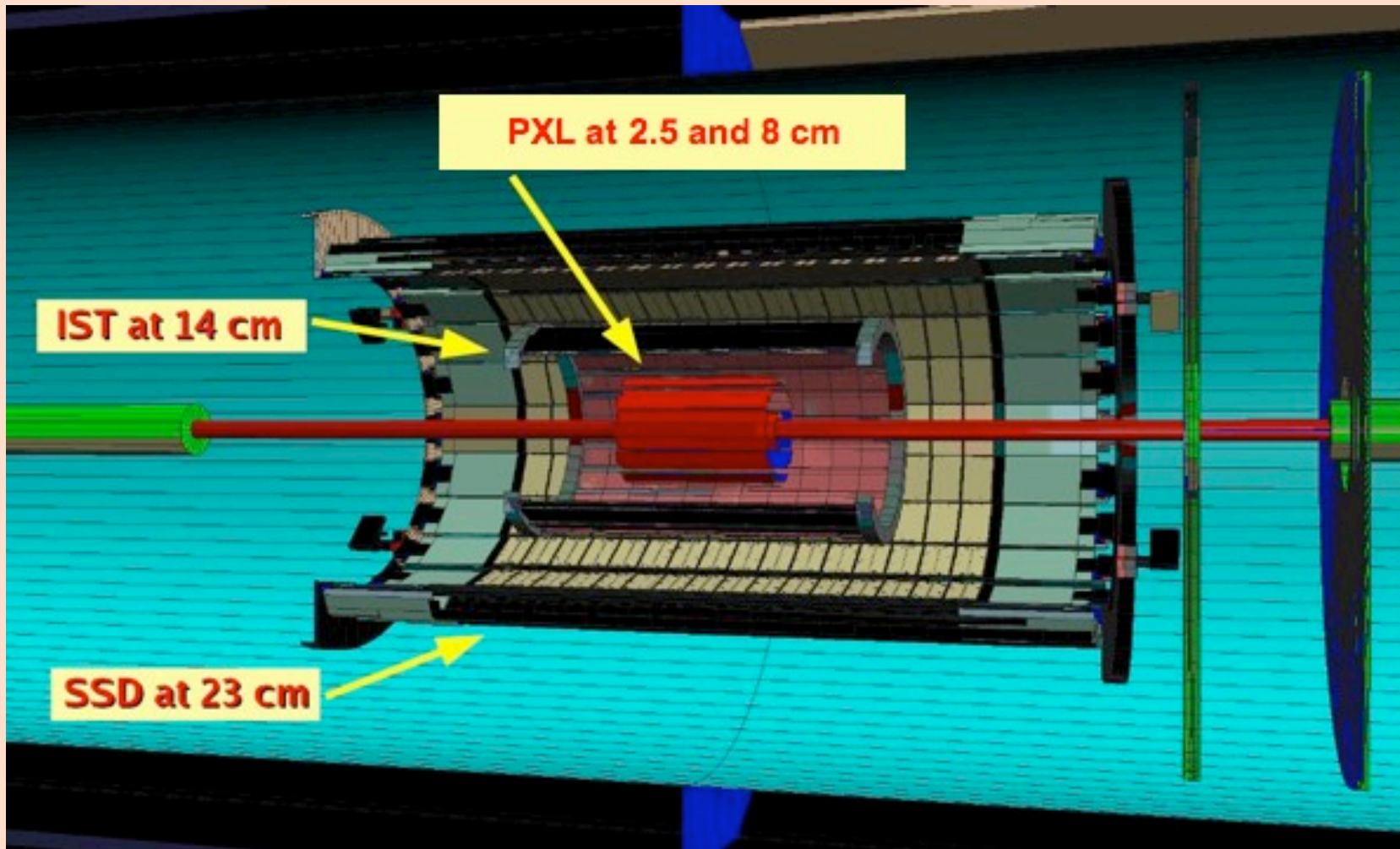


Heavy Flavor Tracker project status

Spiros Margetis
KSU

HFT

STAR Tracking Upgrade to identify mid-rapidity Charm and Bottom hadrons through direct reconstruction and measurement of the displaced vertex



Overview

- **Detector**
- **Physics capabilities**
- **Project Status and Milestones**
- **Current Sub-system activities**
- **Summary**

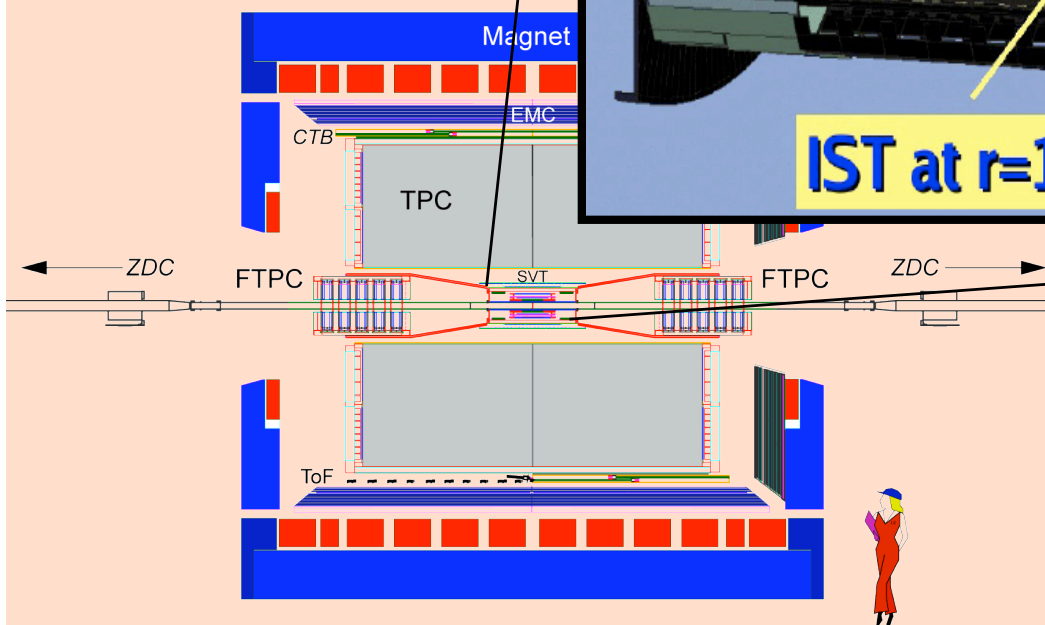
HFT

Design Philosophy

SSD at $r=23\text{cm}$

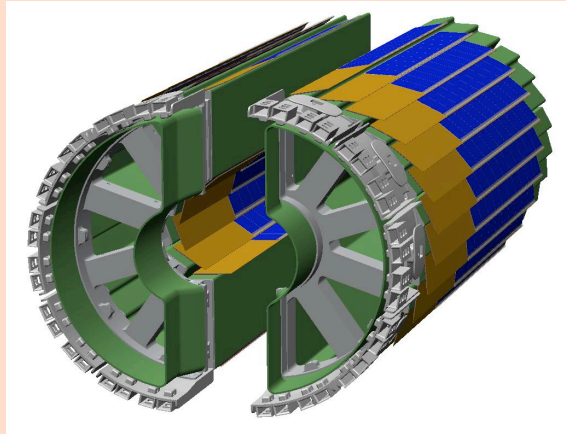
PIXEL at $r=2.5\text{cm}$ and $r=8\text{cm}$

