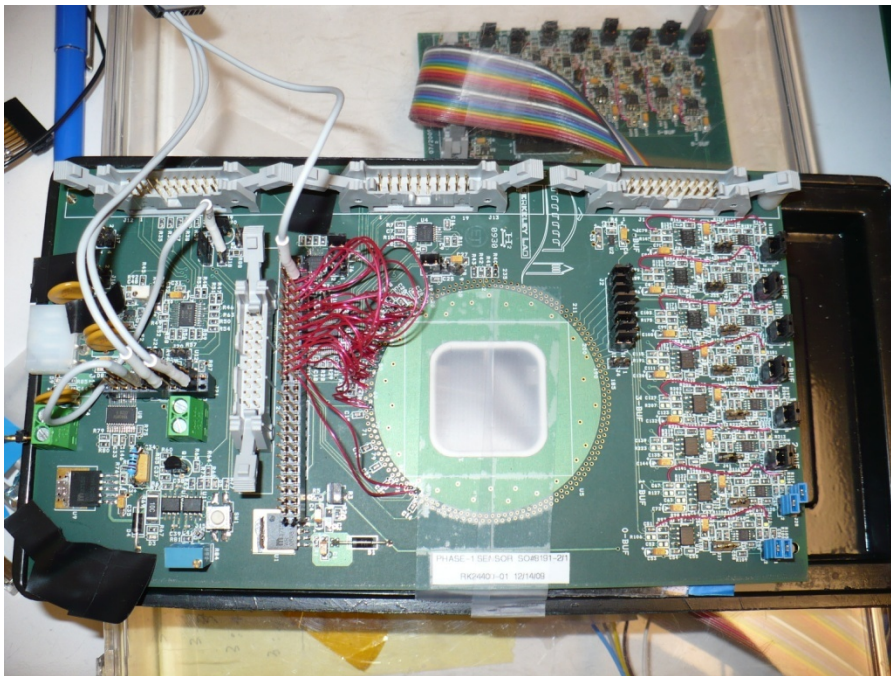
FY10 Tasks

- PXL Cable development
 - Infrastructure testing board
 - Prototype detector cable FR-4 with Cu
 - Prototype detector cable Kapton with Cu
- Probe Testing
 - Phase-2 sensors
- RDO prototyping
 - Full ladder RDO
- Sensor and system development and testing
 - Beam test with Phase-2 @ Fermilab
 - Beam test preparation for Phase-2 sector at PHENIX?
- CD-2/3

http://rnc.lbl.gov/hft/hardware/docs/Group_Tasks_and_timeline_2010_01_25.pdf

Probe testing Status

- We have a probe testing hardware design and testing plan here http://rnc.lbl.gov/hft/hardware/docs/Phase1/Probe_Testing_Phase1.pdf
- We have developed a sensor tracking and QA plan here http://rnc.lbl.gov/hft/hardware/docs/Phase1/sensor_tracking_proposal.doc
- We have designed and produced a probe card and mated it to a probe testing station



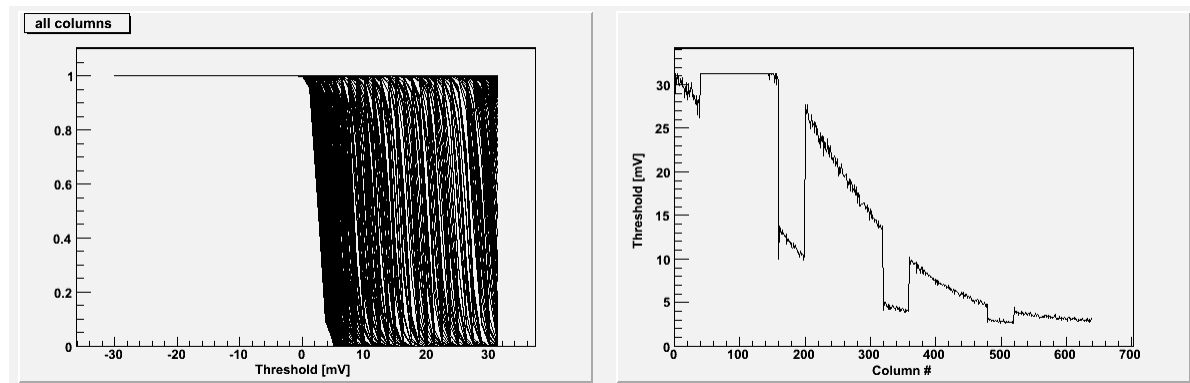
Probe testing Status

- We have tested 13 sensors (full thickness, individual diced sensors). Up to 3 probe tests per sensor.
- Results are very promising with caveats (next slide).
- Evaluation in progress
 - Mount first 3 tested sensors onto individual test boards. Test for function. – Results look mostly consistent for one sensor with some variation.
 - Interface a known good sensor on an individual test board to the probe card inputs. Check probe card function. – Also consistent.
- Automated scripts for testing are working.
- We will begin testing thinned sensors within the next 2 weeks.
- 2nd Probe card has been sent out to have the probes mounted.

Probe testing Status

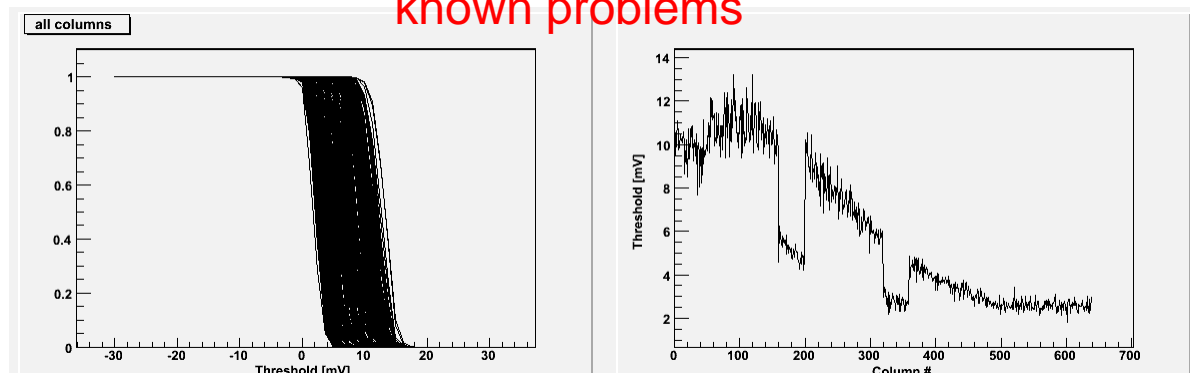
Poor vs better probe contacts (chip E8)

