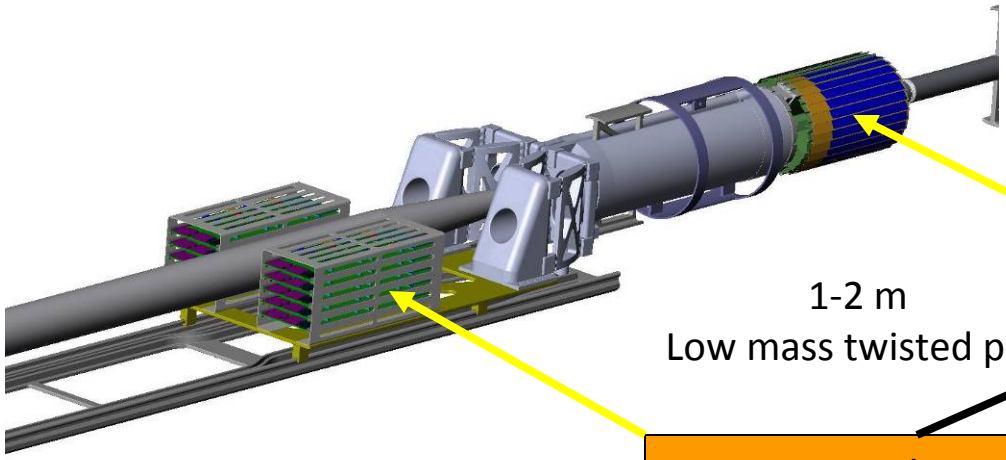
PXL Electronics

Status update for HFT TC meeting on March 10, 2010 at BNL

Outline

- General Design
- FY10 Tasks
- Status of Tasks
- Schedule

General Design



Sensors / Ladders / Sectors
(interaction point)