IST at $r=14\text{cm}$

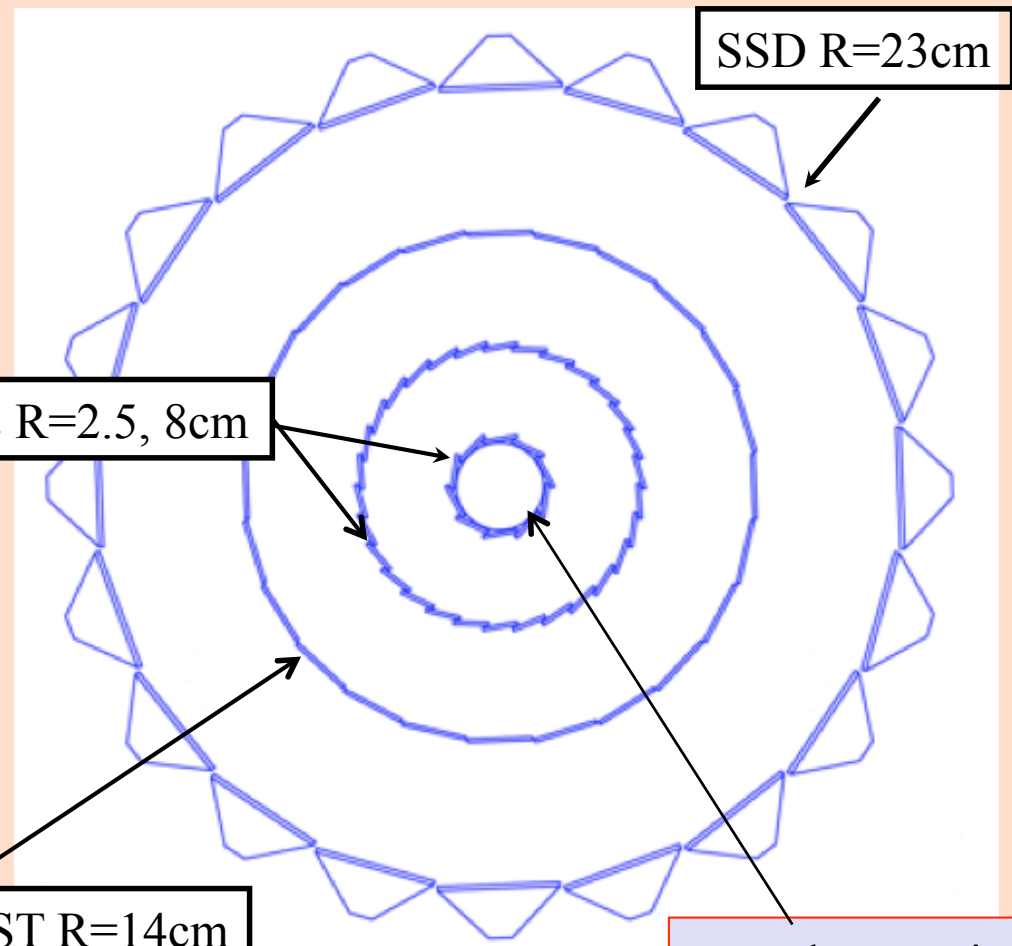


- Low mass
- Near the event vertex
- Active pixels

HFT Technology



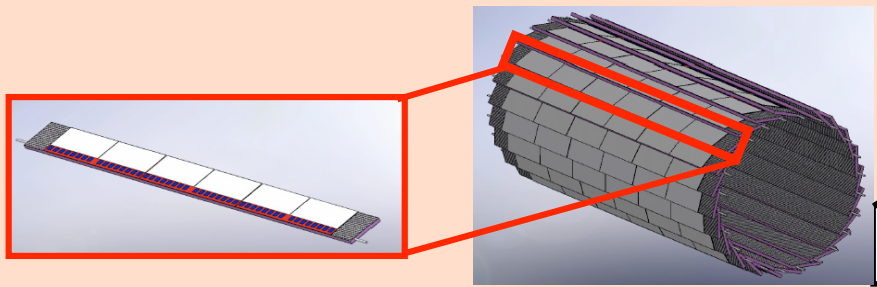
Pixel 1-2 R=2.5, 8cm



SSD R=23cm

IST R=14cm

New beam pipe



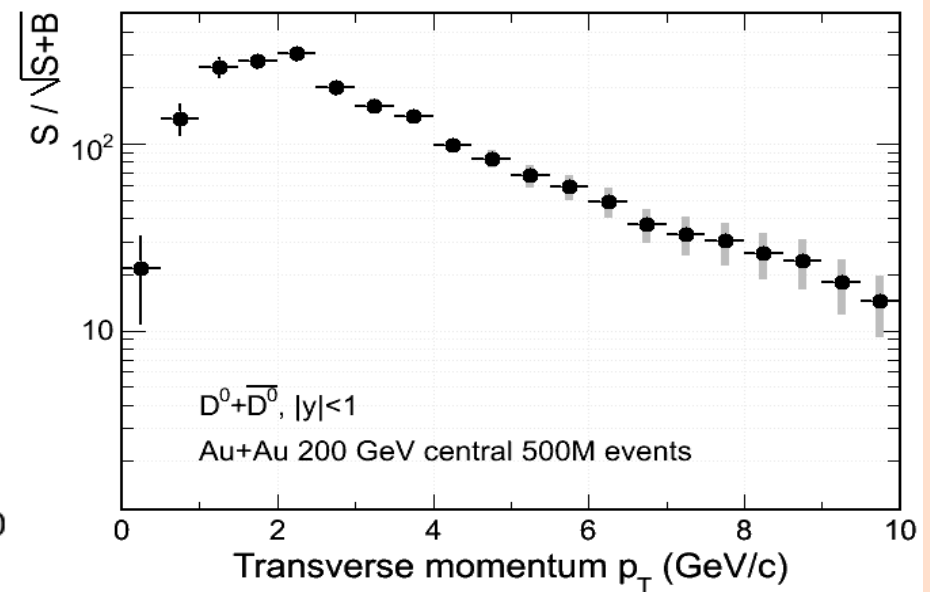
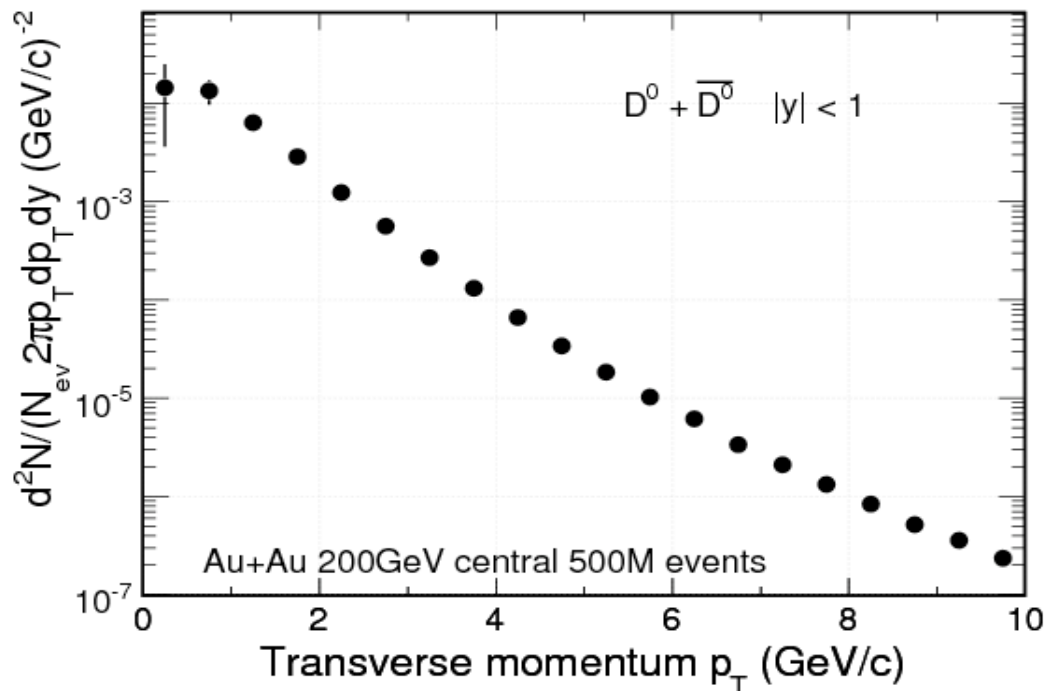
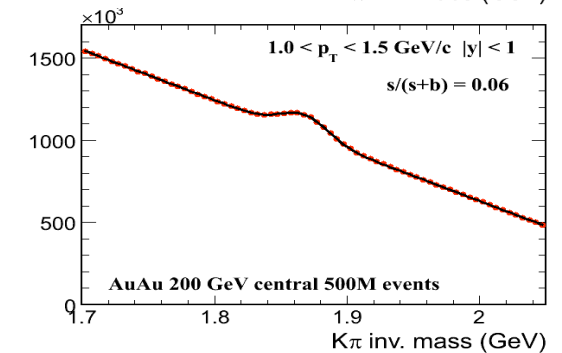
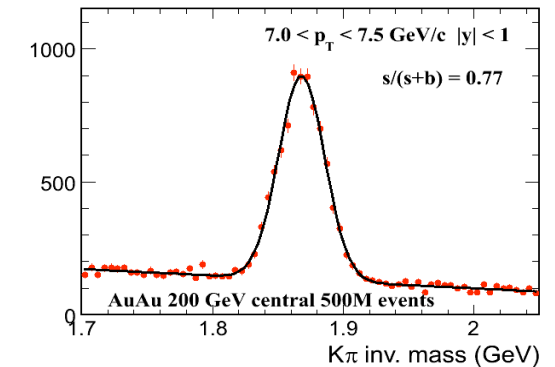
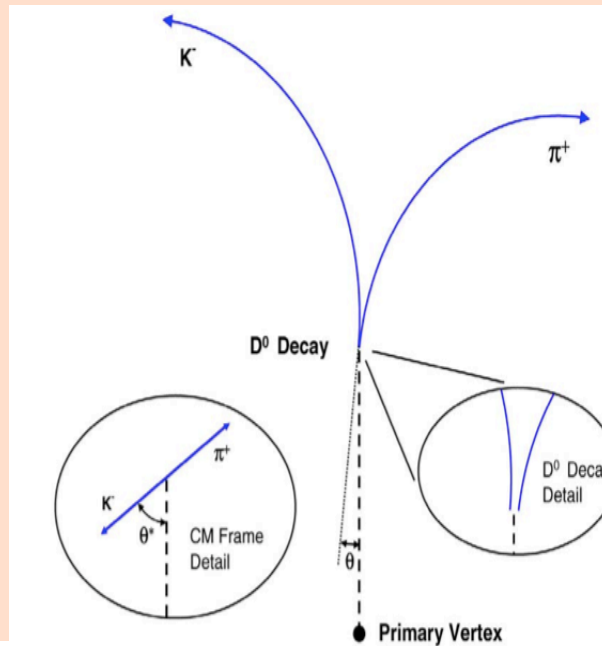
	Technology	Hit resolution R- ϕ (μm - μm)	Radiation Length
SSD	double sided strips	30 - 857	1% X_0
IST	Silicon Strip Pad sensors	170 - 1700	1.2% X_0
PIXEL	Active Pixels	8.6 - 8.6	0.3% X_0