Initial testing
with ~75um
travel past
touchdown



Very Preliminary with
known problems

30 um
additional
lowering of
probe pins



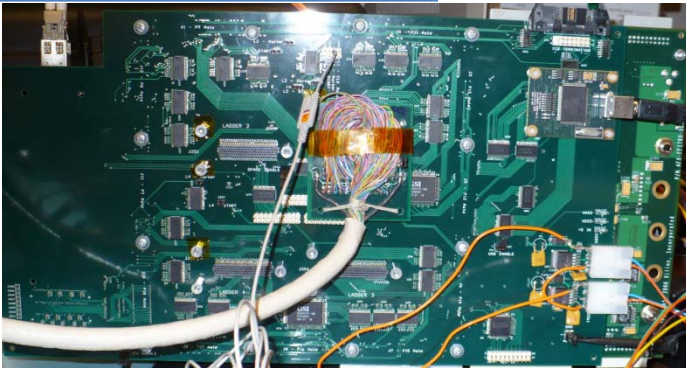
PXL Cable Development Status

- There is extensive documentation of our cable development and testing plan. A report was sent to DOE on 12/31/2009 as part of the CD-1 homework.
http://rnc.lbl.gov/hft/hardware/docs/PXL_flex_cable_and_sys_test_v2.doc.
- Summary
 - Develop FR-4 based infrastructure test PCB. - **DONE**
 - Design FR-4 version of prototype real-size ladder PCB.
 - Translate design into Kapton PCB.
- This effort requires successful probe testing of sensors in order to be able to test full ladders of functional (Phase-2) sensors.
- This is actually a ladder level system test. The testing includes a complete chain of RDO system that has never been fully tested including the prototype MTB and prototype RDO Board. The full ladder signal paths are now being tested.

Ladder Test System

RDO motherboard

Xilinx V-5 Dev Board



MTB

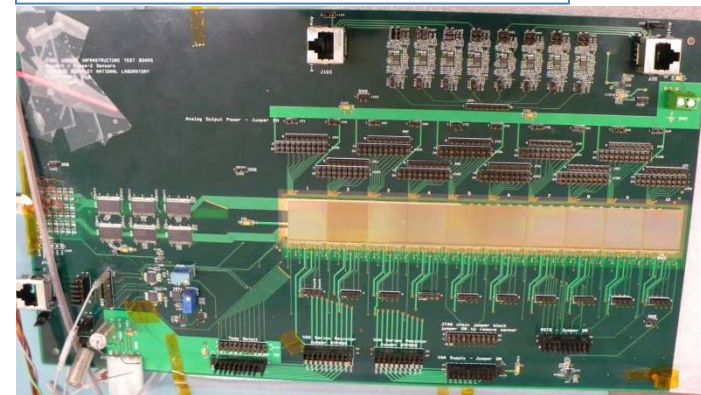
LU-protected power daughtercard



RDO PC



Infrastructure test board



PXL Cable Development Status (ladder level system test)

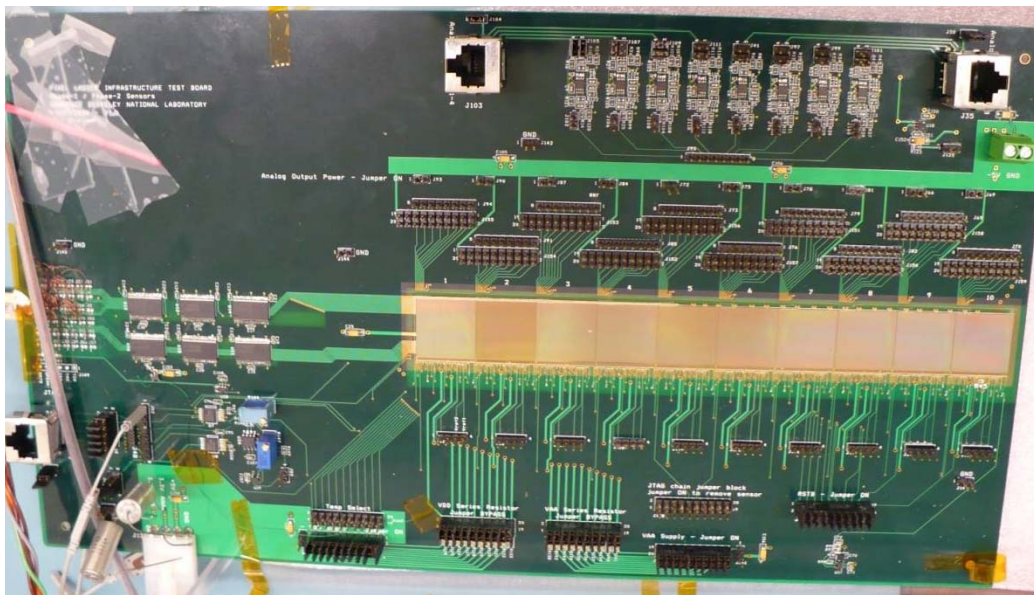
Infrastructure Testing Board

Status:

- 1 Board loaded with 10 Phase-2 sensors.
- JTAG daisy chain working – we can configure and read back.
- Multi-drop LVDS clock working @ 160 MHz.
- Scripted testing is now working for individual sensors on the ladder.

To do:

- Troubleshoot system.
- Test individual sensor baseline.
- Test with all sensors clocked.
- Analyze results.
- Repeat for different configurations.

