

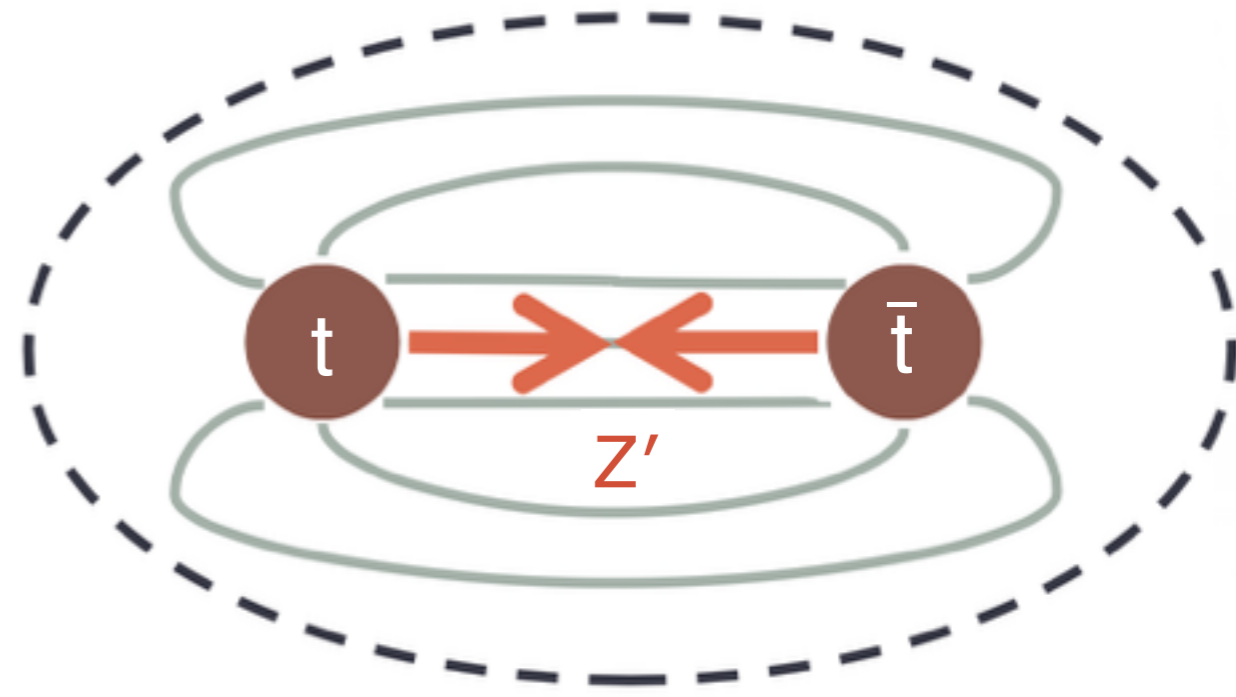
**Semi-Leptonic $Z' \rightarrow t\bar{t}$
Search and the Phase 1
FPIX Upgrade**

Doug Berry

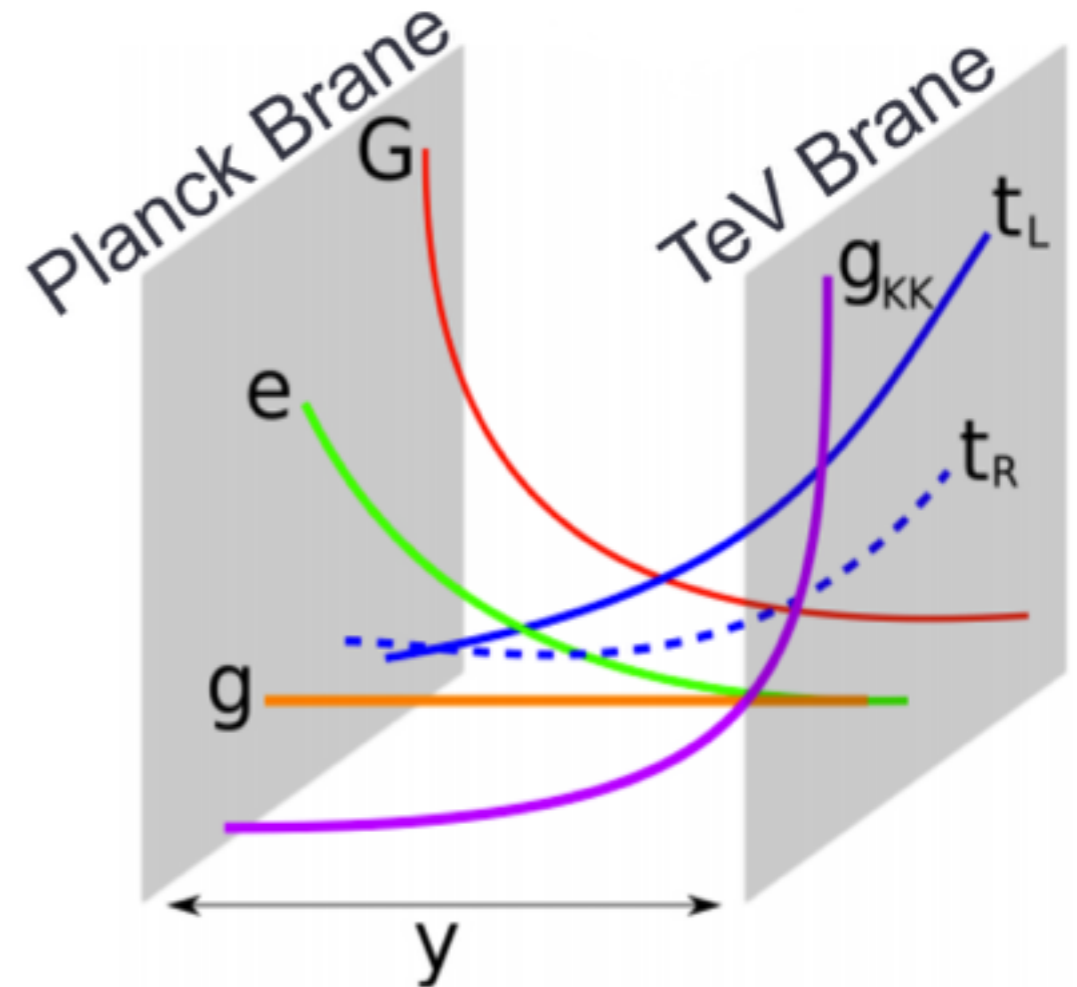
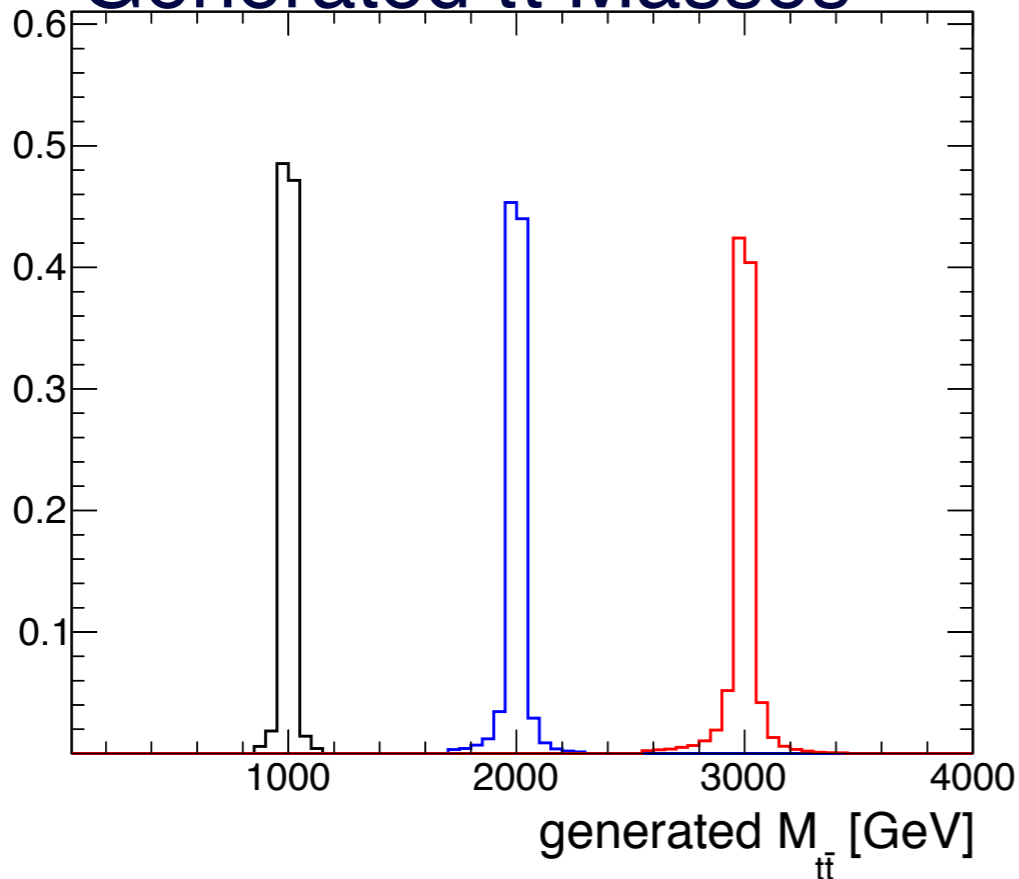