Physics capabilities

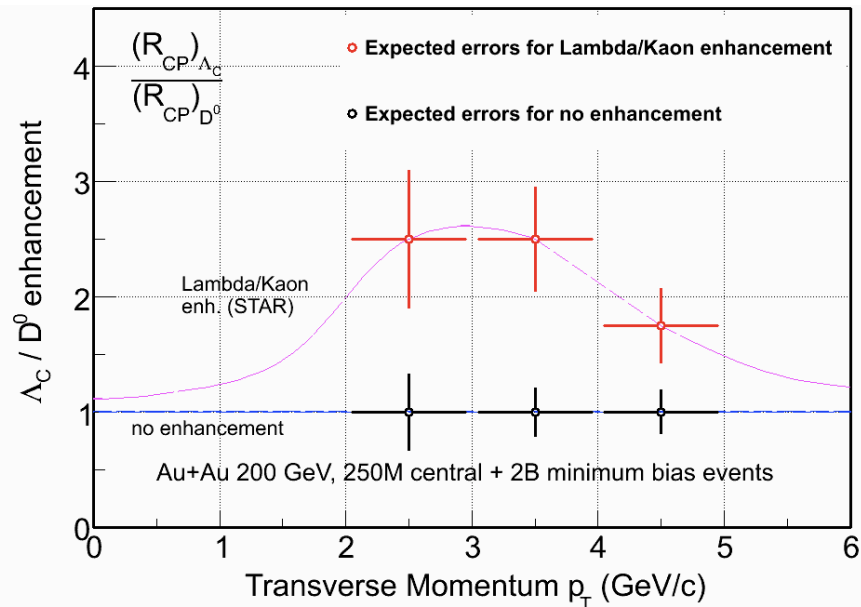
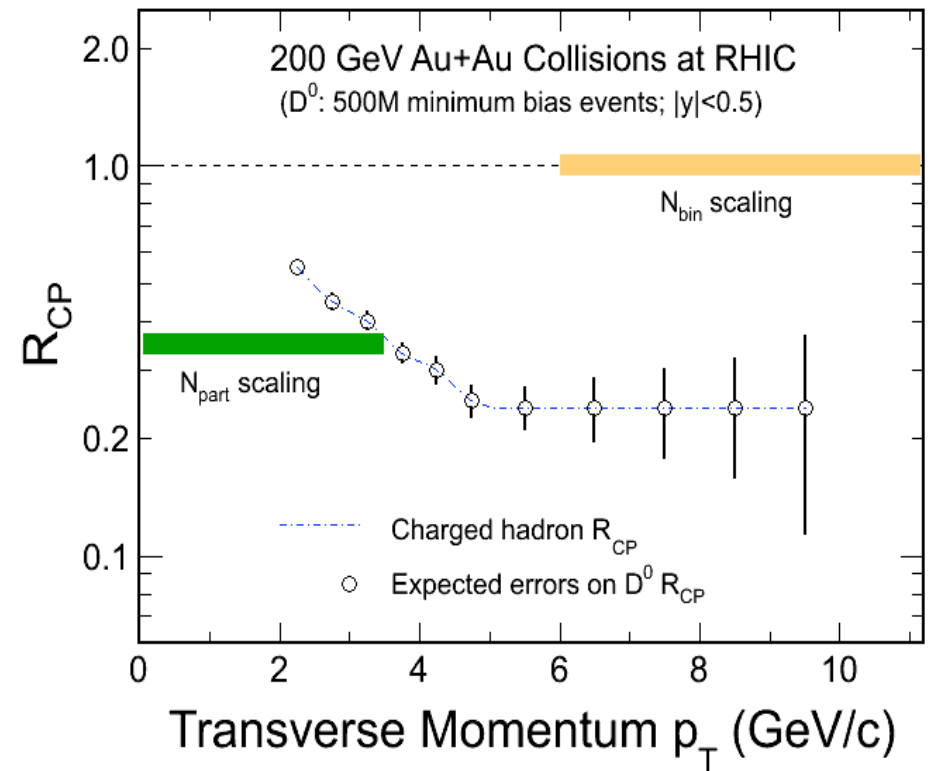
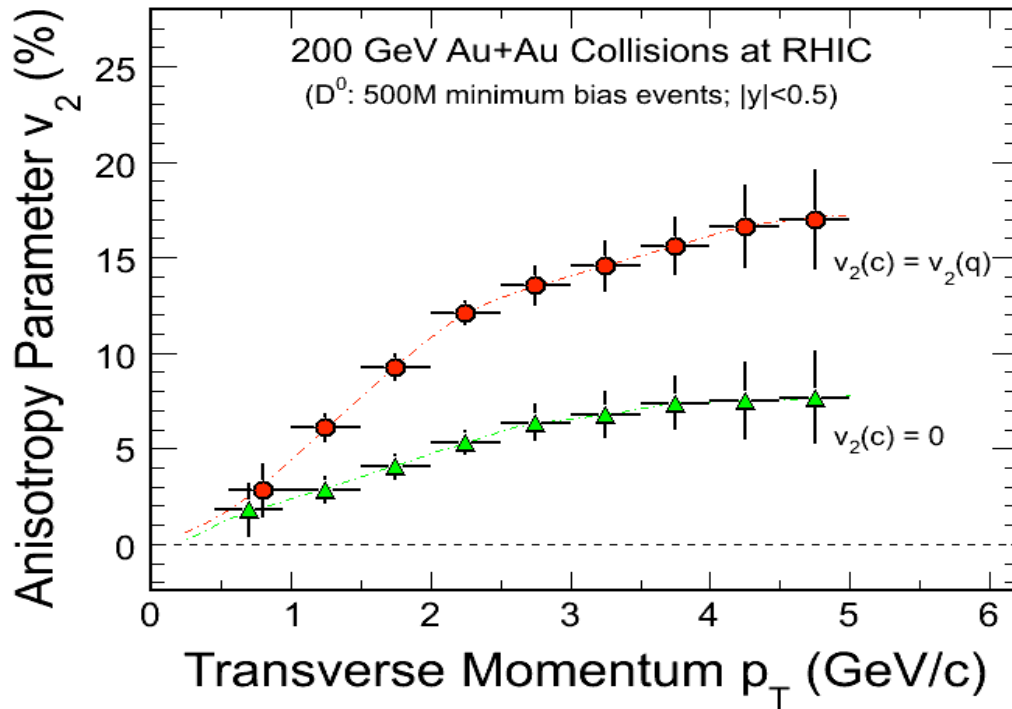
- Detailed D-meson spectroscopy
 - R_{cp} , v_2
- B-meson identification
- Charmed baryons (Λ_c)

Performance example on the $D^0 \rightarrow K\pi$ reconstruction

- Simulation of Au + Au @ 200 GeV Hijing events with STAR tracking software including pixel pileup (RHIC-II luminosity) extrapolated to 500 M events.
- Identification done via topological cuts and PID using Time Of Flight

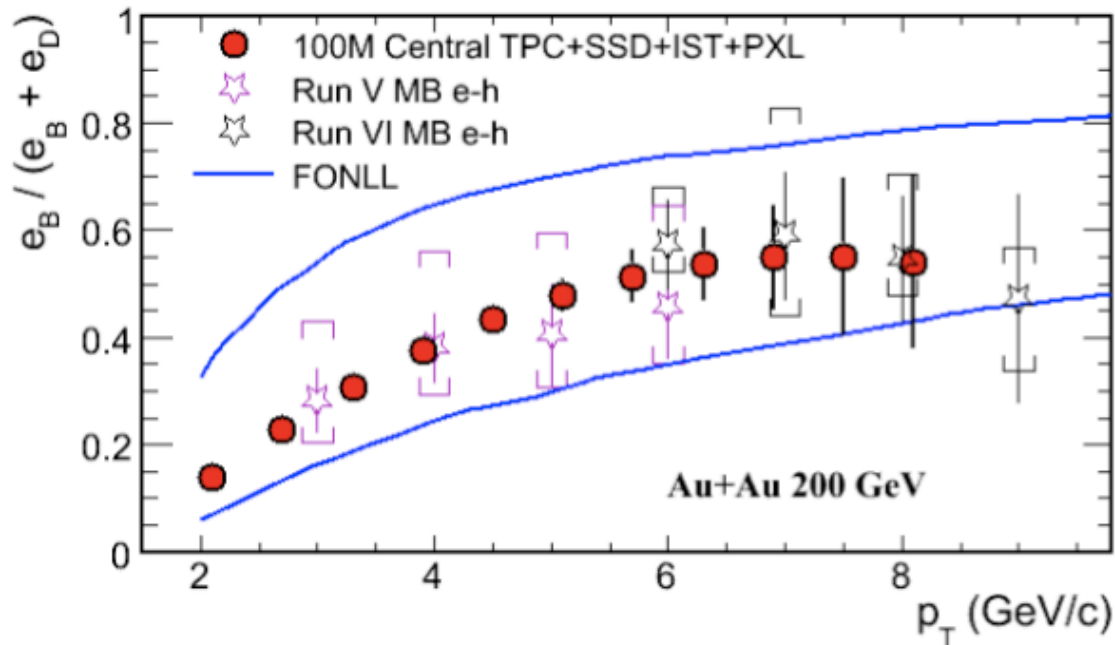
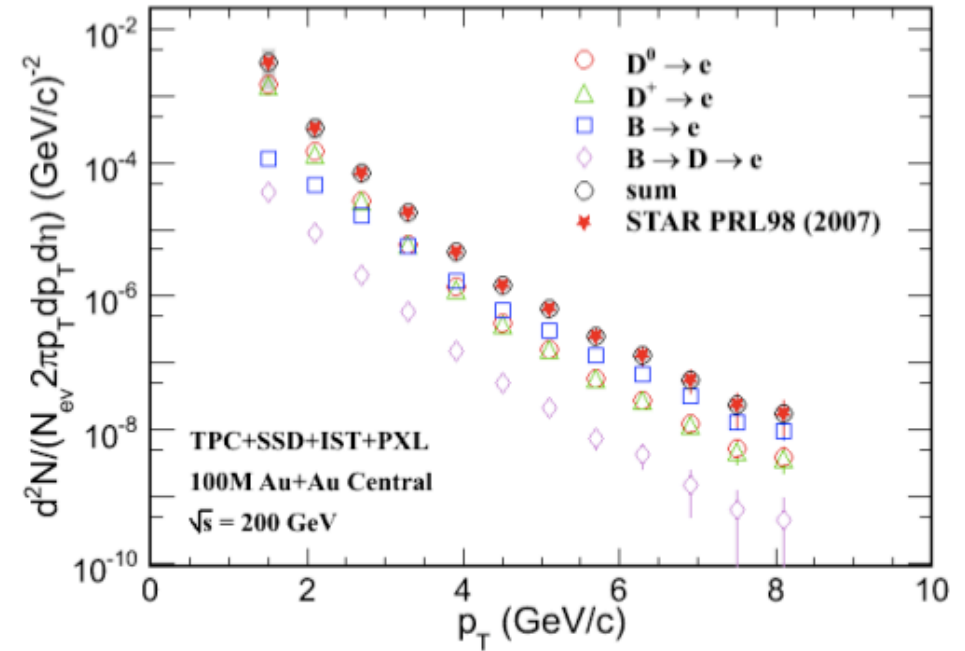
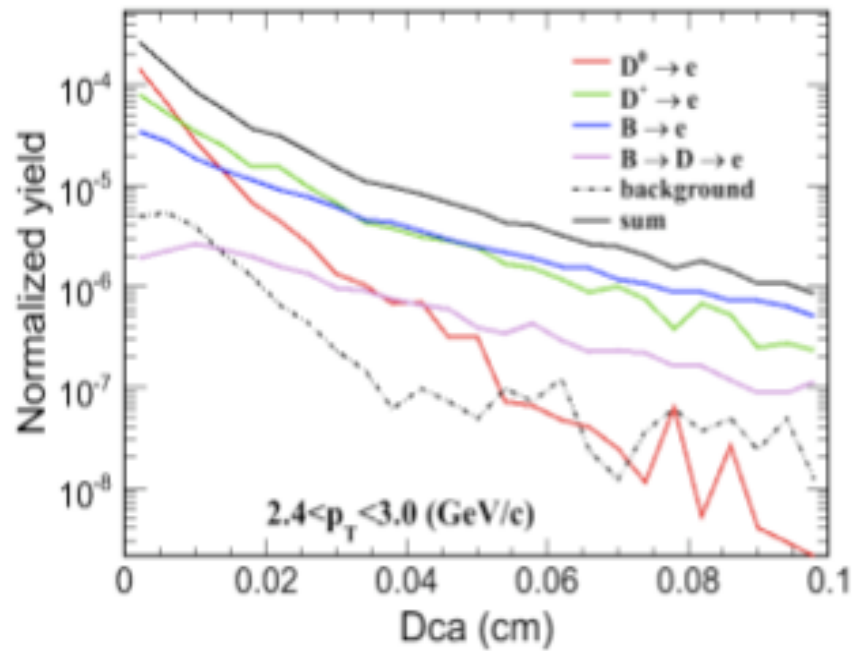