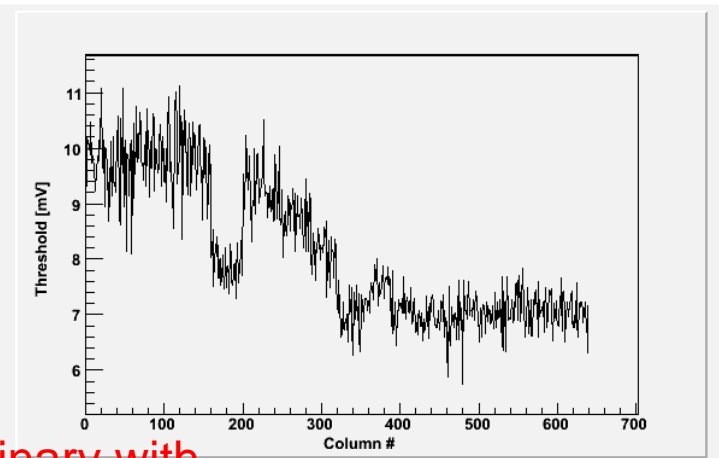
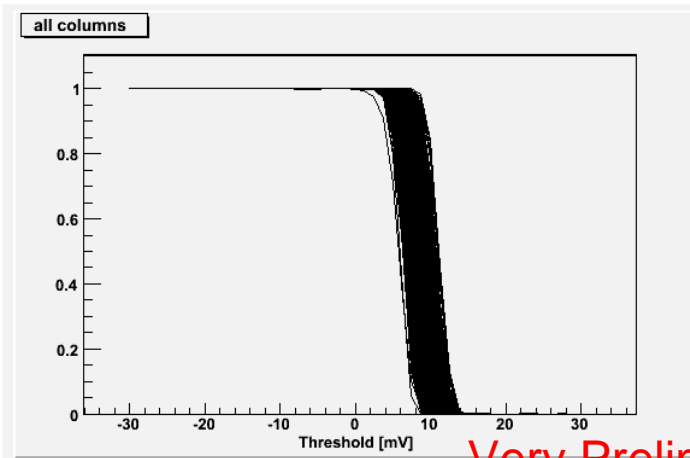


http://rnc.lbl.gov/hft/hardware/docs/Phase1/SCHEMATIC1%20%20PH1_infrastructure_test_board.pdf
http://rnc.lbl.gov/hft/hardware/docs/Phase1/PHASE-1_INFRASTRUCTURE_TEST.DSN

Preliminary Testing Results

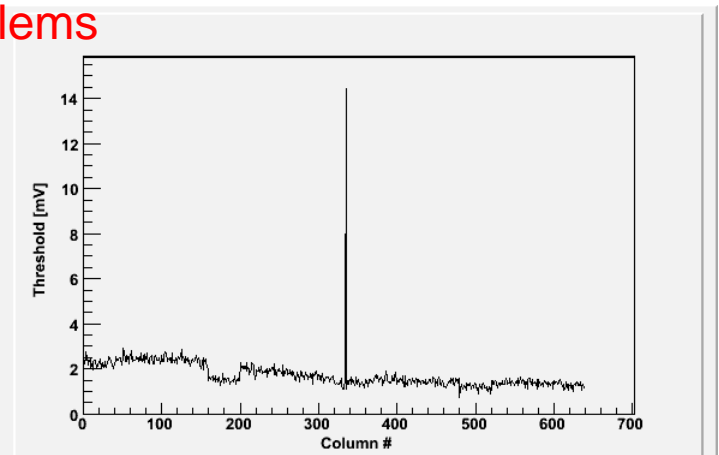
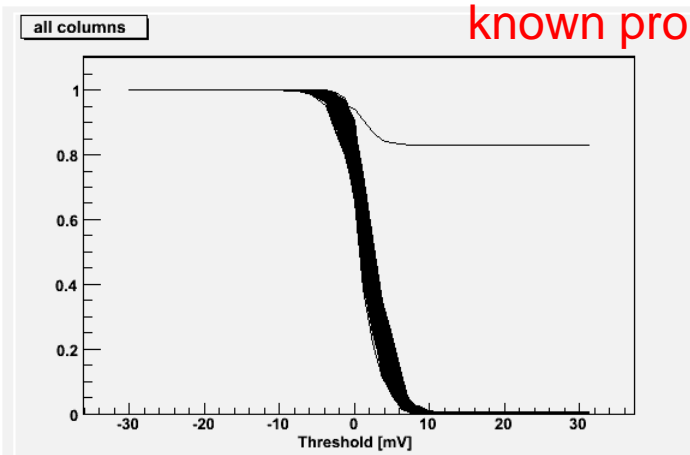
Probe tests vs ladder tests (chip C1)

Probe tests



Very Preliminary with known problems

ITB



PXL Cable Development Status (ladder level system test)

- The complete data and configuration paths appear to be working.
- We have the firmware/software tools to troubleshoot both the infrastructure testing board and the probe testing systems.
- This work has begun – we will fix the existing problems and move to full infrastructure testing of sensor ladders.

PXL Cable Development Status

Cable design options

- A detailed description of the challenge is available here http://rnc.lbl.gov/hft/hardware/docs/PXL_RDO_cable_options_1.doc
- We are attempting a “proof-of-principle” test before the CD-2/3 review.
- A single sided test cable design has been produced for fabrication at Datex to assess capability and quality. (quotation not yet received)
- Some delay due to material issues. It is difficult to find anyone willing to fabricate kapton/Al.
- We have located some 1 mil Al on 1 mil mylar and shipped it to Datex. They are evaluating the suitability.
- Datex will start first attempt at fabrication next week. Results will follow.
- Other vendors (SE SRTIIE, Kharkov,Ukraine and CERN?) will be contacted.

