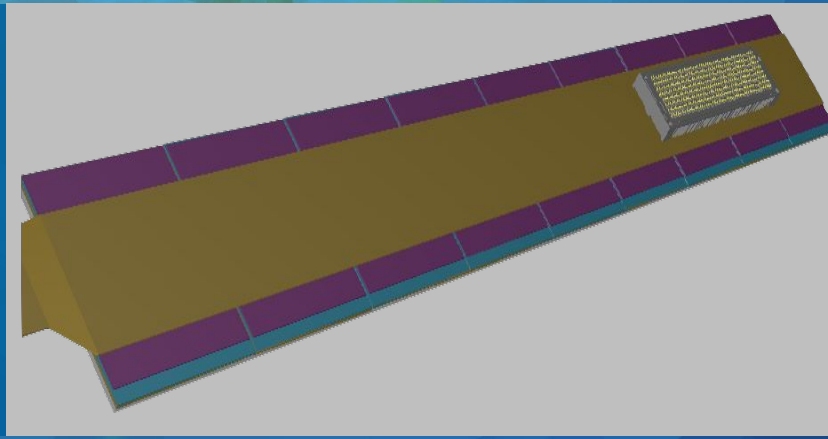
The ePIC Barrel Imaging Calorimeter

Updates AstroPix Wafers and Modules & Staves



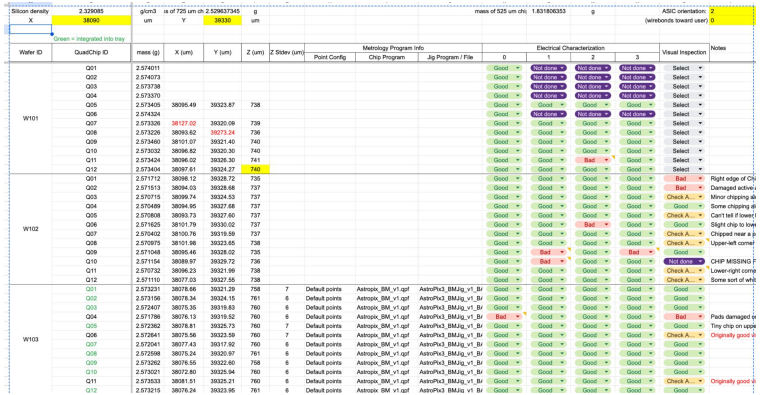
Manoj Jadhav
Argonne National Laboratory

ePIC BIC: General meeting
November 22, 2024

AstroPix

AstroPix v3 Yield Study

- 24 wafers to be QC tested
- Electric characterization (IV), visual inspection (VI), metrology, mass
- 15 wafers completed (tested as quad-chips)
  - 11% quad-chips failed (mostly electrical (6.7%) and VI (4.5%))
  - 14% chips has minor scratches etc. (“check” category)
  - If considered as single chip
    - 2.9% chips failed QC (mostly breakdown below 100V)
    - 3.5% under “check” category



AstroPix Depletion (with AstroPix team)

- Discussion on going about getting full depletion
- testing other monolithic test structures gives same behaviour at high resistivity - Vitaliy
- X-ray beam test next month