Key measurements of the HFT



- 1) v_2 and R_{cp} of D^0
- 2) Charm baryon Λ_c

B-meson capabilities (in progress)



B- \rightarrow e+X approach
Rate limited, not resolution

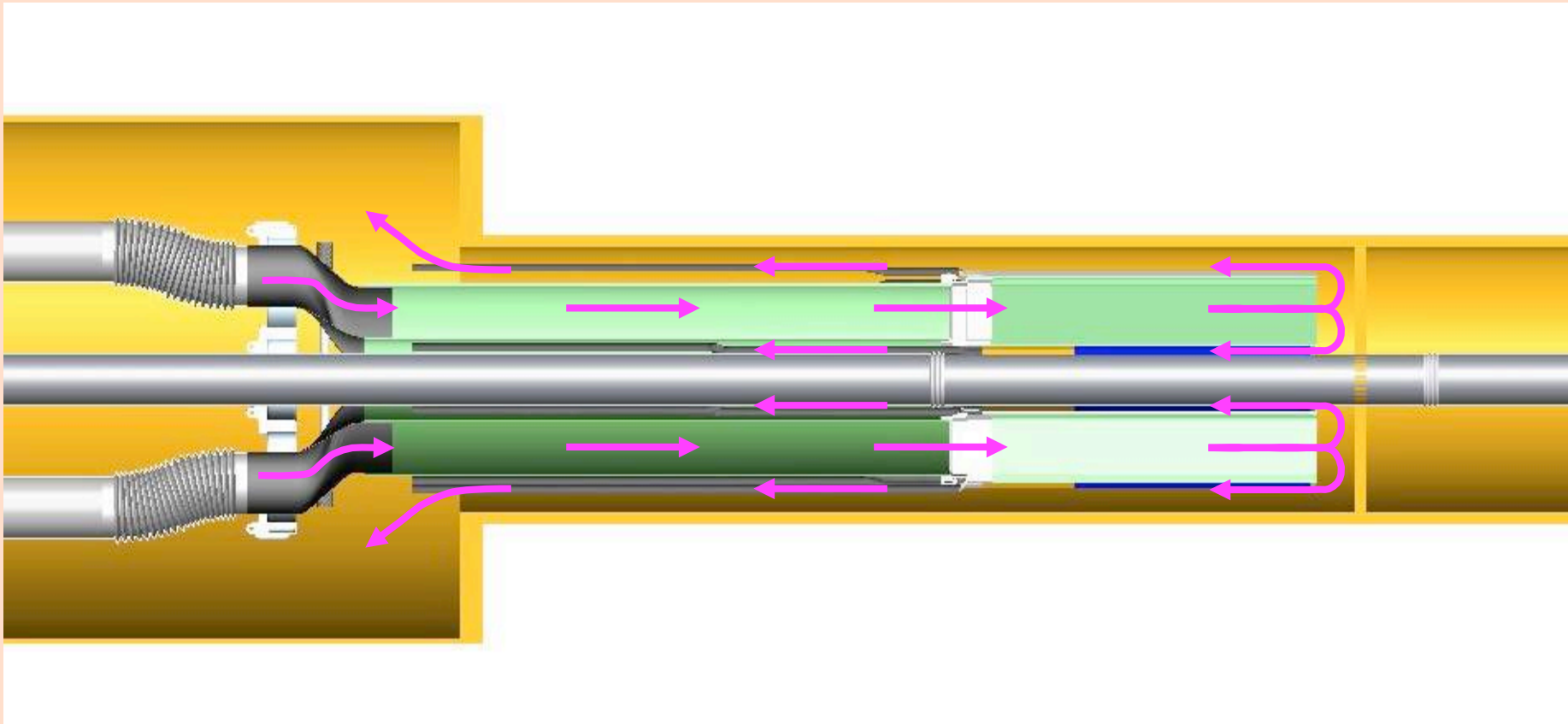
Status/Timeline

- **CD-0 February 2008**
 - **Committee report received January 2009 !!!**
 - **Submitted RMP in February**
 - **Answered questions end of March**
- **Expect CD-1 Review in September 2009**
 - **CDR also completed**
- **On track for FY 10 funding**
- **CD-2/3 planned for September 2010**
- **Installation for Physics in 2013**
- **Estimated cost range:\$11.1M-14.7M**