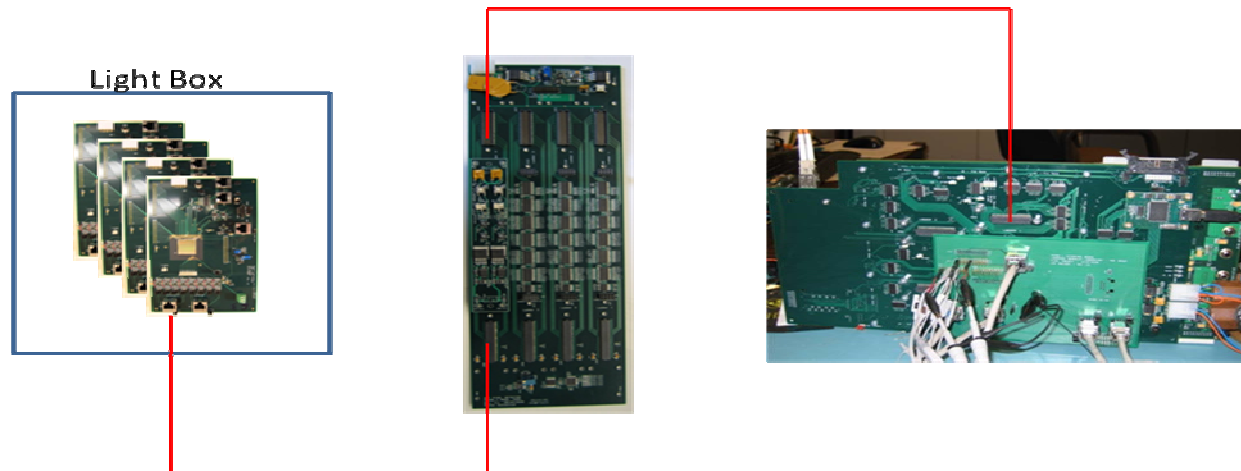
RDO Prototyping Status

- Prototype MTB and RDO boards are fabricated and under test in ladder system test.
- Architecture and Implementation documents are in progress due to be completed within 2 weeks.
- Full sector RDO (4 ladders) in data taking mode is in progress.
- Internal workshop/review is scheduled for June 23-24 2010 at LBNL.
- Development of slow control and monitoring system to integrated after internal review.
- Effort for beam testing firmware and software is underway.

Sensor and system development and testing status

Beam test at Fermilab

- Measure efficiency of Phase-2 sensors using a sensor telescope.



http://rnc.lbl.gov/hft/hardware/docs/Phase1/Phase-1_telescope_proposal.pdf

Sensor and system development and testing status

Beam test at Fermilab

- We have a draft telescope design (see previous link) and test plan.
- Plan uses existing Phase-2 individual testing board design, existing prototype MTB and RDO boards.
 - New testing boards have been ordered
 - 50 um Phase-2 sensors will be delivered in 1 week.
 - Design for individual testing board modification is complete.
- Initial contact with test beam facility at Fermilab.

To do:

- Join with the FGT effort? Depends on schedule.
- Write and submit test beam proposal.
- Develop firmware for beam test of 4 sensor telescope.
- Develop light box and mechanical support structure.
- Fabricate trigger detectors (if required)

Sensor and system development and testing status

Beam Test at PHENIX

- Test a full sector of Phase-2 prototype sensors with a full prototype readout path at PHENIX with the new low radius beam pipe.

This would be a very significant test if it can be arranged.

This requires:

- Hardware design to integrate with PHENIX.
- Coordination with PHENIX for space, electronics space, power, etc.
- Successful cable design and fabrication (kapton with Cu traces) – **Critical Path**.
- Completion of all sector RDO firmware and software.
- Full validation of assembly fixturing and tools.
- Testing and QA hardware, firmware and software for fabrication stages.
- No schedule delays

Schedule (from TC 3/11/2010)

- PXL Cable development
 - Infrastructure testing board – testing complete May-w4
 - Prototype detector cable FR-4 with Cu – testing complete July-w4
 - Prototype detector cable Kapton with Cu – testing complete October-w4
- Probe Testing
 - Phase-2 sensors – batch probe testing thinned sensors working May-w2
- RDO prototyping
 - Full ladder RDO – documentation complete and internal review May-w1
- Sensor and system development and testing
 - Beam test with Phase-2 @ Fermilab – TBD, hopefully August-September
 - Beam test preparation for Phase-2 sector at PHENIX? - TBD
- CD-2/3 – TBD, more information after this meeting?

CD-2/3

Needed

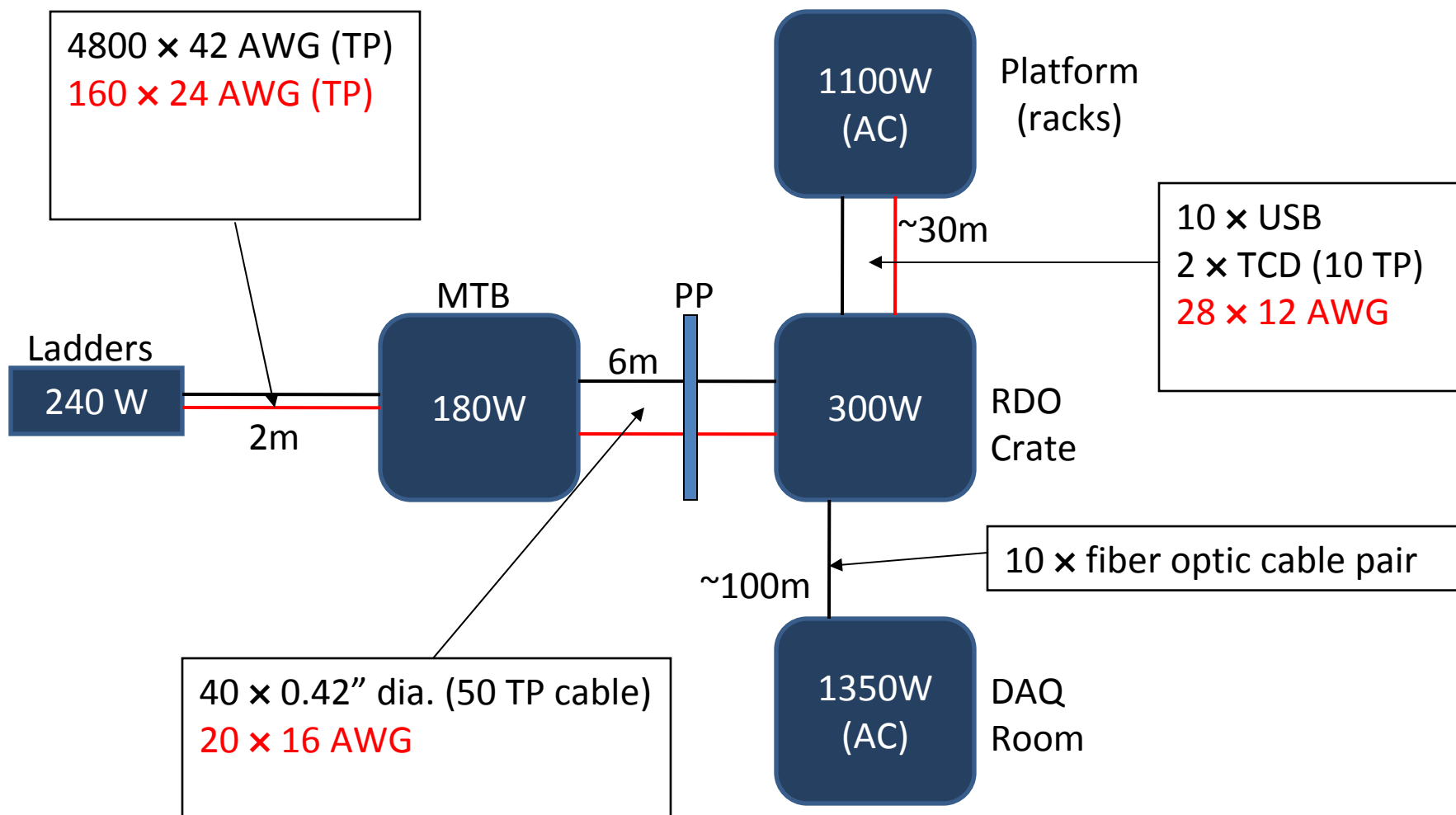
- List of the full set of documentation required for CD-2/3 and schedule for the production of these documents. - **DONE**
- Understanding of mechanism for producing additional required cost and schedule documentation, maintenance and updates.
- Institutional reporting requirements and path for fulfilling.
- STAR liaisons and infrastructure and design sign-off authority structure.
- Sarah will give a presentation on our cost and scheduling efforts for Pixel.