$Z' \rightarrow t\bar{t}$ Semi-Leptonic Search

- This analysis searches for a heavy resonance decaying into two boosted top quarks
- It is a generic search that sets explicit limits for Z' and g_{KK}

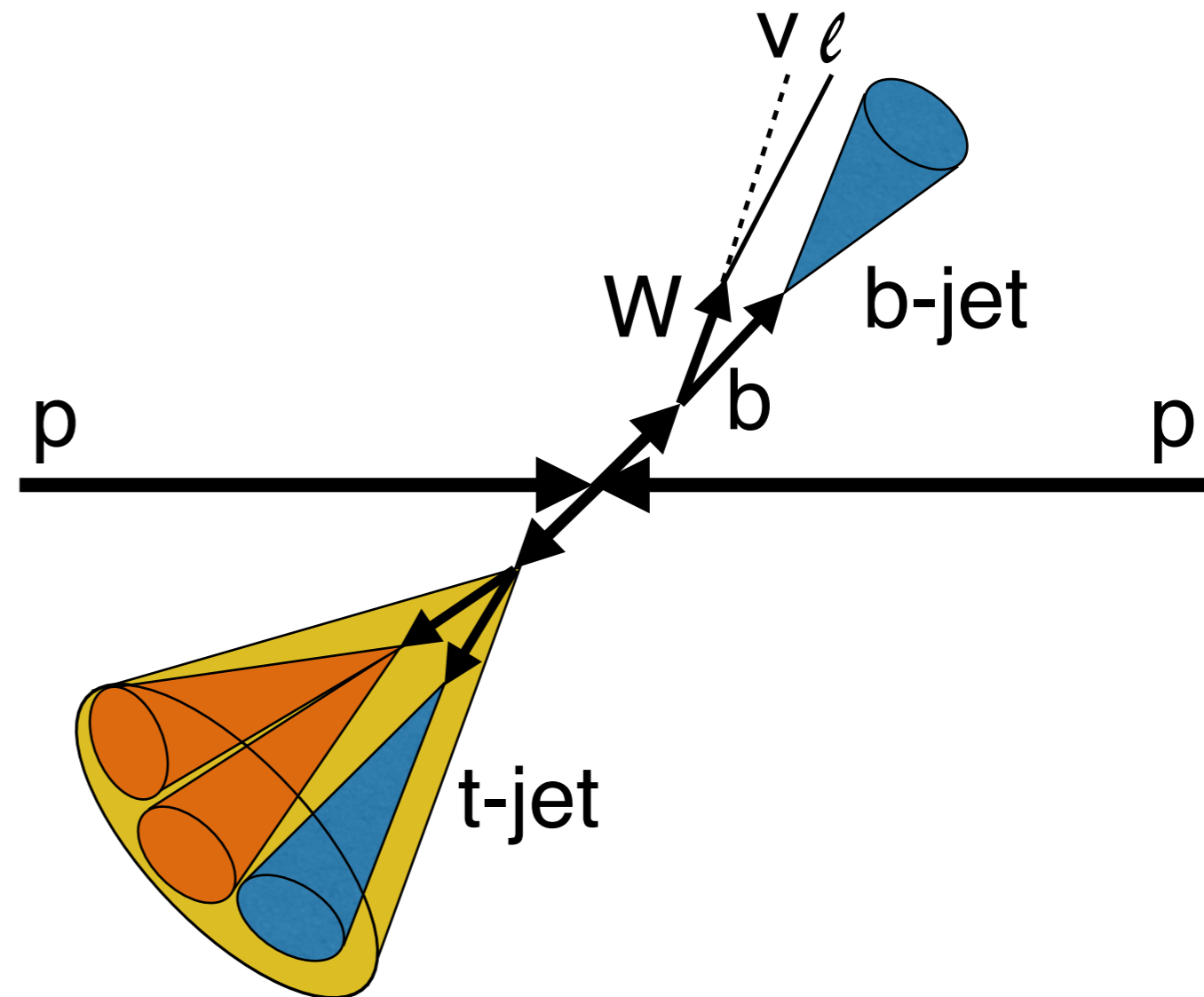


Generated $t\bar{t}$ Masses

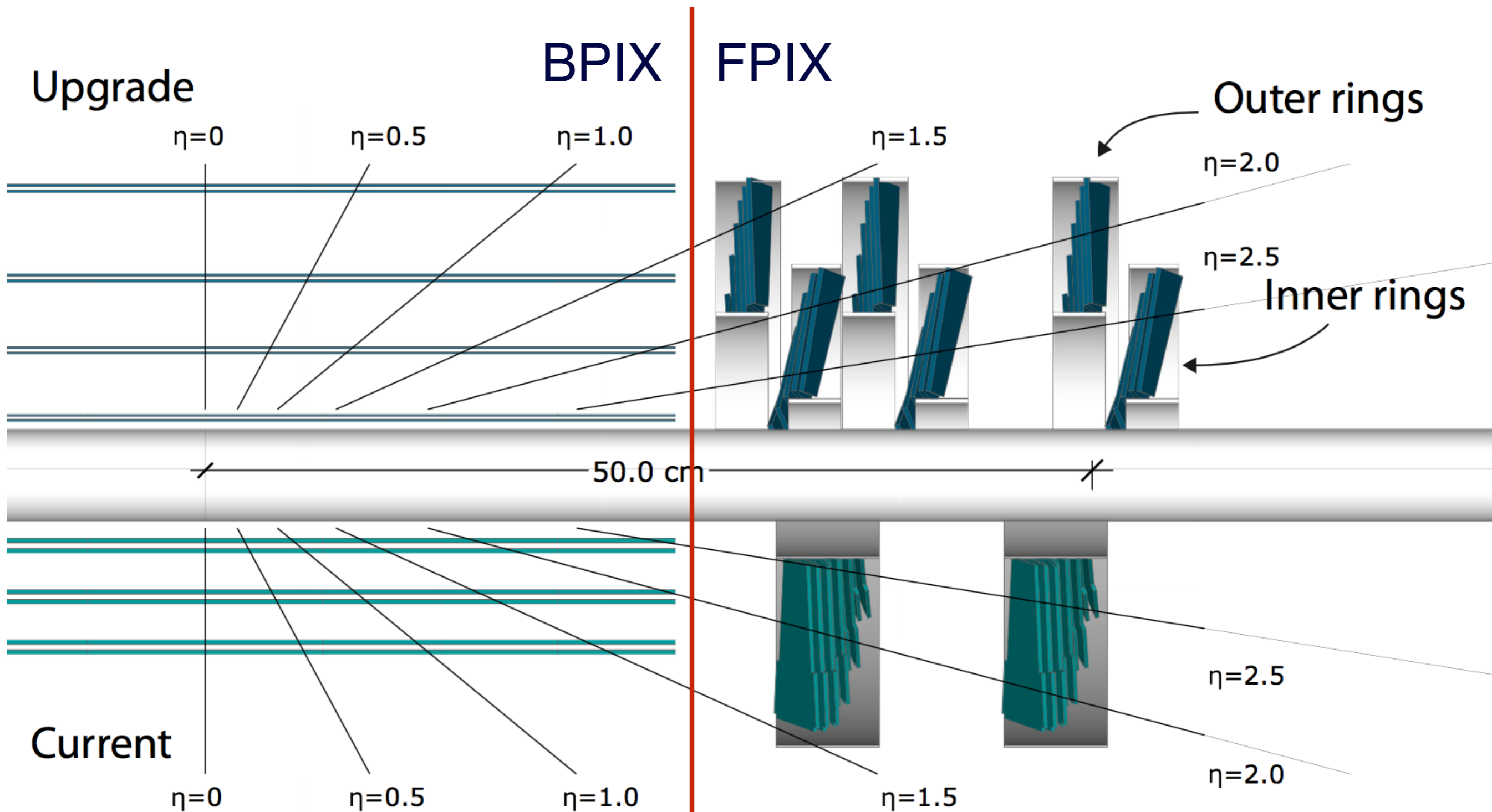


Boosted Tops

- The boosted semi-leptonic channel produces non-isolated leptons, which require special triggering and reconstruction techniques
- Being located at the LPC allow us to collaborate with the numerous analyzers who have expertise with boosted and hadronic objects
- Additional, the Condor queue, EOS, and the lpc interactive nodes provide the resources needed to create, debug, and running the analysis