HFT Milestones

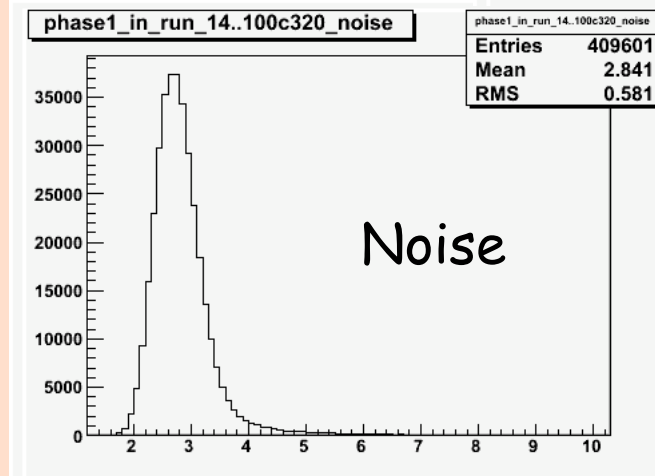
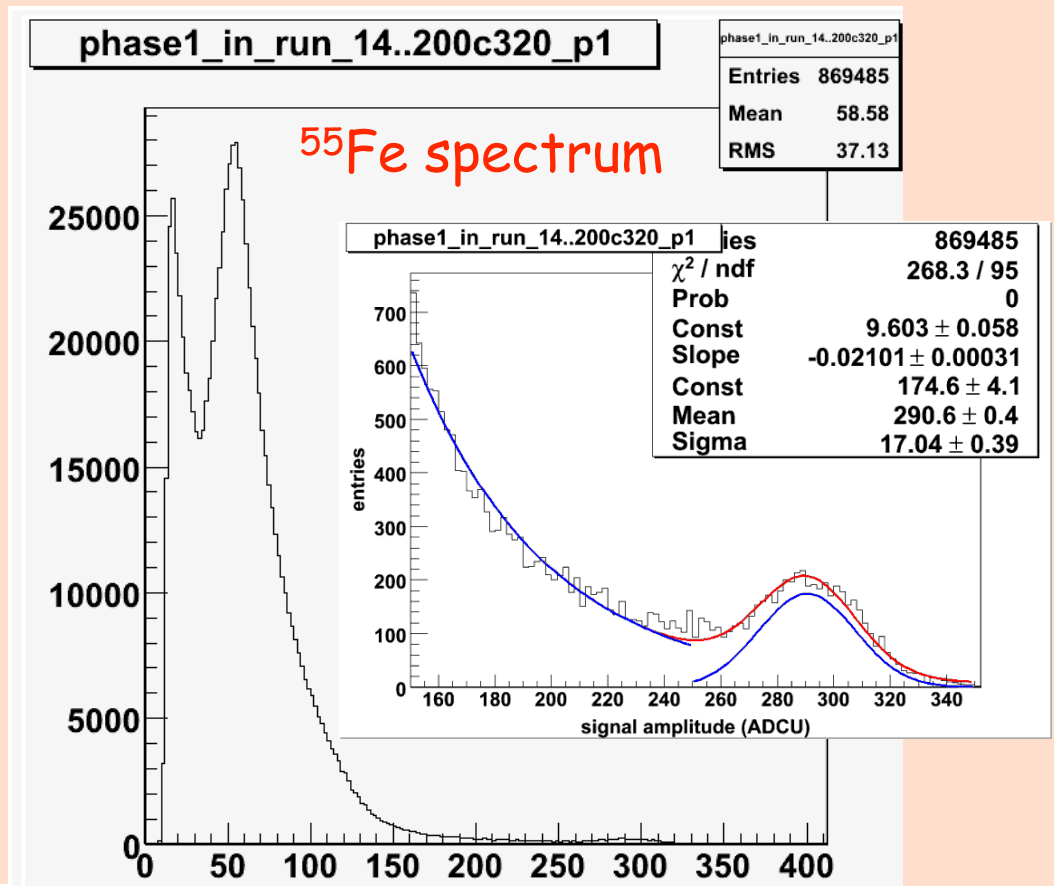
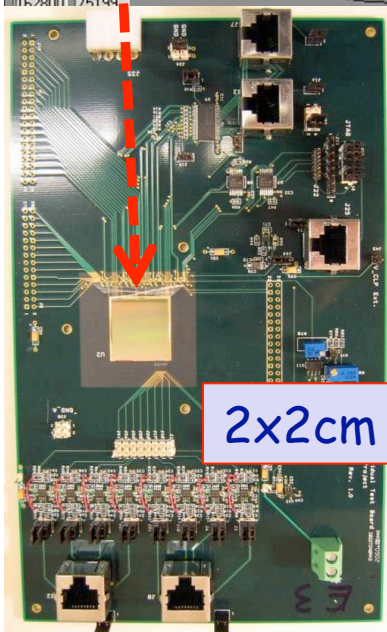
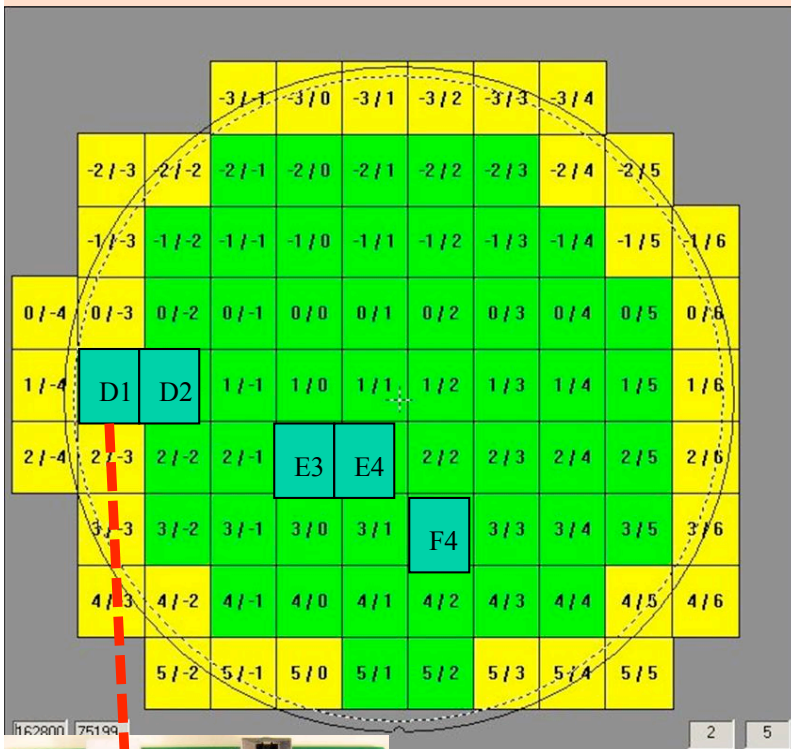
- 4Q FY09 CD-1
- 4Q FY10 CD-2/3
- 4Q FY11 PIXEL + FGT mount complete
 - Install engineering prototype
 - Can be done with Phase- 1 sensors
- 4Q FY11 *Ultimate* ready for production
- 4Q FY 12 Pixel ready
 - With *Ultimate* Sensors

Sub-system activities - PIXELS



- Sensor development
- Ladder fabrication
- Pixel air-cooling / Vibration tests
- Installation challenges
- Mapping

PIXEL Phase-1 sensor built and tested

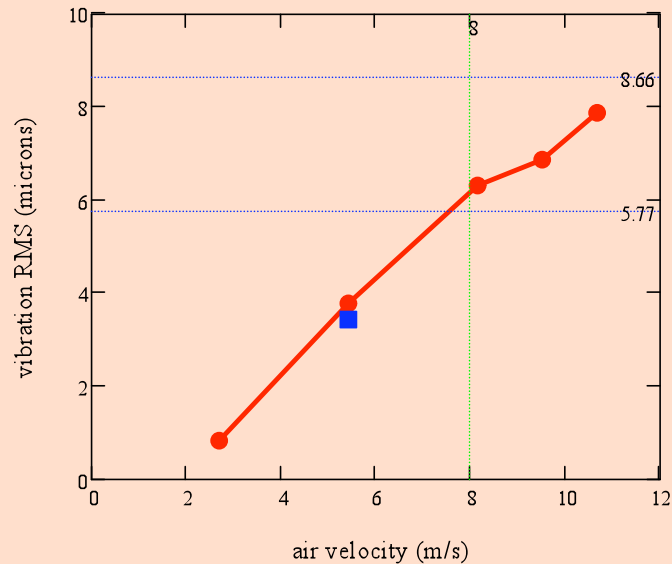


- To be used in engineering run
- High yield, sufficient quality
- Full test, it works !
- ENC $\sim 16e^-$ (analog output)

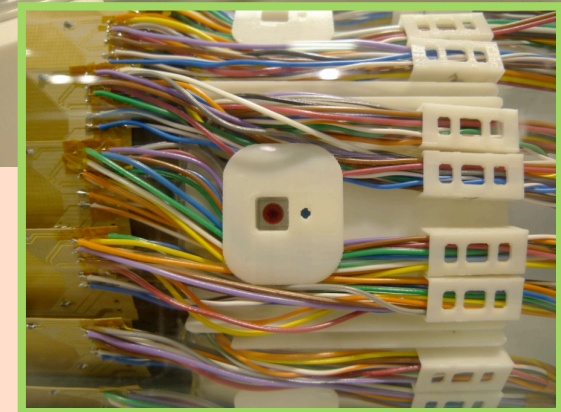
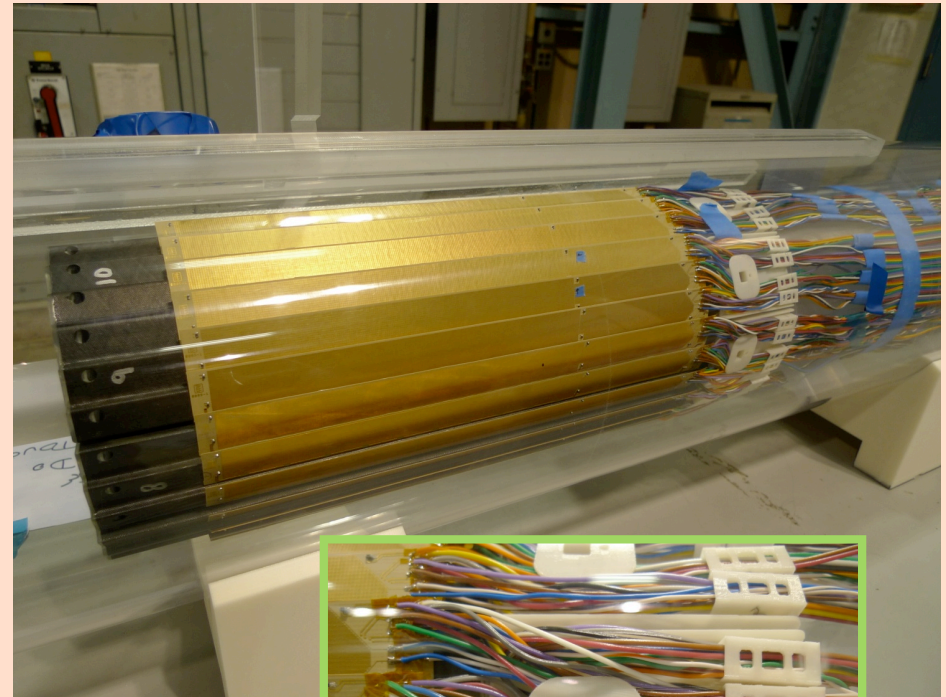
Full sized PIXEL cooling tests