backup

Probe testing Status

- We need to probe test quantities (~50) of Phase-2 sensors for assembly onto prototype cables to assess the cable design.
- This will serve as the development path for the sensor tracking, handling and QA for the main production testing.
- We will be testing diced and thinned sensors. This is not usual practice for probe testing (usually wafers) and presents mechanical and handling challenges. HW will present progress on vacuum chuck design for automated production.
- Firmware and software for automated testing is complete and under test.

Sensor / RDO Services (preliminary)



PXL Cable Development Status

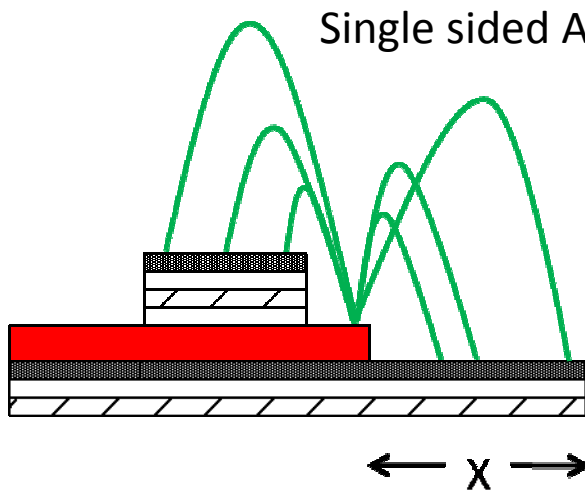
3 identified Cable design options



Double sided Aluminum conductor **with** vias



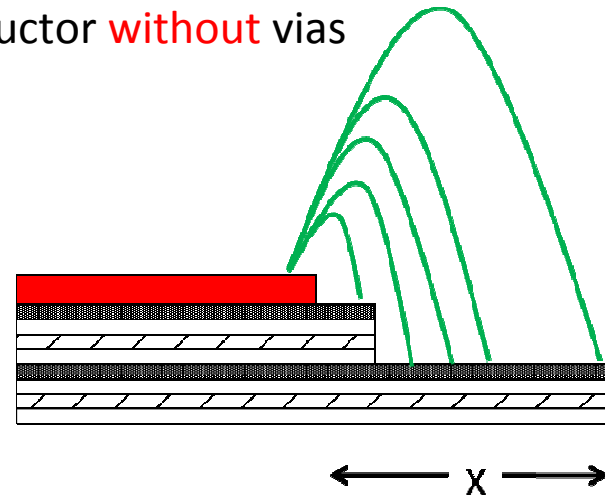
Single sided Aluminum conductor **without** vias