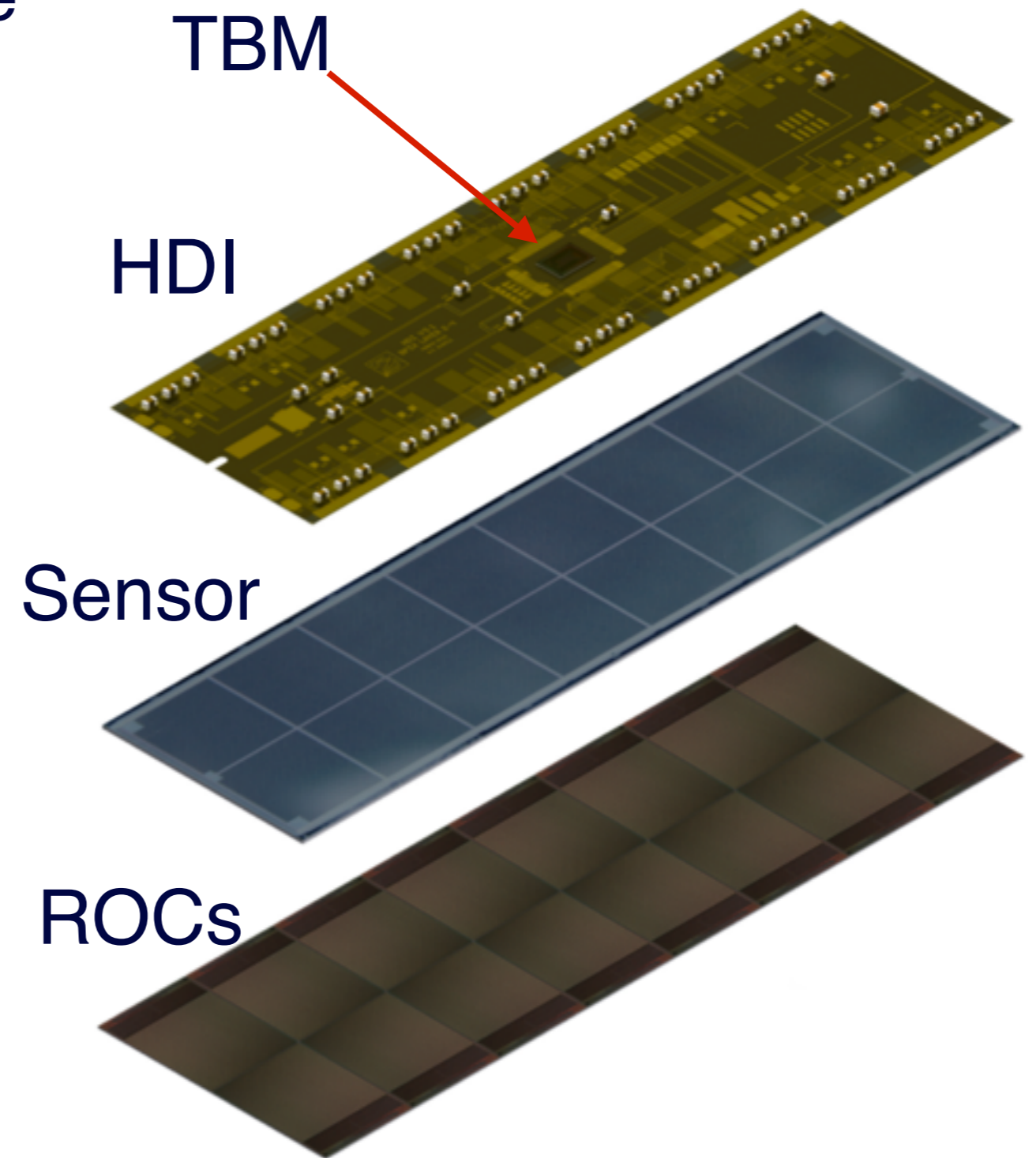
Phase 1 Pixel Upgrade



D. Berry

FPIX Modules

- An FPIX module is a composite of three sub-components
 - High Density Interconnect (HDI)
 - The Token Bit Manager (TBM) is mounted on top on the HDI
- Silicon Sensor Wafer
- 16 Readout Chips (ROC) bump bonded to silicon sensor



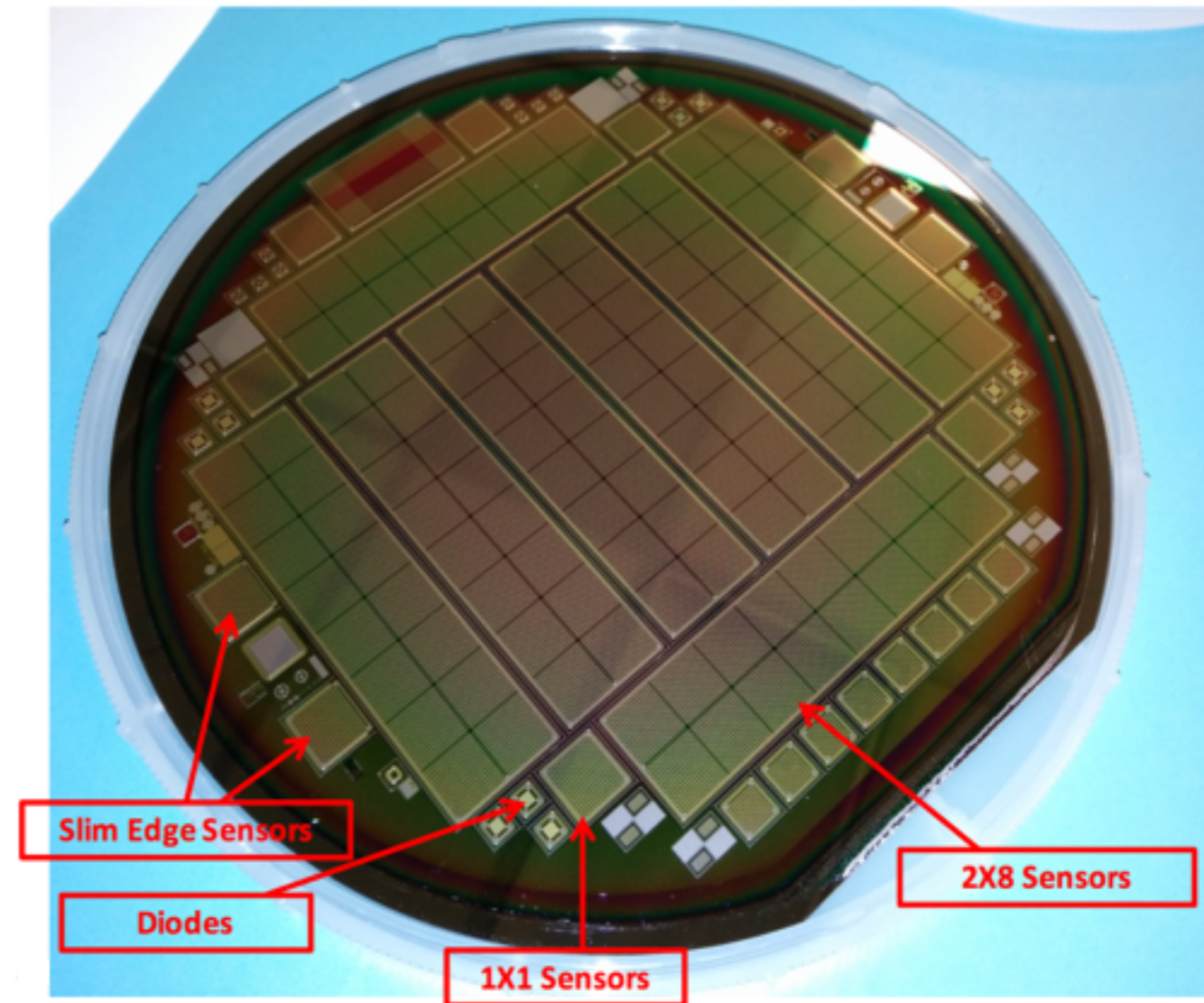
HDI

- The HDIs are produced by two different vendors
 - Compunetics and Printed Circuits Inc,
- Each HDI is visually inspected, tested, soldered, and tested again by LCP and FNAL personal