AstroPix

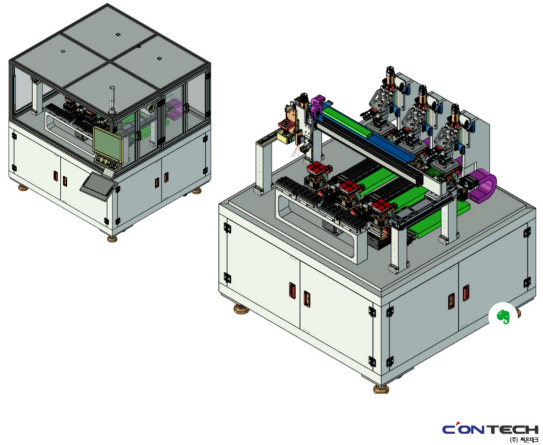
AstroPix testing in South Korea

- Chip testing station design
- Full presentation link

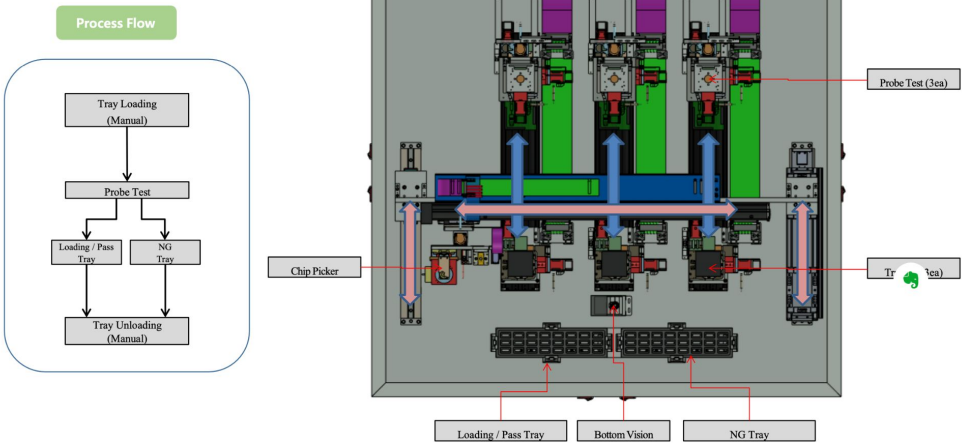
Introduction to Equipment

➢ Description

- Probe Test System
- Tray Loading : Manual
- Probe Test Motion : Z Axis – Servo Motor
- Chip Picker Motion : X,Y,Z Axis - Servo Motor
- Transfer Motion : Y Axis - Servo Motor



Process Flow (A TYPE)



Confidential

CONTECH

AstroPix

AstroPix v5

- Jessica received the quotation
- P.O. for submission under process

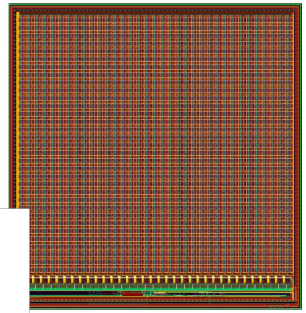
Pixel Matrix:

- 36 cols x 34 rows
  - —32 Columns with Standard NMOS Comparator
  - —2 Columns with dynamic Feedback
  - —1 Column with NMOS Comparator and Resistor Load
  - —1 Column with NMOS Comparator and PMOS Load
- 500u Pixel Pitch and 300u Pixel Size
- 3 Tunebits per Pixel
- Pixel Dynamic Range 20 keV - 700 keV
- Noise Floor 5 keV (2%@662 keV)
- Bias Voltage up to 400-500 V to maximize depletion
- Fully NMOS Comparator
- In Pixel amplifier with Dynamic Feedback option for improved Dynamic Range

Power Consumption:

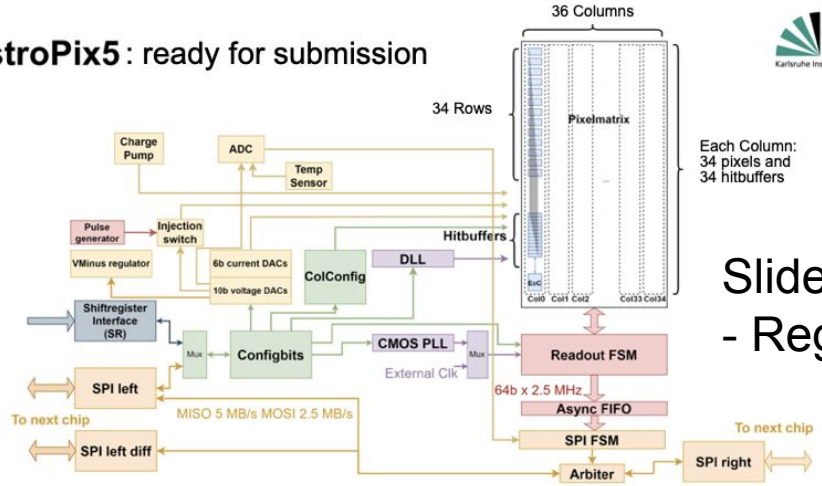
- Pixel 4.6 uW
- Pixel matrix 5.3 mW
- Digital 2.2 mW
  - — 700 uW DigitalTop