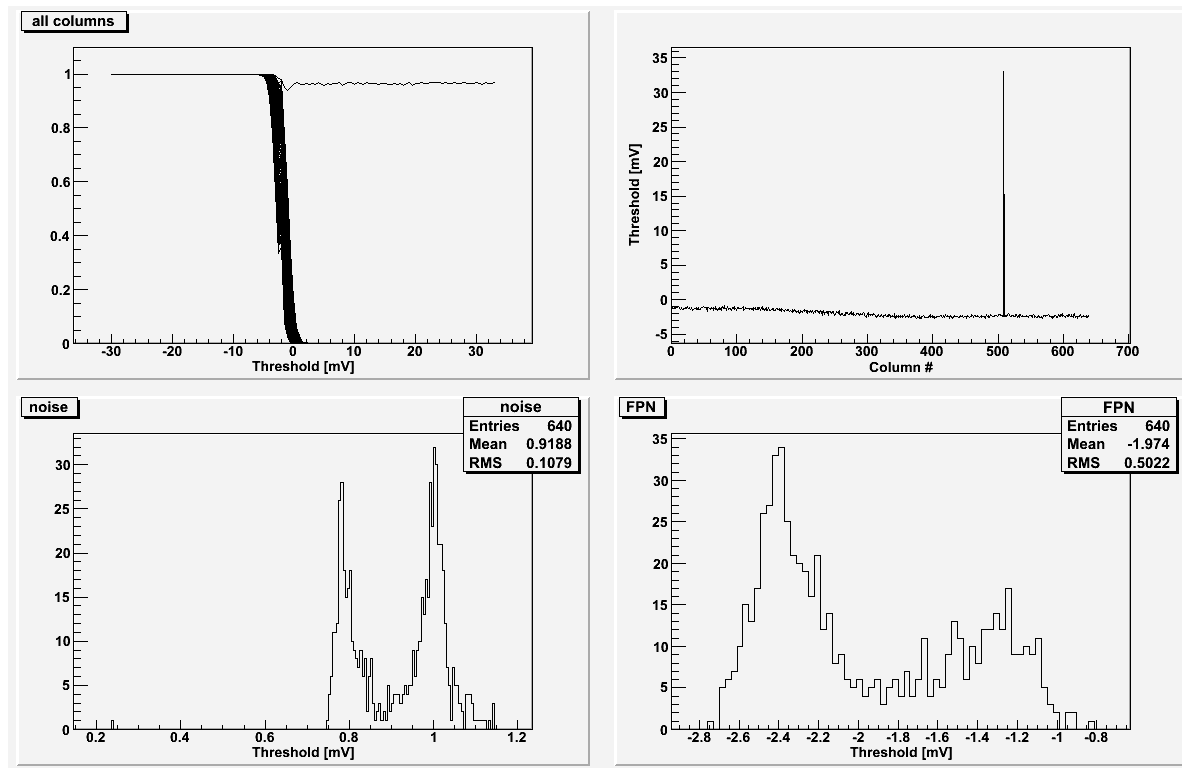
Sensor

Layer 1

Layer 2

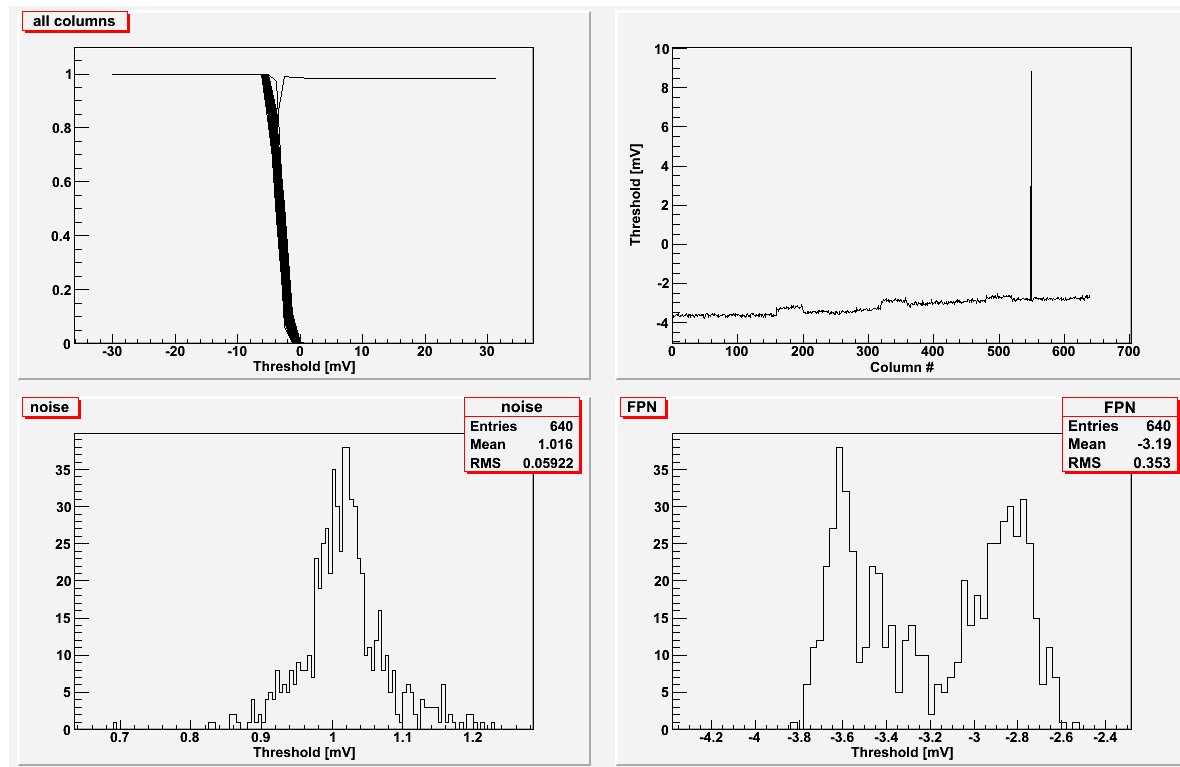


Chip A1 individual test (crop this image to show only left upper corner)