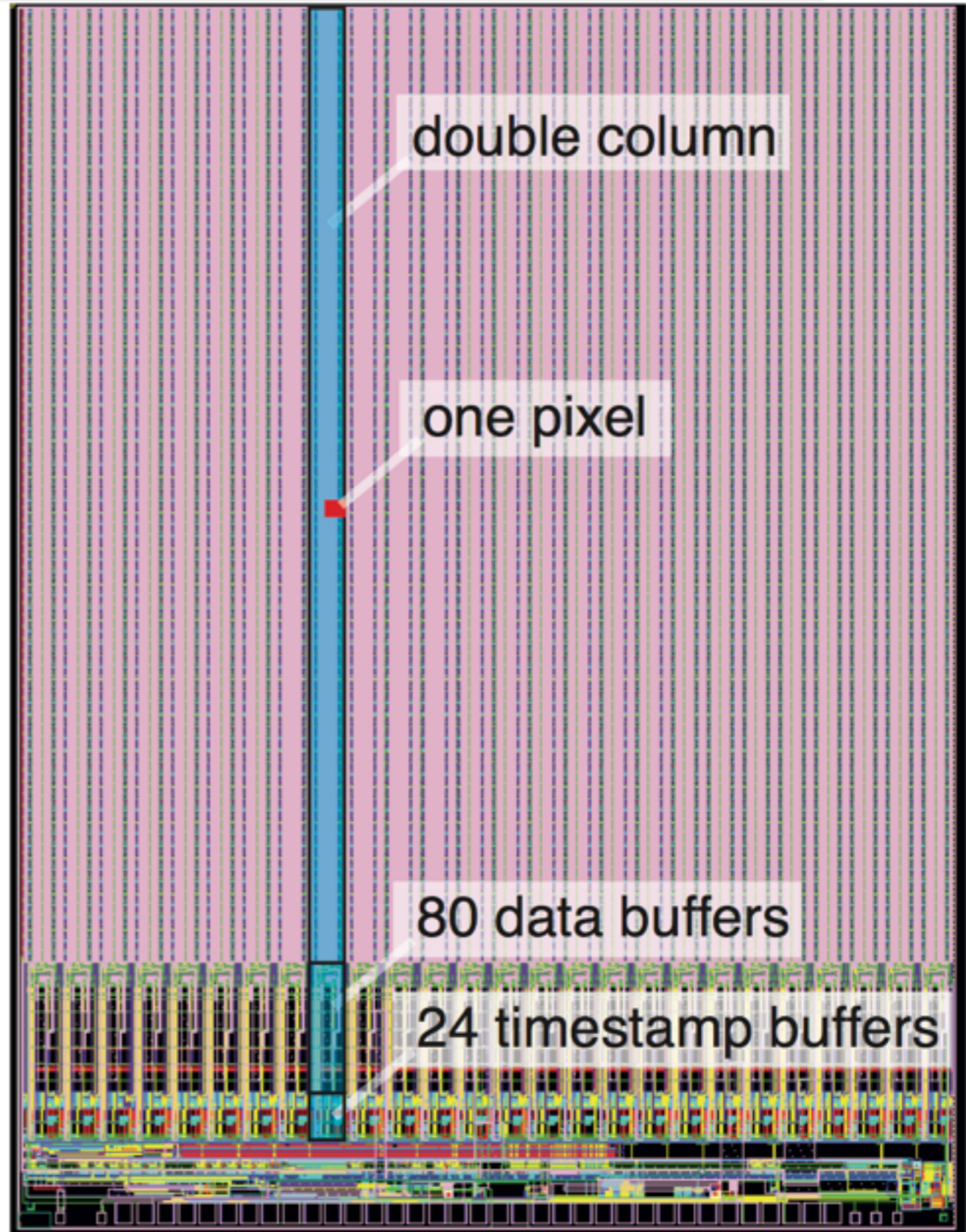
Silicon Wafers

- Two batches of Silicon Wafers were manufactured by Sintef
 - First batch of 120 wafers had a yield of 95.3%
 - Second batch of 45 wafers had a yield of 97.2%
- 1264 good sensors have been delivered to RTI for bump bonding
- All silicon wafers were tested by personal located at the LPC