1-2 m
Low mass twisted pair

LU Protected Regulators,
Mass Termination Boards

Platform

30 m

Power
Supplies

30 m

6 m - twisted pair

RDO Boards

100 m - Fiber optic

DAQ Room

DAQ PCs

Control
PCs

30 m

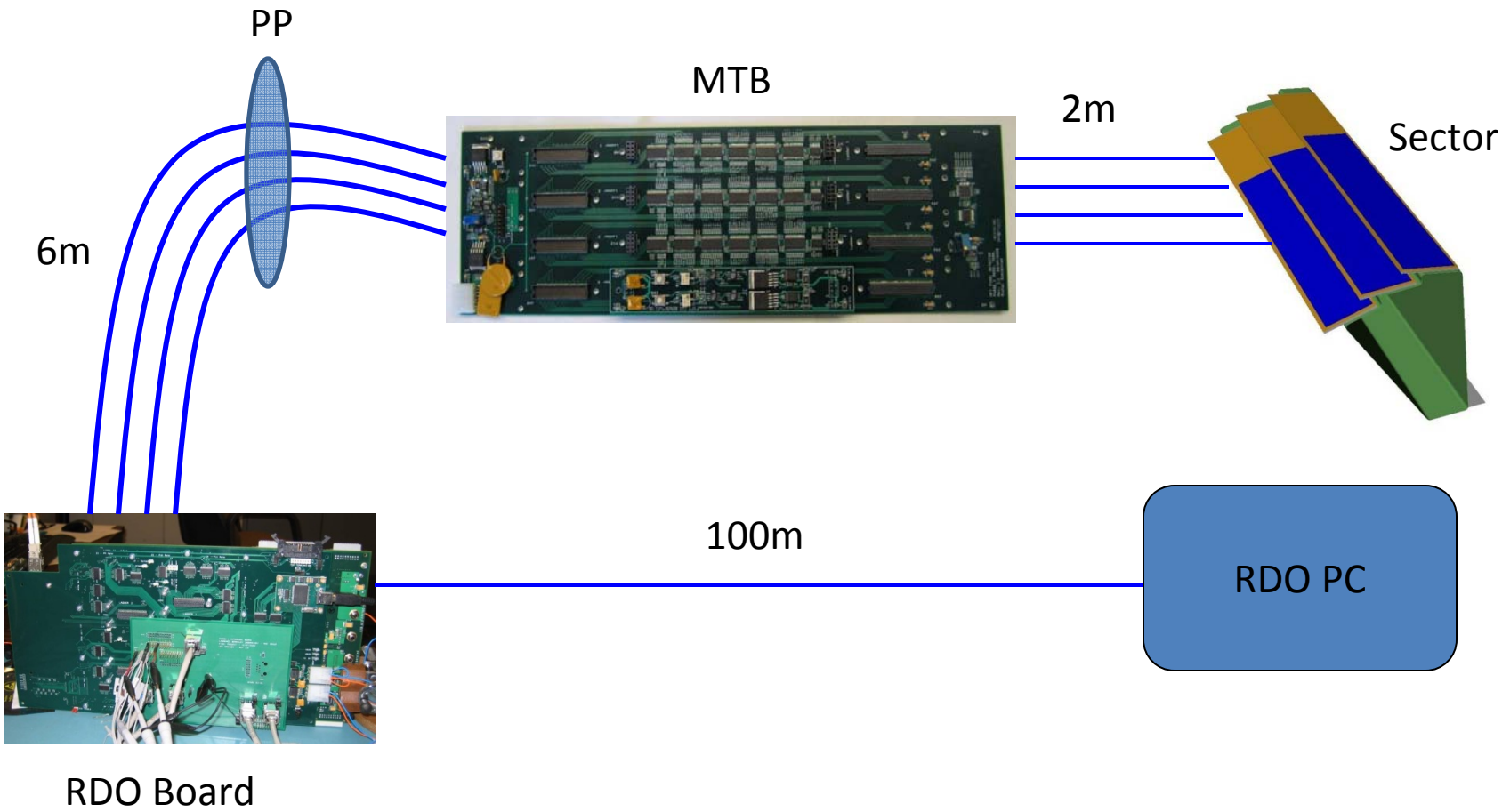
30 m

STAR
Trigger

(Low Rad Area)

General Design

PXL Detector is a parallel system of 10 sectors



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

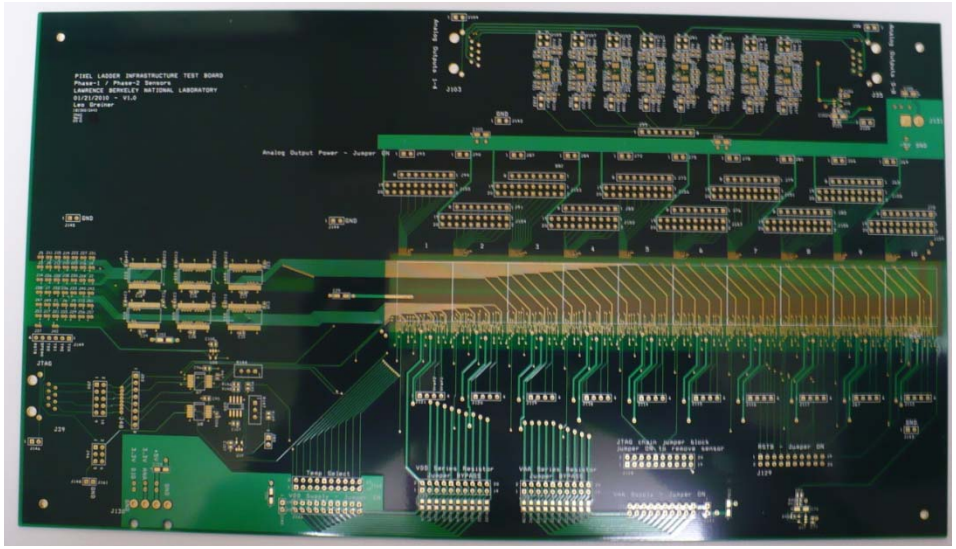
PXL Cable Development Status

- 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.
  - 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.
- As a comment – our yields (from small sample sizes) are very high for the Phase-2 sensors. We can begin the testing of the first infrastructure testing board using untested sensors if necessary.

PXL Cable Development Status

Infrastructure Testing Board



Status:
- Design complete –
- Layout complete -
- Boards back from fabrication -

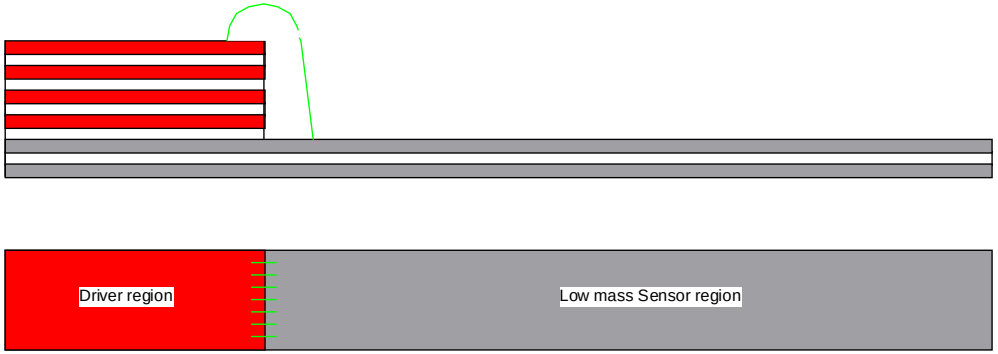
To do:
- Fabricate alignment fixtures for sensors
- Glue down 10 (untested?) sensors
- Wirebond
- Load PCB components
- Test
- Repeat