Ladder Vibration

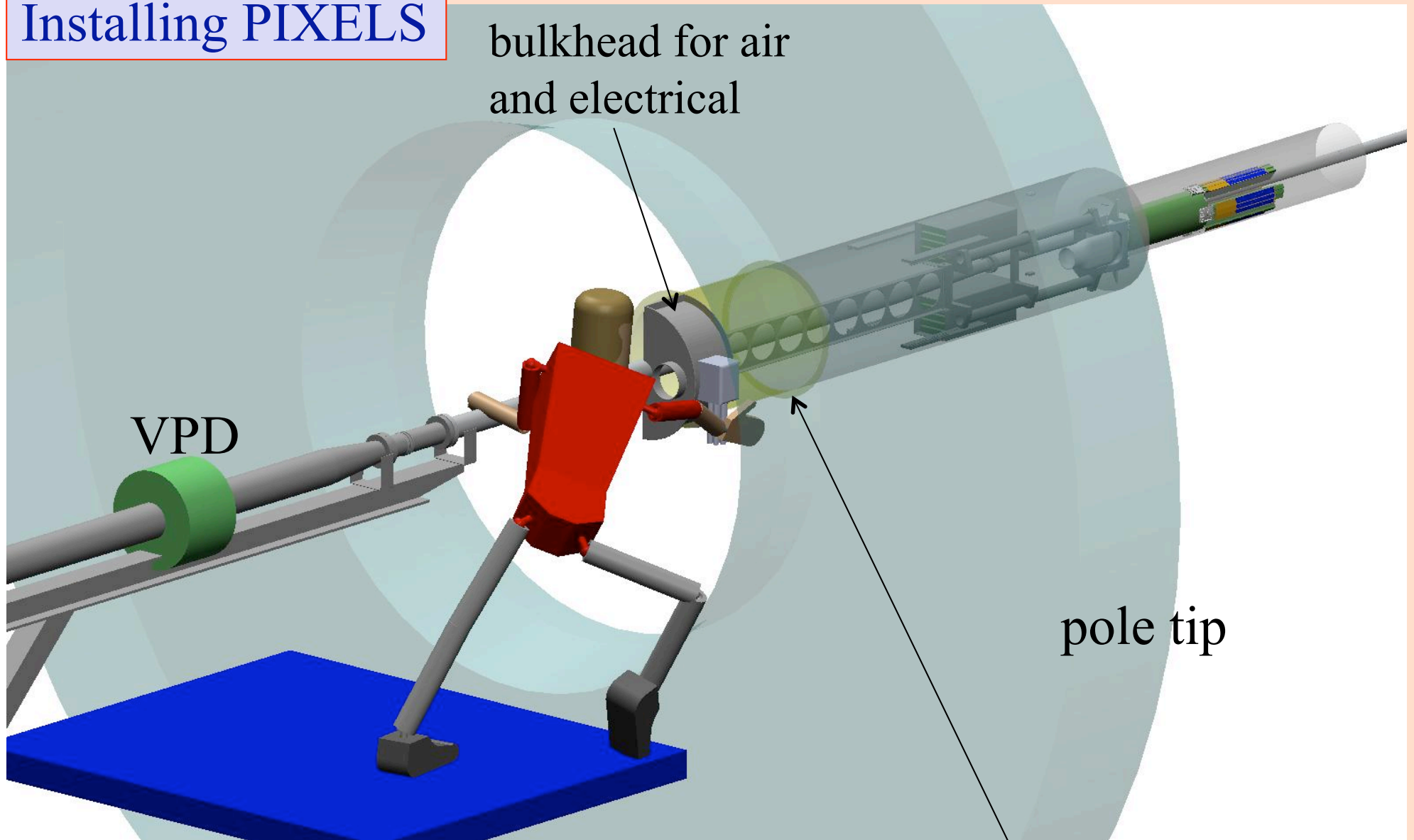


●—● measured vibration with negative pressure mode
■—■ measured vibration with positive pressure mode



- Air cooling for low mass
- Low vibrations for calibration
- Low ΔT for low deformation

Installing PIXELS



bulkhead for air
and electrical

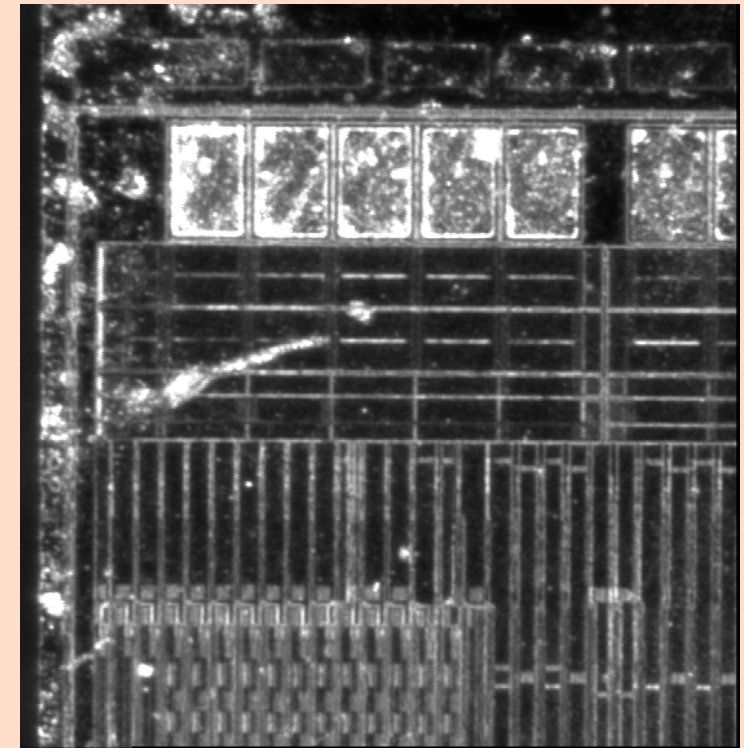
VPD

pole tip

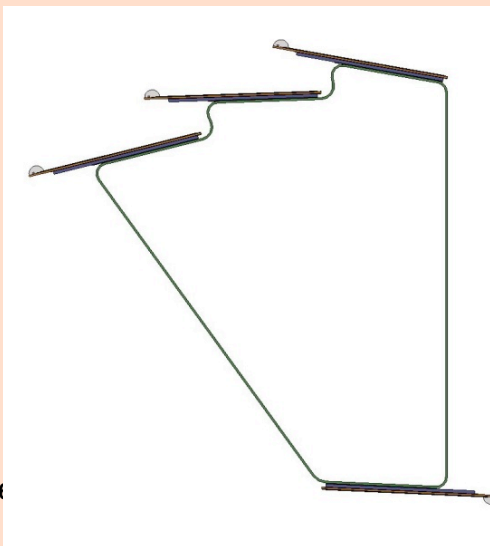
MSC extension to allow reach through
for assembly

Development of PIXEL spatial map procedure

Bob Connors
Spiros Margetis
Yifei Zhang

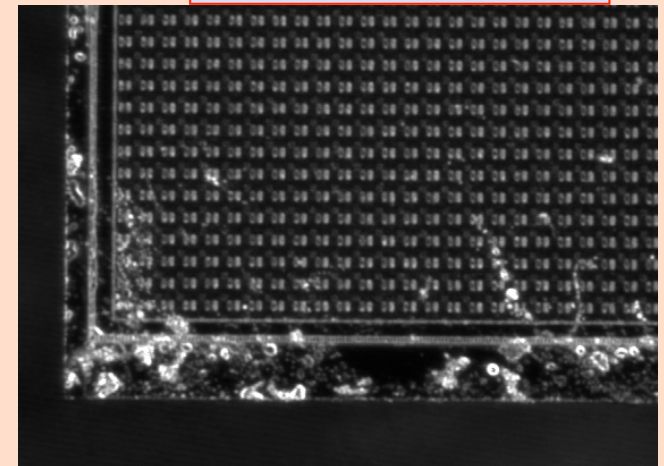


MEMOSTAR3, 30 μm pitch



touch probe 2-3 μm (xyz) and
visual 2-3 μm (xy) 50 μm (z)

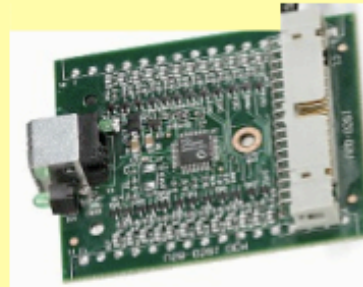
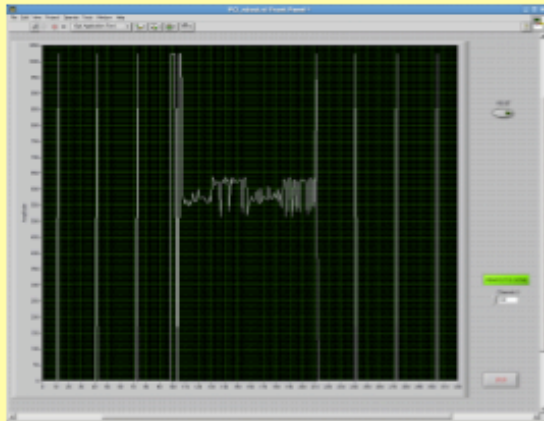
active volume: huge