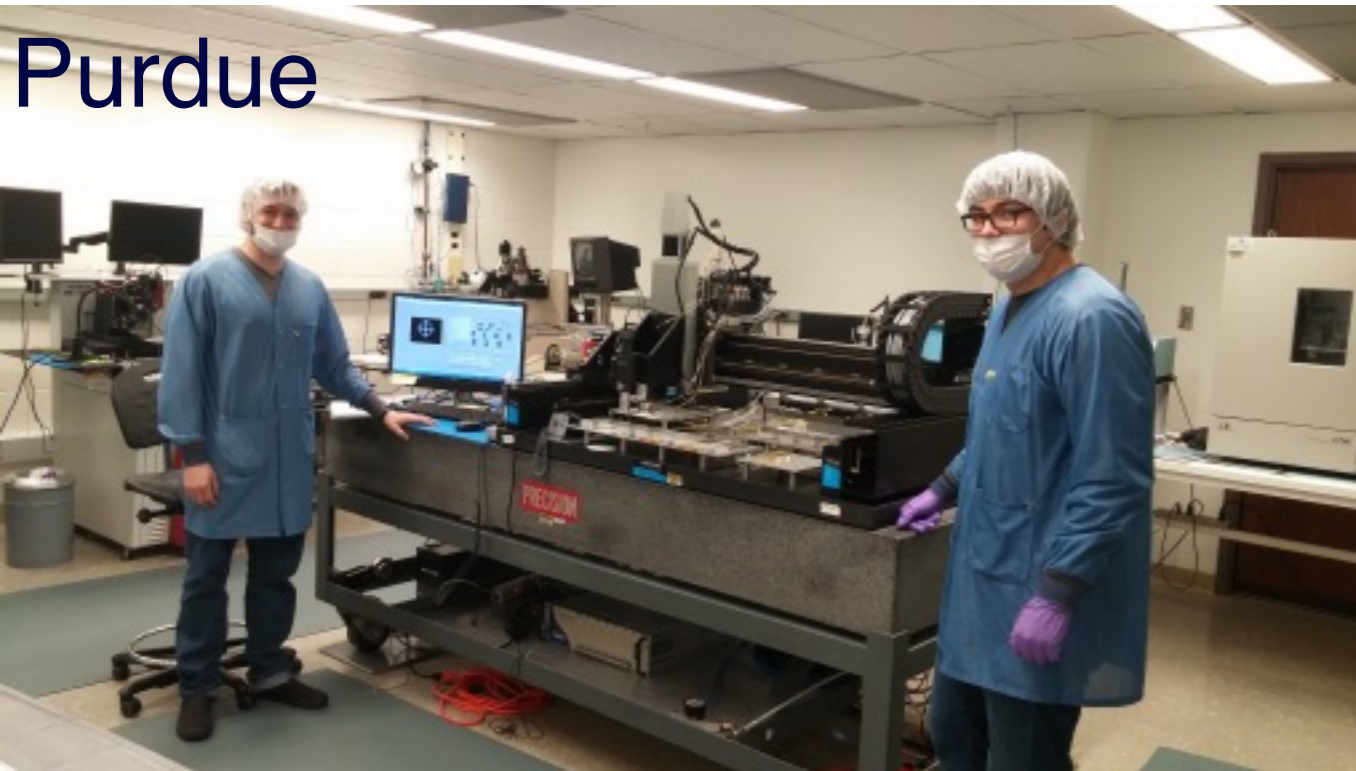
Readout Chips

- ROC wafers were manufactured by Global Foundries
- The initial order of ROCs was enough for 1150 modules
 - A second batch of 24 ROC wafers is being processed and will be ready for bump bonding in early July
- We will have enough sensor and ROC wafers to build 1250 modules (672 required for FPIX)
- All ROCs were tested by FNAL personal