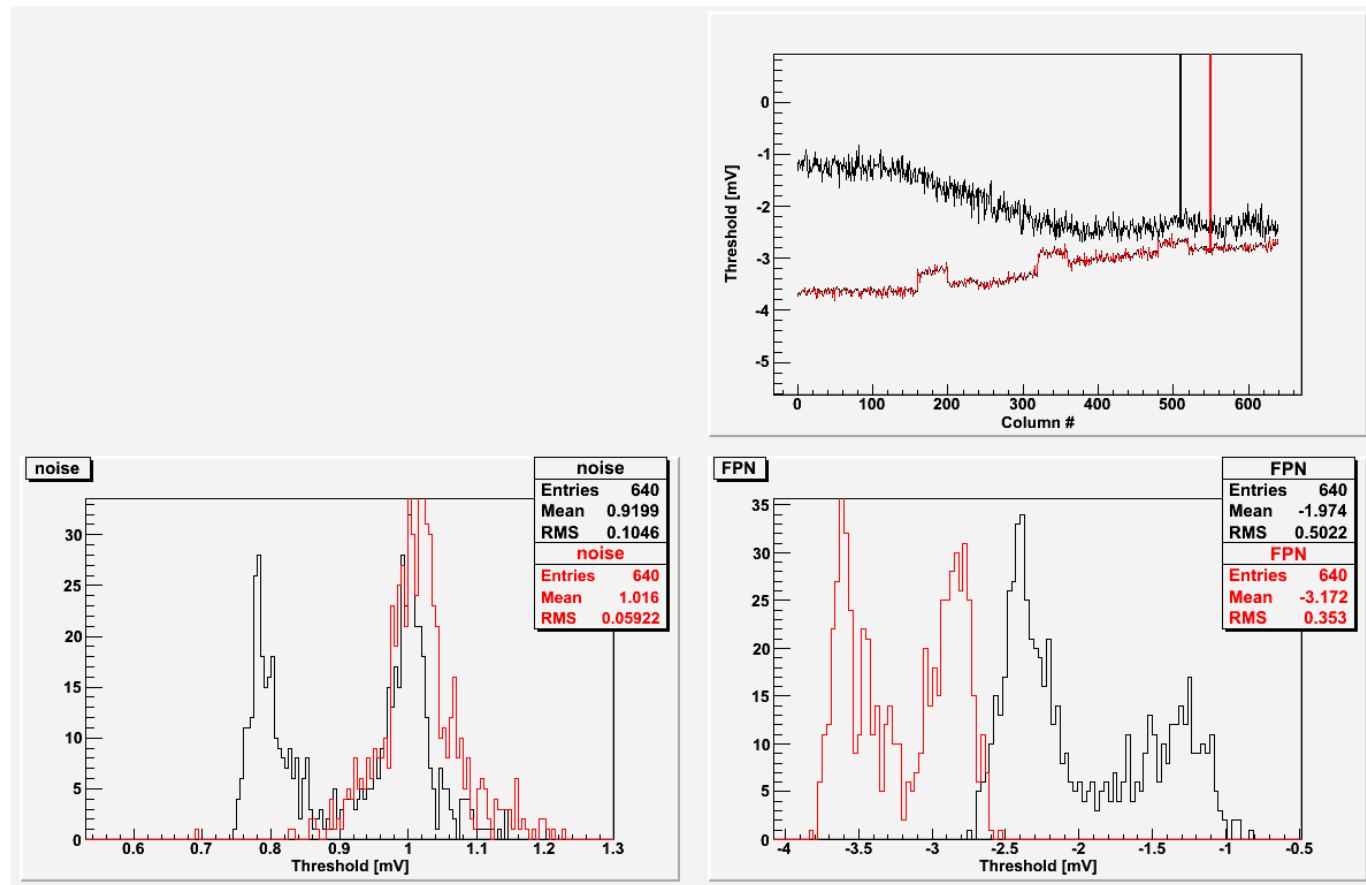


Chip A1 probe test results

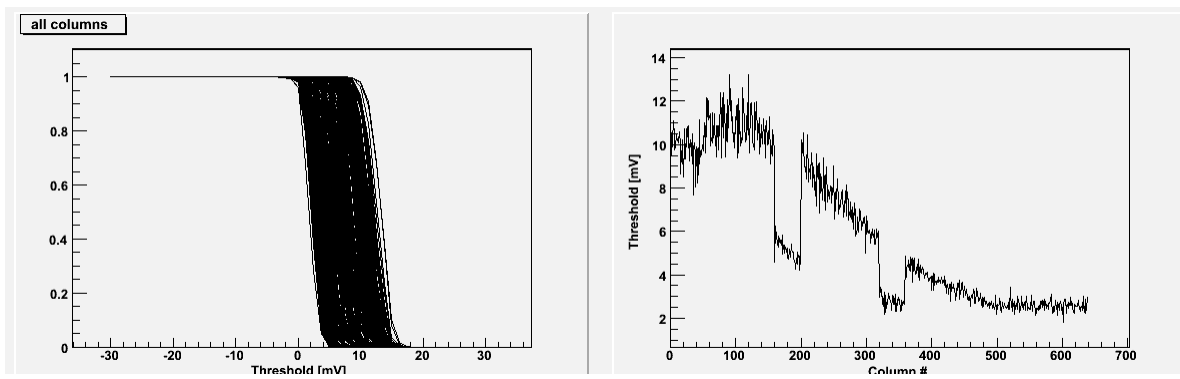
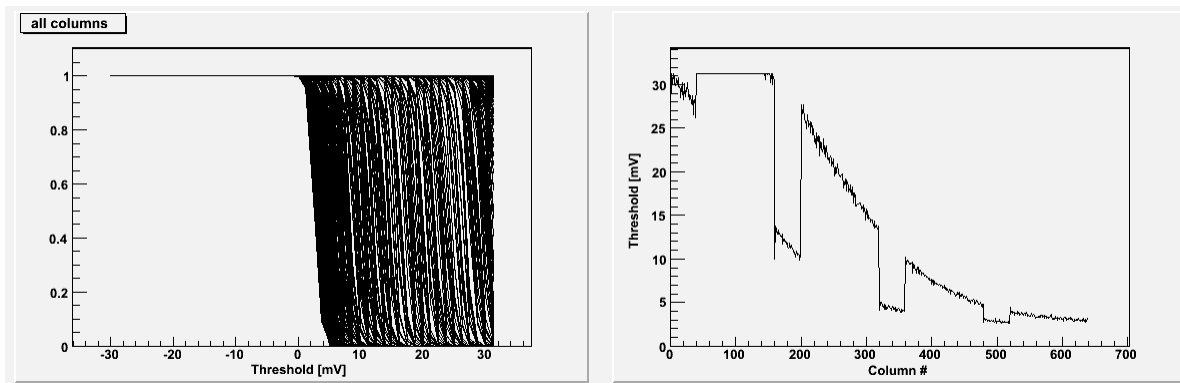
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Chip A1 individual tests (black) vs probe test results (red)