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

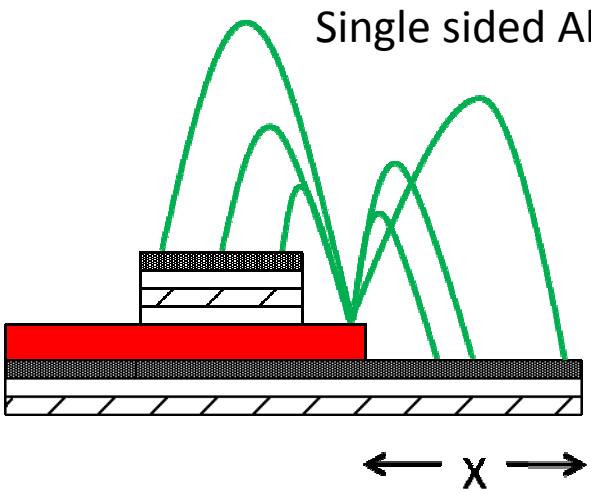
PXL Cable Development Status

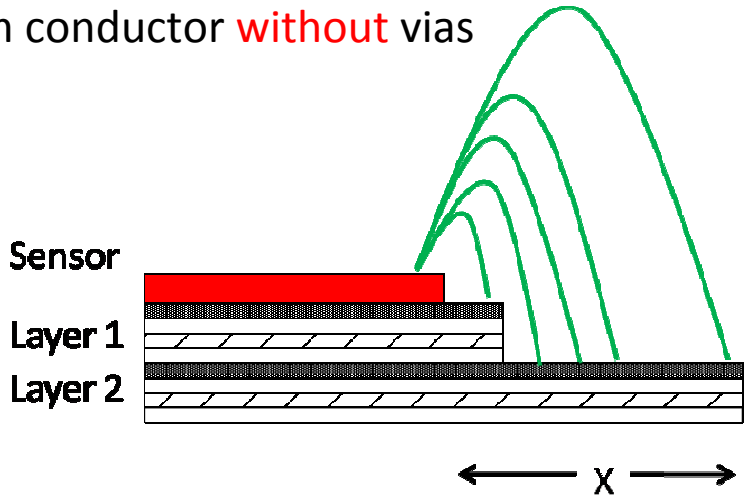
3 identified Cable design options



Double sided Aluminum conductor with vias

Single sided Aluminum conductor without vias





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)

•Al Cables with vias are hard and Datex could not produce a test piece for some time.

•A single sided cable only fits into the existing geometry if we use 2 cables and one is attached to a band on top of the sensors.

•To test the viability of this option while keeping with the plan for measuring the pixel positions to a 20 um window, we will thin 10 sensors to 120um (equivalent radiation length without stiffener), glue them to a cable prototype and measure the curvature and position of each.

•Other vendors (CERN?) will be contacted.