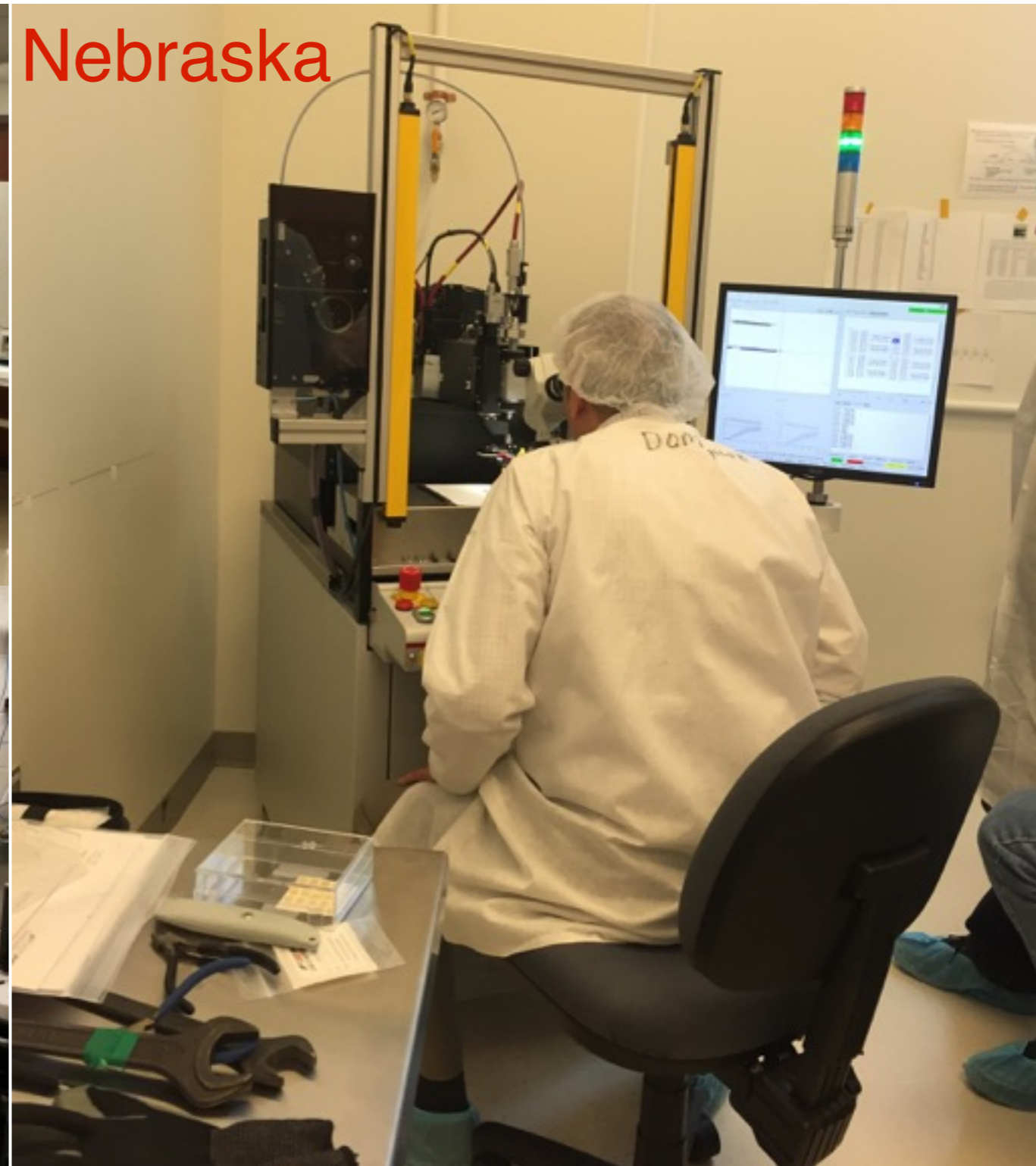


Module Assembly Sites

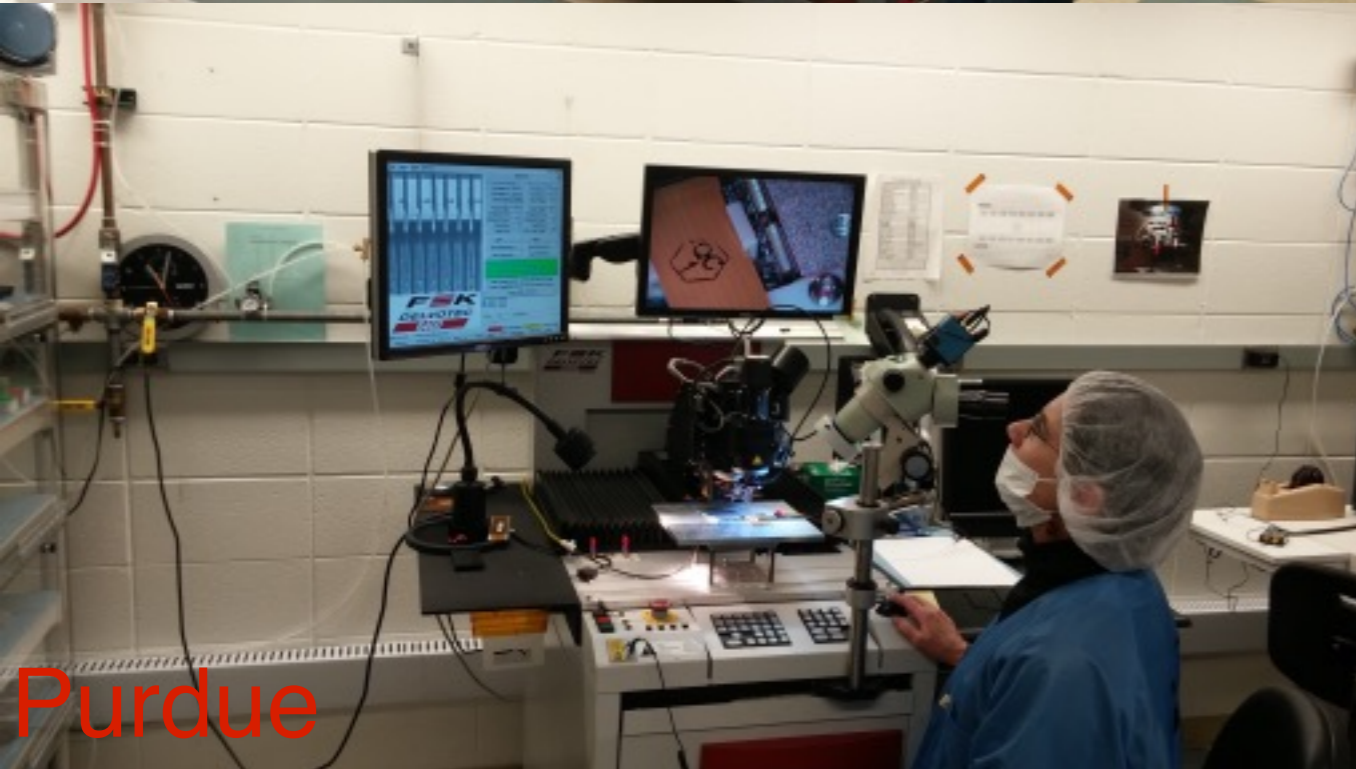
Purdue



Nebraska

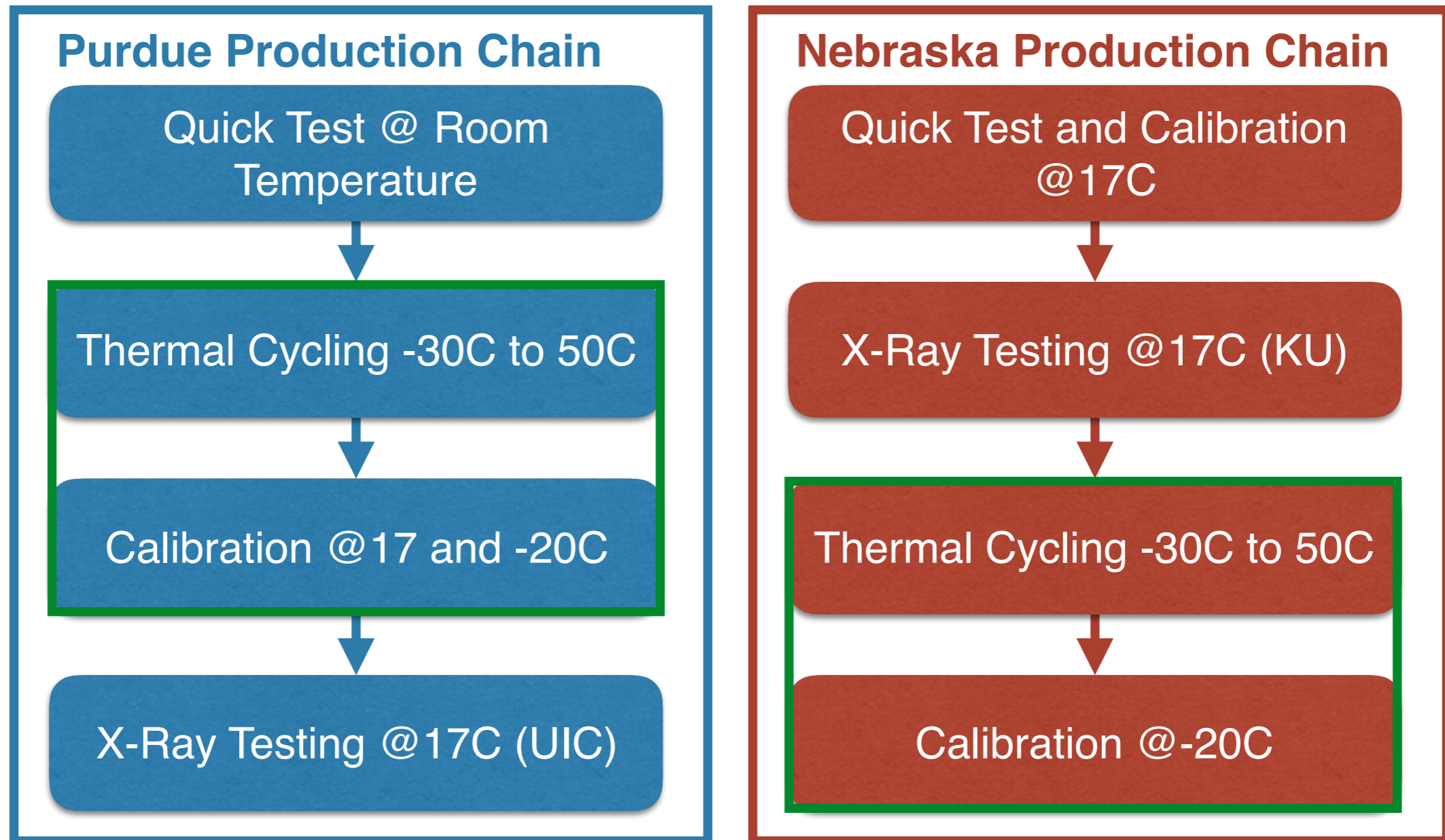


Purdue



Module Flow

- Two assembly sites are producing modules for FPIX
- Activities in the green boxes are performed here at FNAL