Total: ~2 mW/cm² for 2x2 cm chip



AstroPix v5

AstroPix5: ready for submission

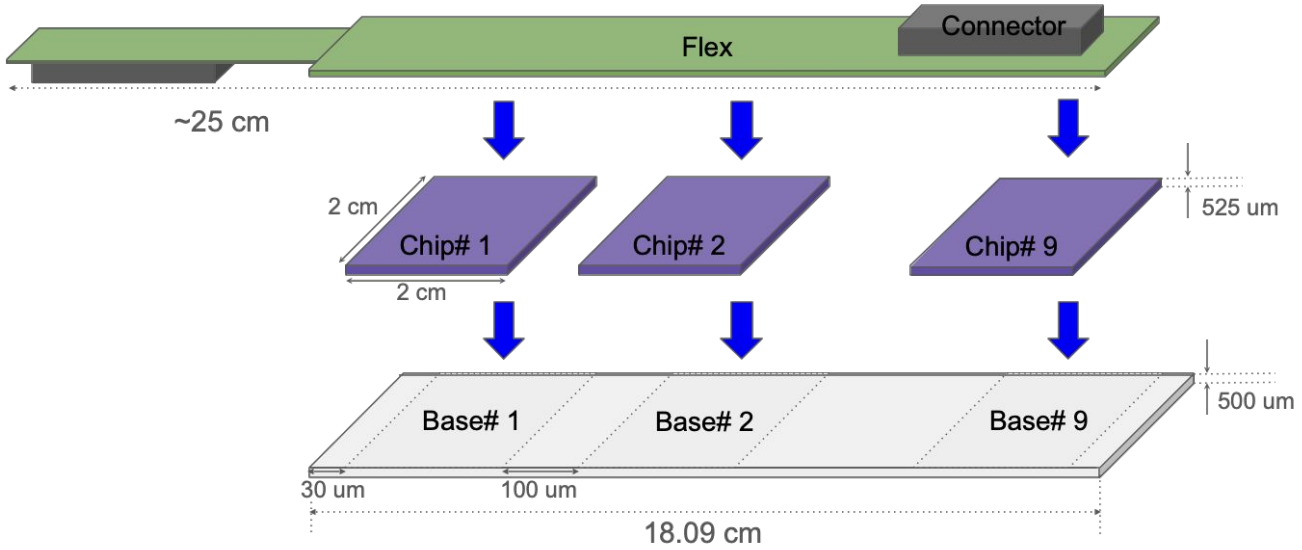


Slide from PDR2 - Regina

AstroPix Module

Module design

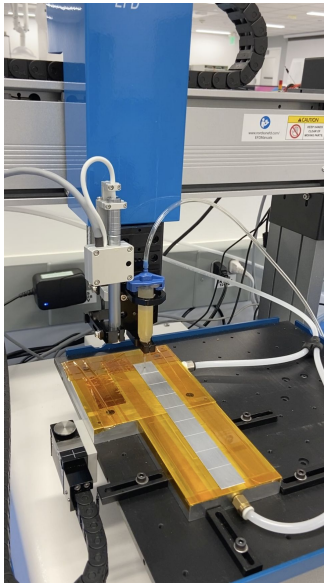
- AstroPix Module comprises of 3 layers/components
  - **Base Plate (Aluminum)**
  - **Nine AstroPix Chips**
  - **Flex PCB**
- **Failsafe design** - easy to rework on Stave