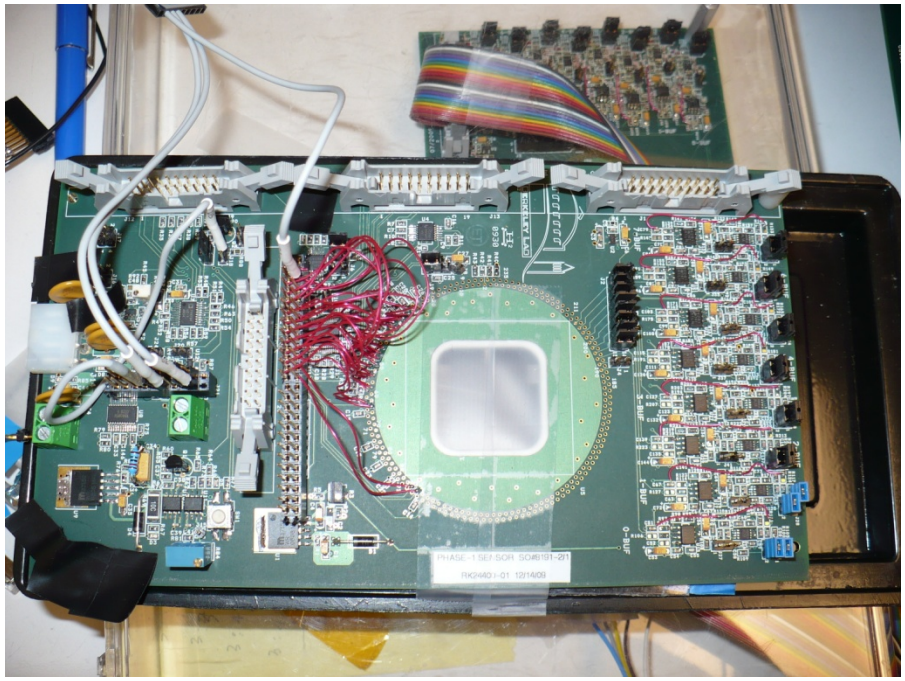
Probe testing Status

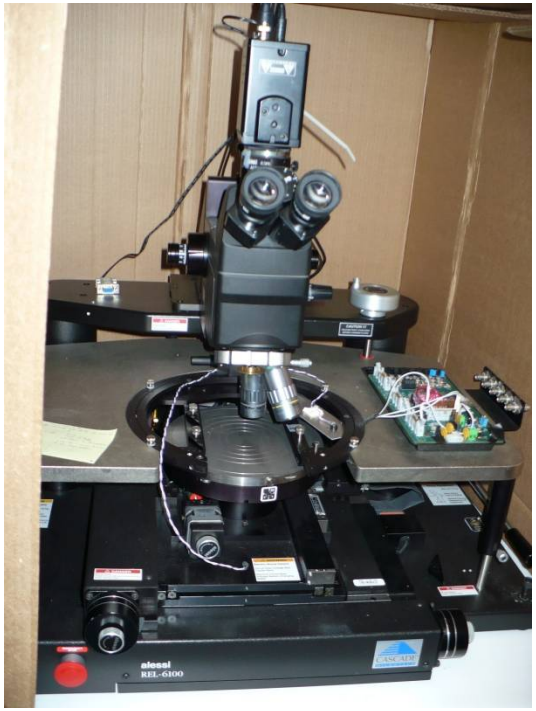
- We need to probe test quantities (~50) of Phase-2 sensors for assembly onto prototype cables to assess the cable design.
- This will serve as the development path for the sensor tracking, handling and QA for the main production testing.
- We will be testing diced and thinned sensors. This is not usual 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.

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 3 sensors (full thickness, individual diced sensors). Up to 3 probe tests per sensor.
- Sensors are tested at 3 voltages (we can save 15% power running sensors at 3.0V instead of 3.3V).
- Results are inconsistent – 2 sensors function reasonably at ≥ least 1 voltage.
- Evaluation in progress
  - Mount all 3 sensors onto individual test boards. Test for function.
  - Interface a known good sensor on an individual test board to the probe card inputs. Check probe card function.
- New update – sensor inconsistent testing results understood, firmware problem. This is fixed and new testing is underway.

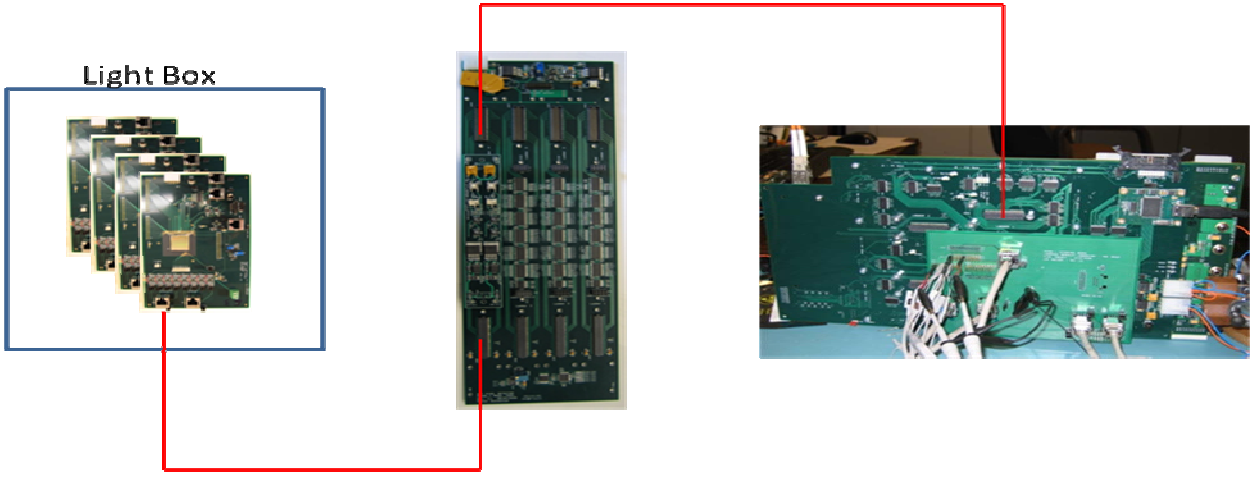
RDO Prototyping Status

- Prototype MTB and RDO boards are fabricated and under test.
- Architecture and Implementation documents are in progress.
- Full RDO of ladders x 4 (sectors) in data taking mode.
- Internal review within the next 2 months.
- 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 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.
•Initial contact with test beam facility at Fermilab.

To do:
•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

- 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.
- 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.
- ??

backup

Sensor / RDO Services (preliminary)