Module Testing

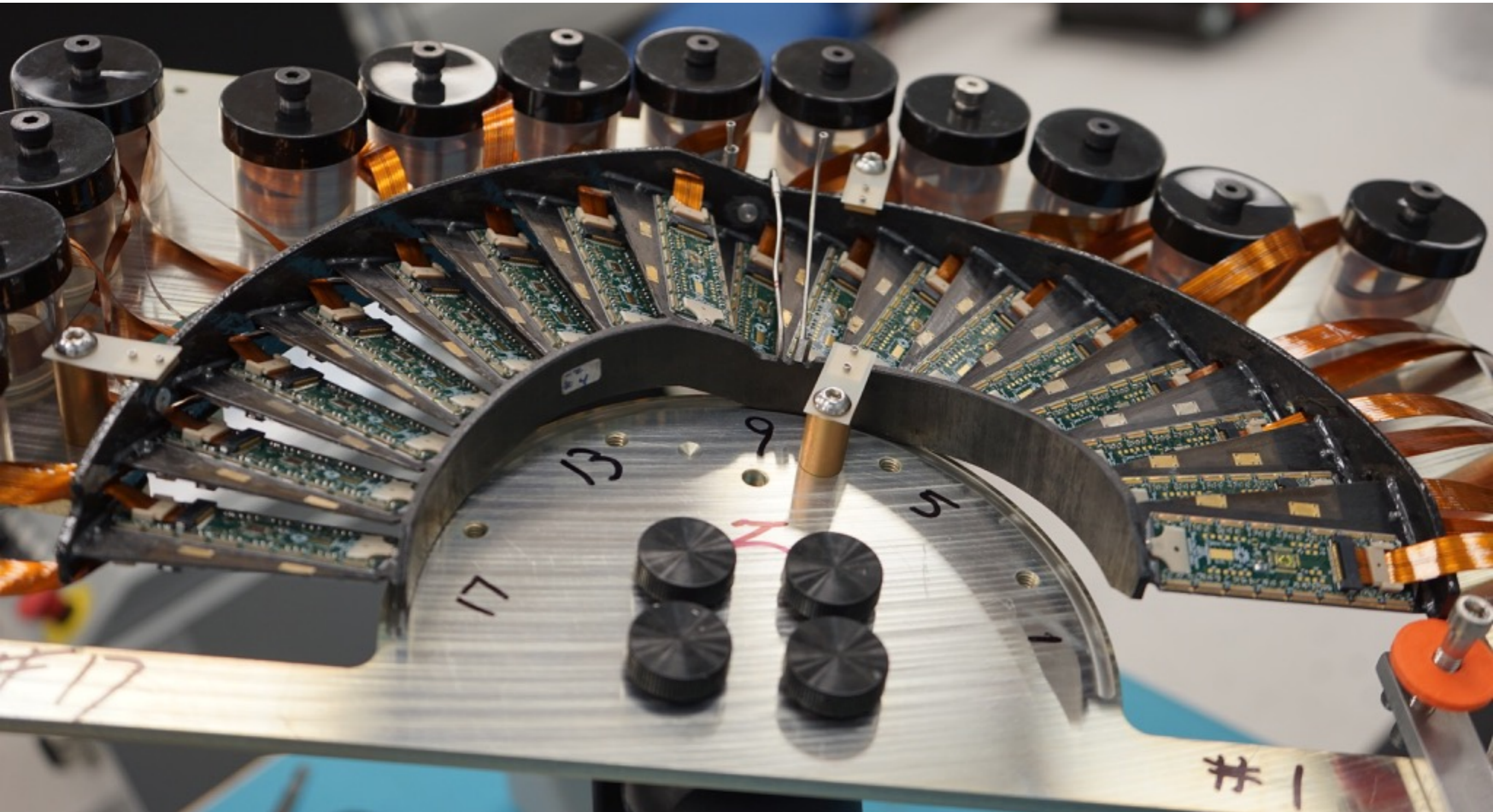
- Module testing performs a comprehensive testing suit that measures many different quantities
 - Determine the operational parameters of the pixel
 - Sets the timing parameters of the TBM and ROC
 - Calibrates the pixel
 - Measures the pixel noise
 - Measures the response of each pixel
 - Assesses the quality of the bump bonds
 - Measures the leakage current of the sensor



- Module testing shifts are filled by almost two dozen undergrads, graduates, post-docs and faculty members positioned at or visiting the LPC



Half Disk



Collaborators

- **Phase 1 Pixel Upgrade**

- FNAL
- Kansas State University
- The Ohio State University
- Purdue University
- Purdue University Calumet
- Rice University
- Rutgers University
- SUNY Buffalo
- UC Davis
- UC Riverside
- University of Colorado - Boulder
- University of Illinois at Chicago
- University of Iowa
- University of Kansas
- University of Nebraska - Lincoln
- University of Puerto Rico
- Wayne State University

- **$Z' \rightarrow t\bar{t}$ Semi-leptonic Analysis**

- **UIC**

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- **D. Berry**
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- **Universität Hamburg**

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- T. Peiffer

- **Universidad Autónoma de Madrid**

- M. Missiroli



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Summary

- THE LPC provides crucial support to the analysis efforts at UIC
 - The computing resources of the LPC run the analysis
 - The LPC hosts analyzers who are experts in the physics object required for the boosted Z' search
- The LPC attracts critical personal to the Phase 1 FPIX Upgrade
 - Without the LPC we would not have the personal needed to test all the FPIX modules and sub-components
 - Having the LPC at FNAL enables interactions between physicist, engineers, and technicians that will lead to a successful Phase 1 FPIX upgrade