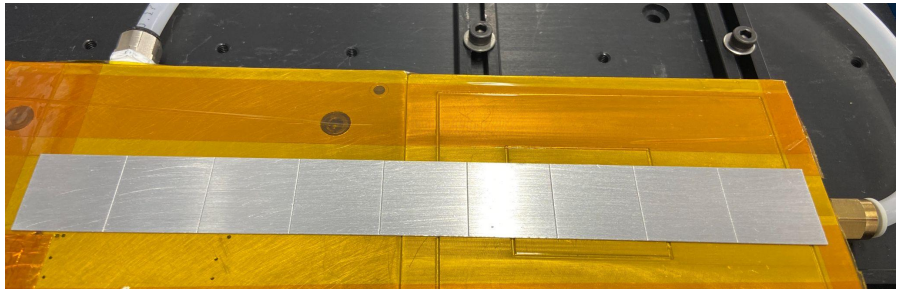


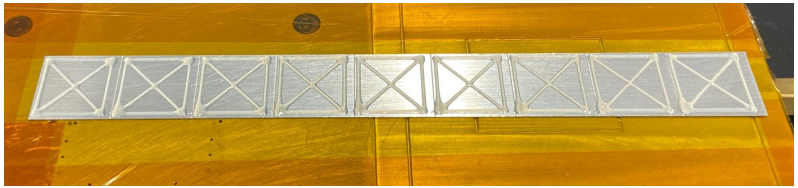
AstroPix Module Prototyping

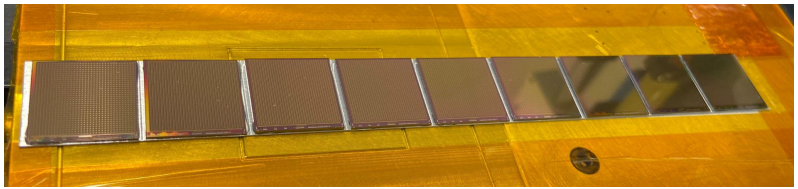
Prototype - Aluminum base plate

- **Benchmarking** Mechanical support for **AstroPix Module**
- 500 µm thick Al plate with some fiducials
  - Develop assembly procedure
  - first trial for fabrication of base plate
  - locking mechanism still missing (discussion ongoing)
- Trial runs with AstroPix v3 sensors (smaller than final version)
- Glue dispenser robot for glue pattern and controlling glue amount
- Dummy silicon chips will be used (getting diced)



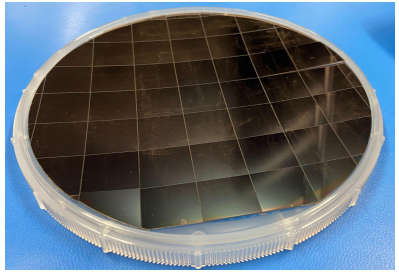


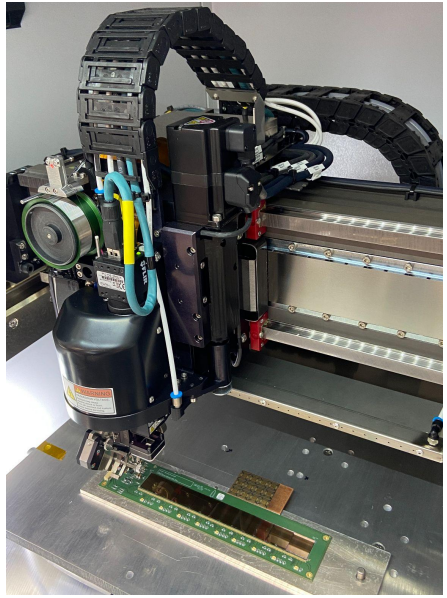




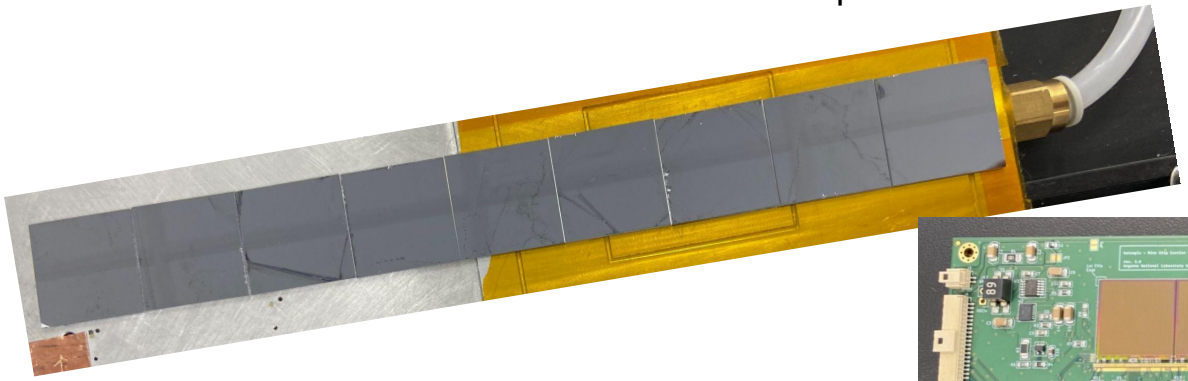
AstroPix Module Prototyping

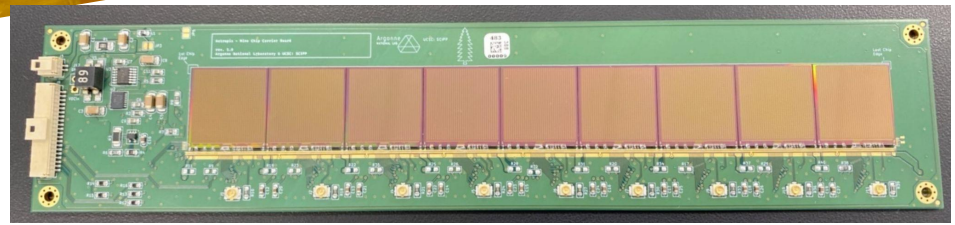
Updated status since last week!