Sub-system activities - IST

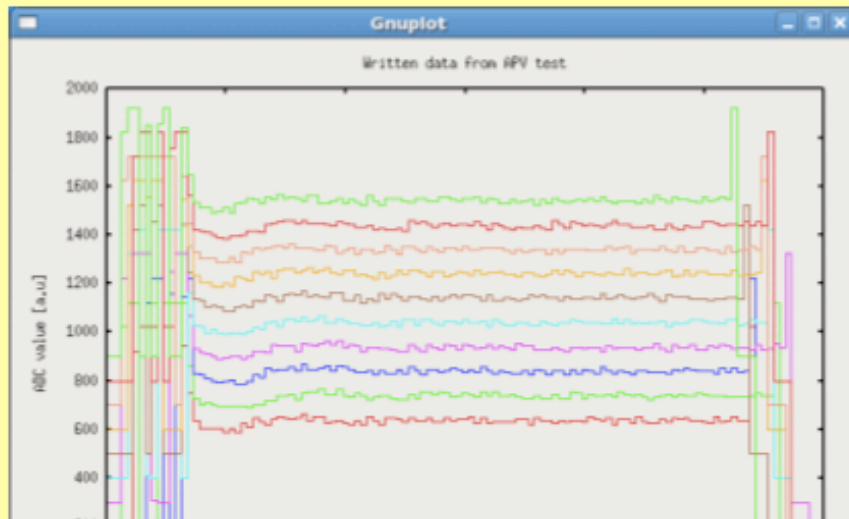


LabVIEW 8.6



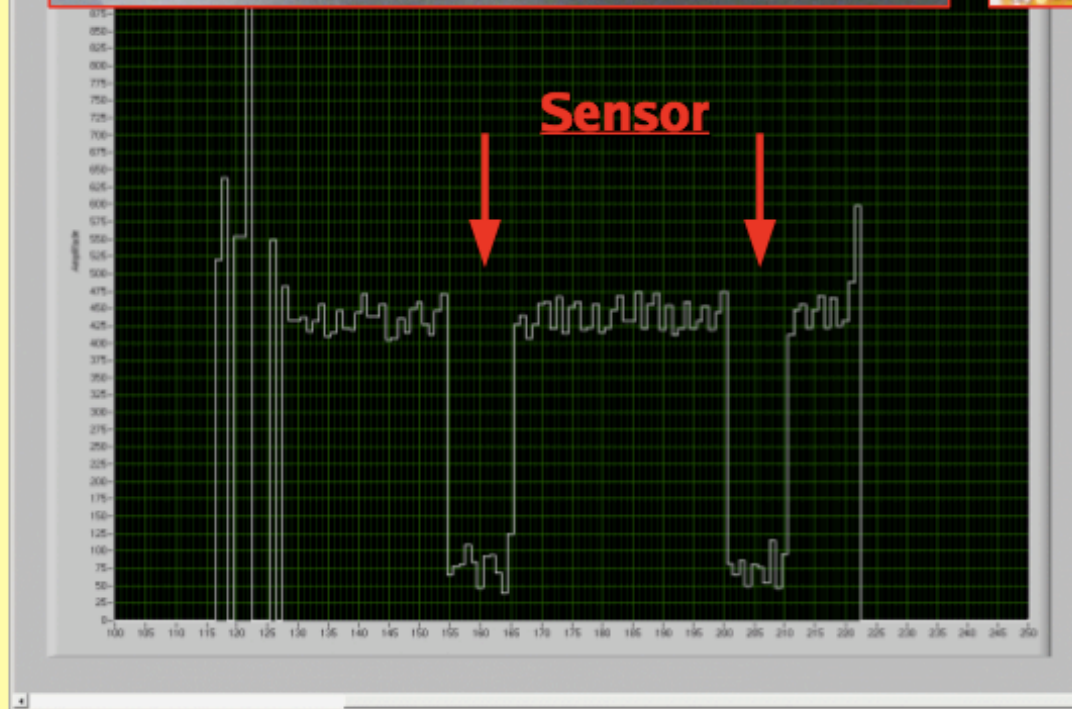
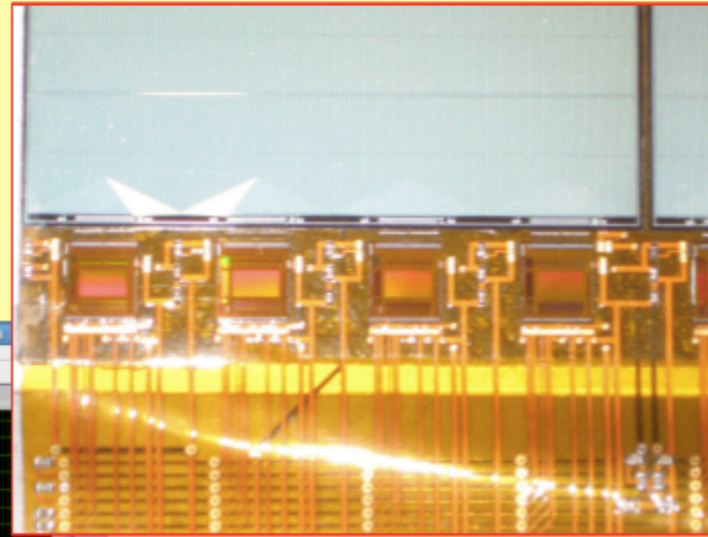
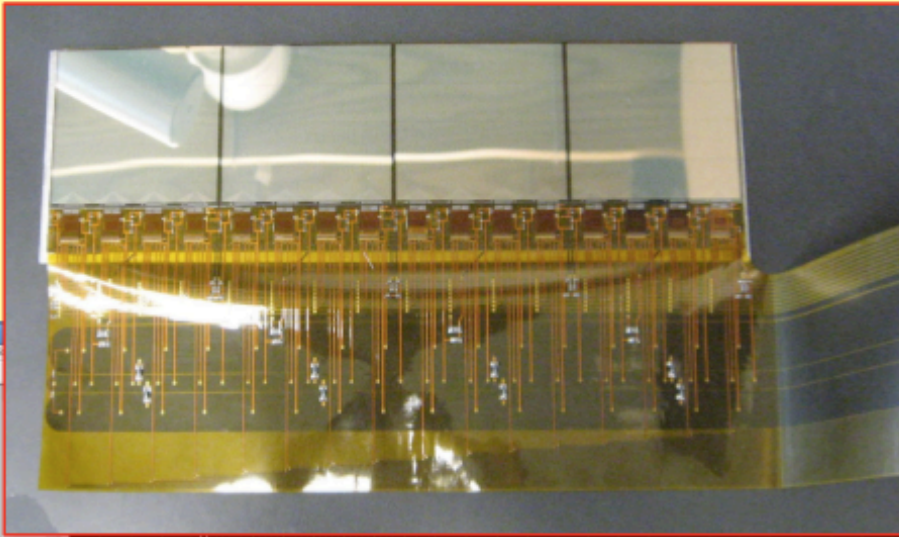
USB<->DIO

FPGA_CU GEM_CU APV



- Sensors
- Readout chips
- Hybrid/cable
- Readout systems
- Mechanical support
- Cooling system
- Wire bonding
- IST prototype module
- CDR & Schedules

IST prototype



¼ of sensors bonded

→ 1 mil wire @ 44 um pitch!

→ probably can do all bondings

Readout chips operational

→ I2C works, can set parameters

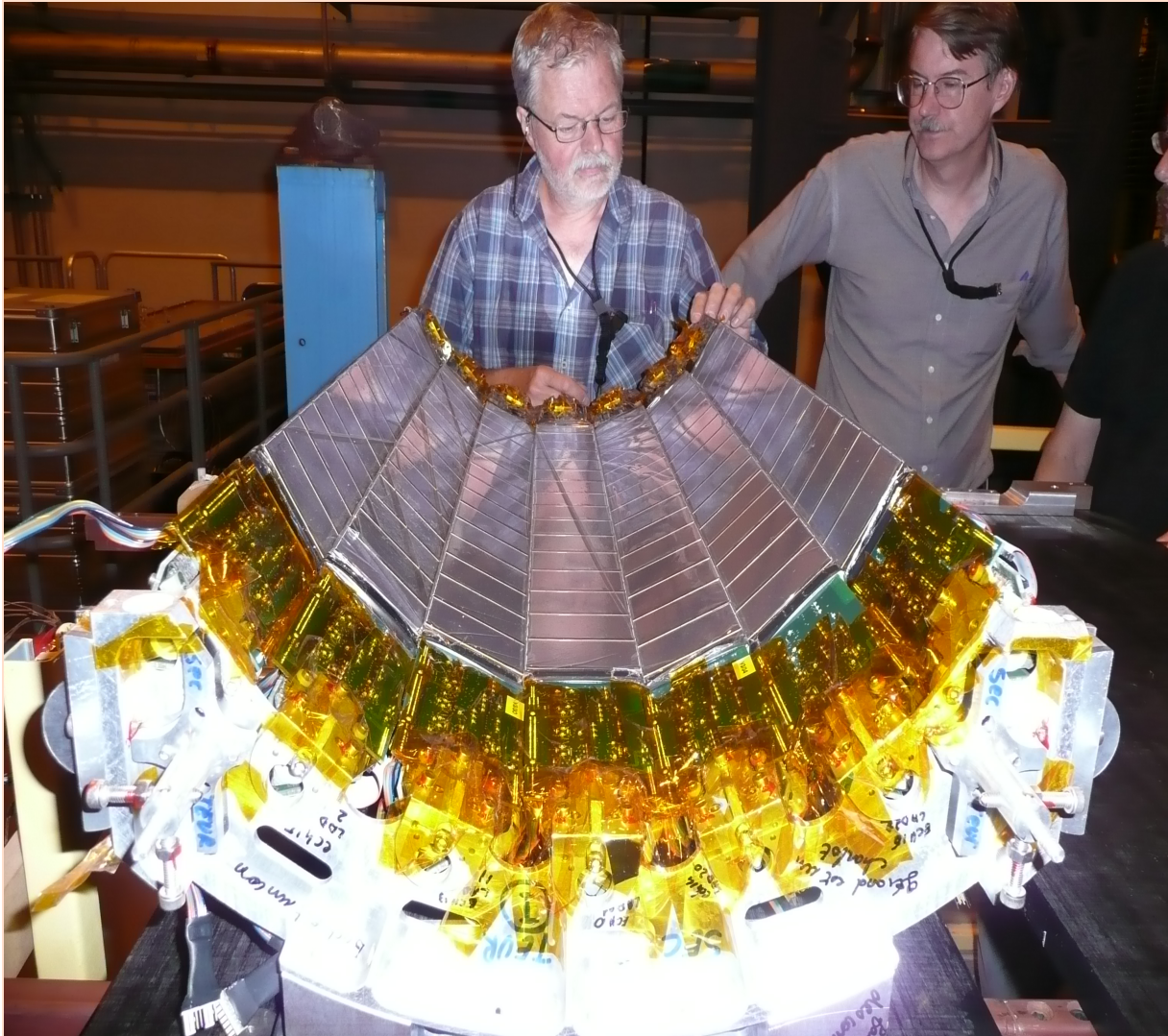
→ chips are reading out

Sensors show up in the right place

Speed demon at 16ms/channel

→ ~25 seconds per sensor

Sub-system activities - SSD



- All bad ladders repaired
- Electronics
 - Read Wafers in parallel
 - Upgrade RDOs
 - DAQ1000 compatible
- New Air-cooling system
- New mechanical mounting on cone
- Installation work