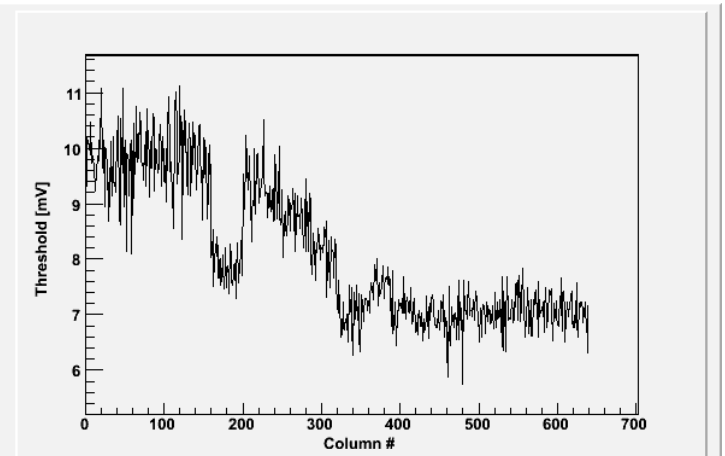
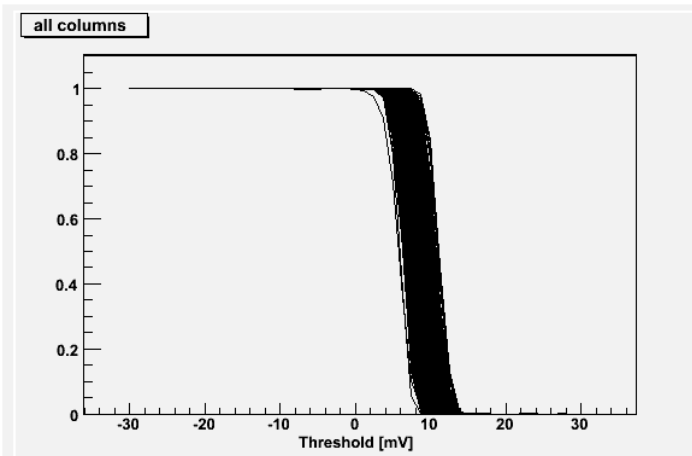


Poor vs better probe contacts (chip E8)

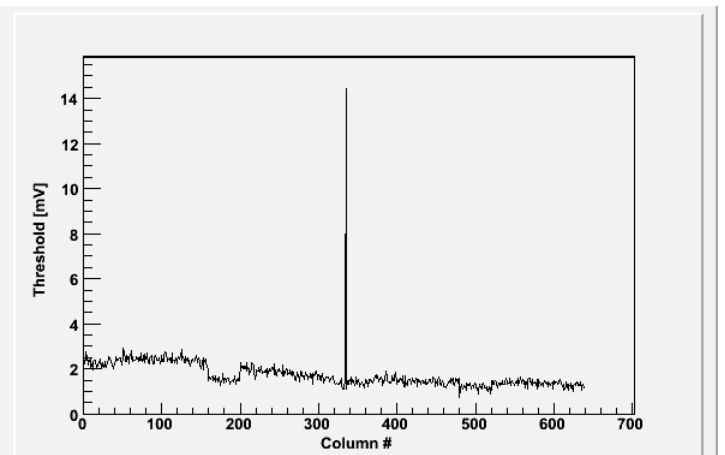
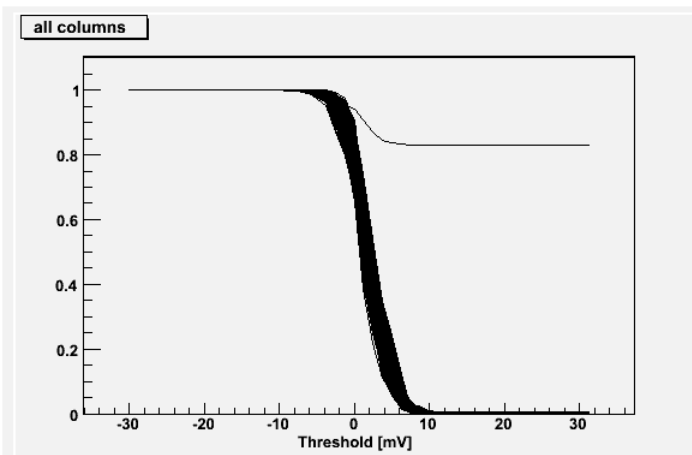


Probe tests vs ladder tests (chip C1)

Probe tests

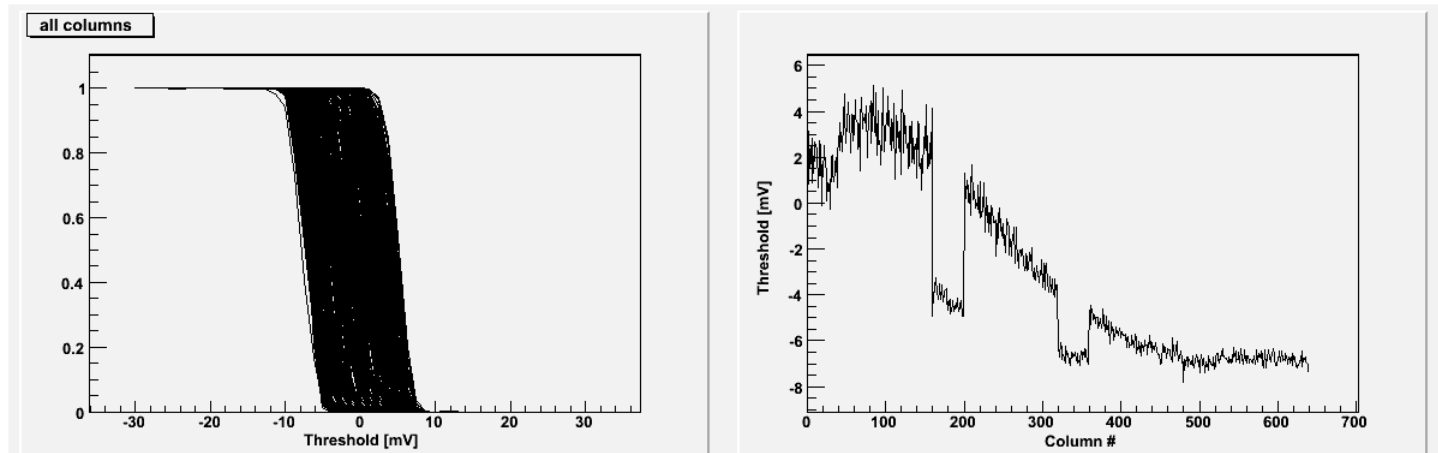


ITB



Probe tests vs ladder tests (chip D9)

Probe tests



ITB