- Module test PCB delivered
- Dummy chips delivered
- **First PCB assembled and wirebonded**
  - Testing will start very soon
- **First assembly of Dummy chips on Al base plate**
  - Will send few dummies and Al base plate to UCSC soon

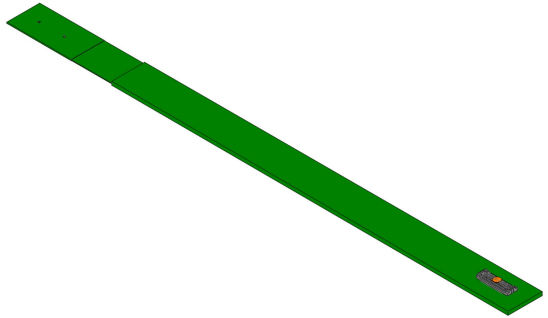


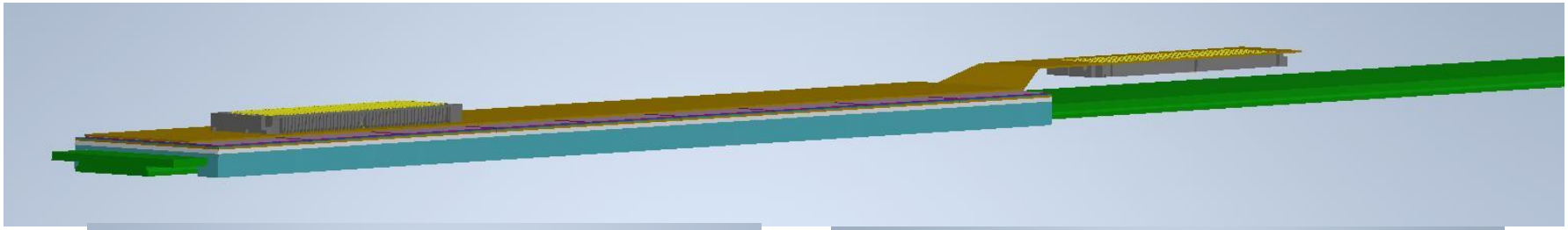


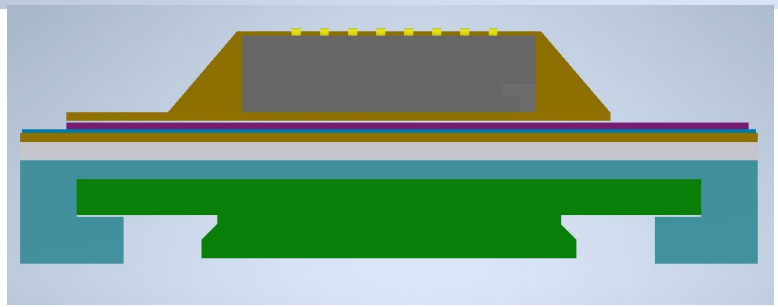
AstroPix Stave and Module

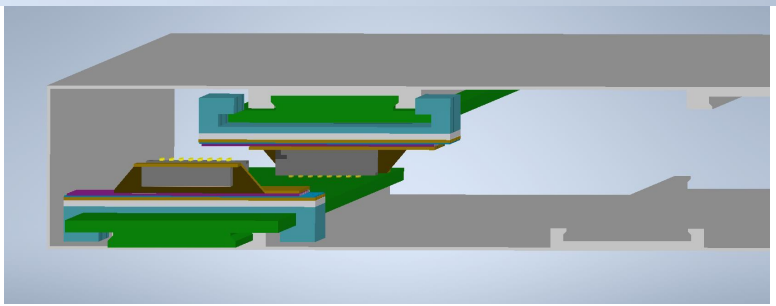
Design of Stave and Flex

- Oklahoma is working on Astrolinx (first prototype with v3)
  - Samtech connector (SLH-020-1.50-G-D-K)
  - Rigid PCB instead flex?
    - To reduced mechanical stress under connector
- Stave design update (under trials)









Summary

- Module design is finalized and comprises of 3 main components
  - Aluminum base plate
  - AstroPix Chip (current version v5)
  - Flex PCB
- Single flavor AstroPix Module (>30000 modules)
- Designed a test PCB to validate Module design and electrical performance
- Initial prototype of base plate for defining assembly procedure
- To do tasks
  - Locking mechanism for base plate
  - Adhesive selections
  - Finalize connector of Flex PCB
  - Designing of Flex PCB
- Argonne is assembly site for ITkPix ATLAS - ES&H work control and planning in place
  - Mechanical, chemical, and electrical hazards

BACKUP