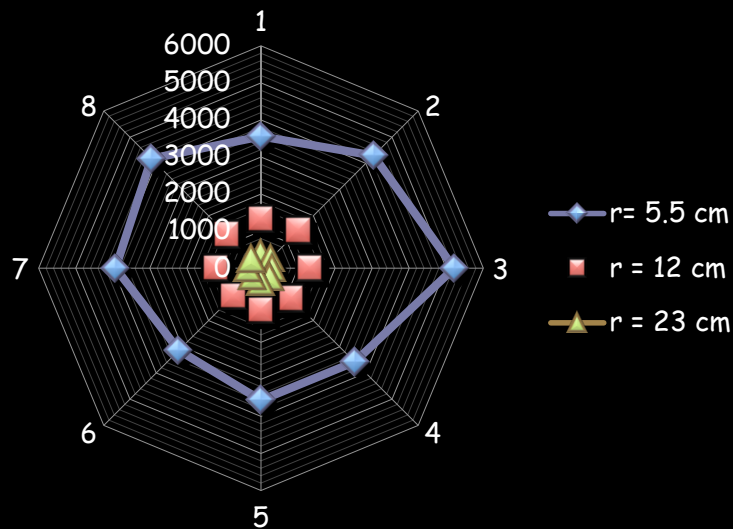
Existing detector face lift - part of HFT project now

Other activities - Radiation environment

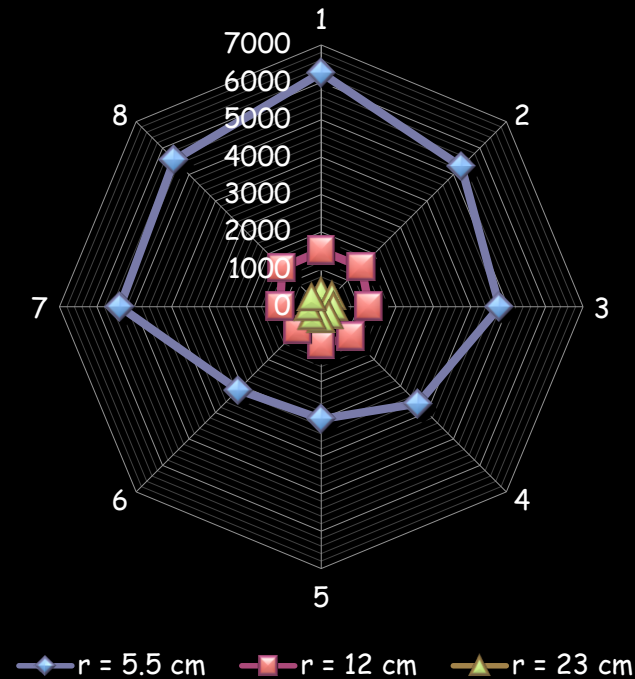
In RHIC-II high luminosity environment dose not trivial

East and West Distributions - krad

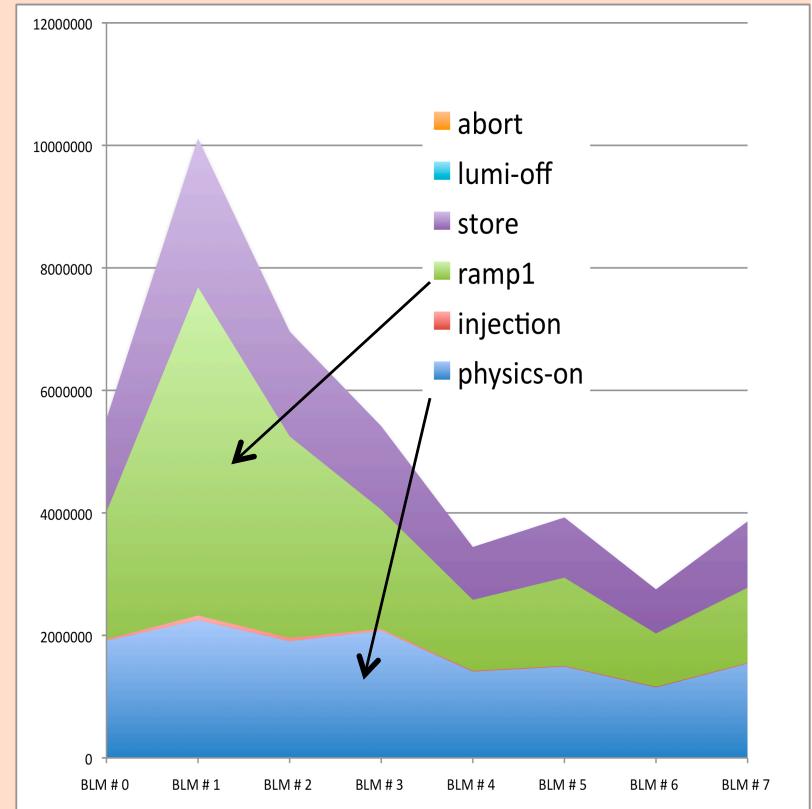
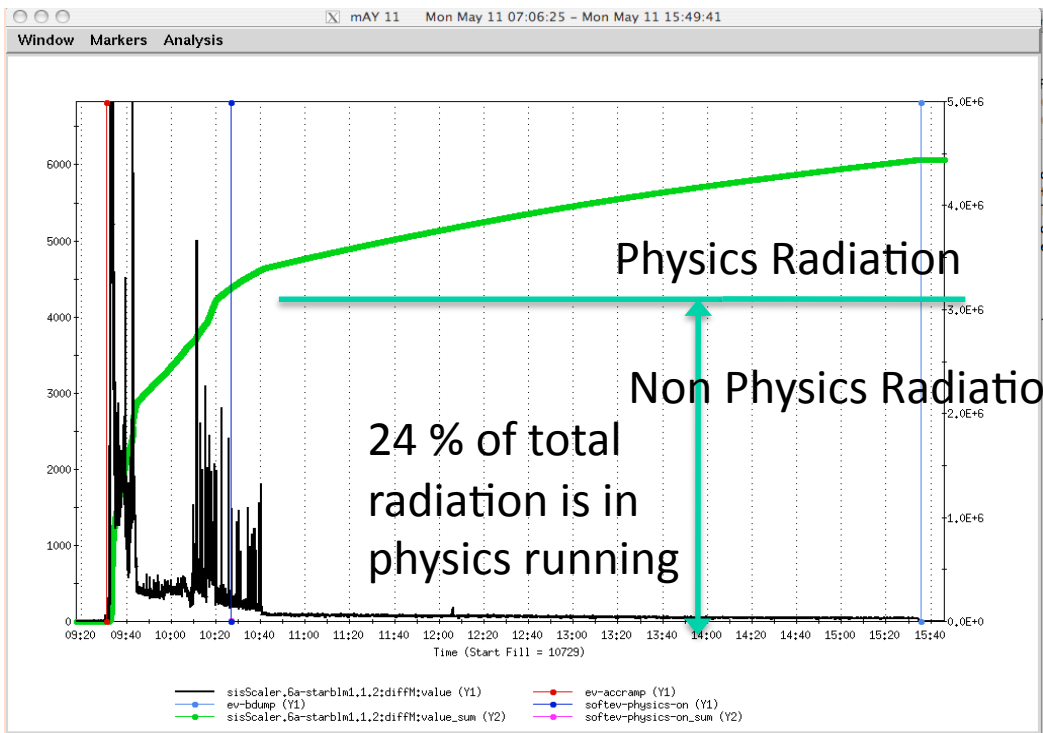
East Side - BBC 500 GeV/c
GeV/c - Rad - View
looking from outside
STAR



BBC West 500 GeV/c
Rad - View Looking from
outside STAR

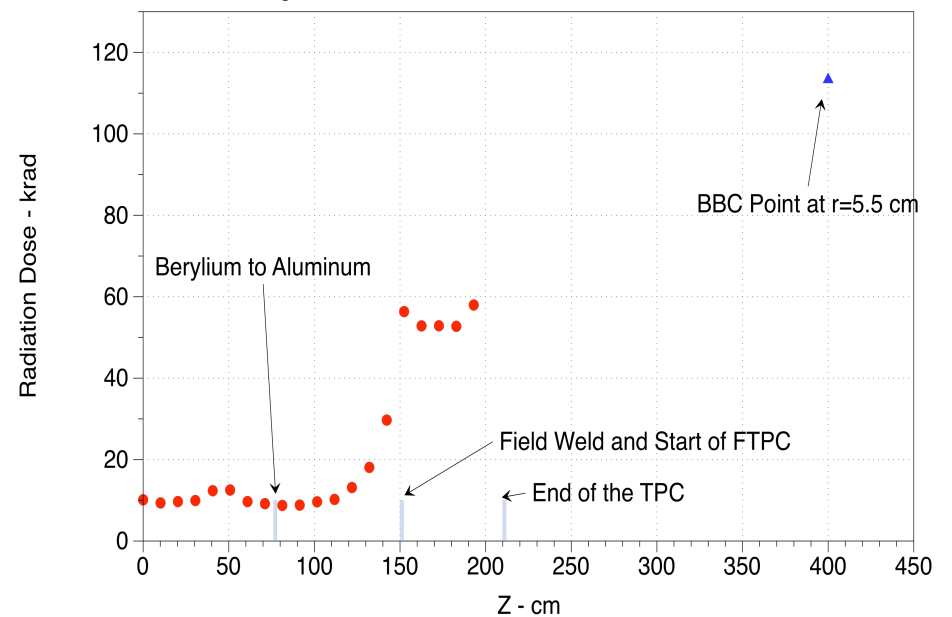


Large asymmetric radiation at BBCs



Integrated Dose for PP - 500 GeV/c - Run 9 at R = 3.8 cm

- Silicon sensitive during complete RHIC Fill
- Most significant radiation happens during ramp and tuning
- Appears that radiation increases in Z
- Need
 - Better understanding of Z and R dependence near beam
 - RHIC needs to modify its tuning to minimize damage to silicon



Other activities

- (New) Beam Pipe Design/Construction
- Integration/Cone/Assembly of
 - HFT components
 - HFT/FGT
 - Stability of support, cabling etc

All activity reports posted on Drupal/HFT meeting pages

Summary

- Intense effort in all fronts
 - For several years now
- Project finally on a firm path to completion
- Rich physics program from Day-1