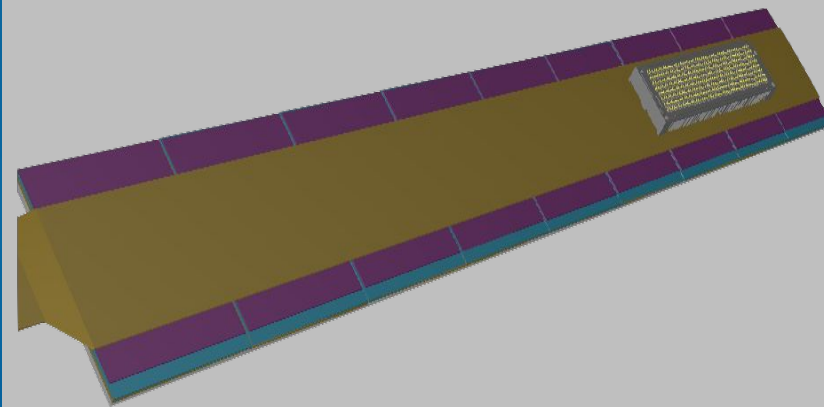


The ePIC Barrel Imaging Calorimeter

Updates AstroPix Wafers and Modules & Staves



Manoj Jadhav
Argonne National Laboratory

ePIC BIC: General meeting
November 22, 2024



AstroPix Depletion (with AstroPix team)

- 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

Shower density	2.530056	g/m ²	wt of W	2.53671345	g	means of 325 air cells	1.837050323	g	ASCC orientation	0	(network based) test			
	30000	g/m ²	Y	30000	g/m ²									
Scan a given identification														
Water ID	Quench ID	mass [g]	X [mm]	Y [mm]	Z [mm]	Side [mm]	Point Count	Menstruation Program [mm]	Ap Program / File	0	Electrical Characterization	3	Visual Inspection	Notes
W101	G01	2.94011								Good	Good	Good	Select	
	G02	2.94073								Good	Good	Good	Select	
	G03	2.93738								Good	Good	Good	Select	
	G04	2.93270								Good	Good	Good	Select	
	G05	2.93495	30050.49	30032.87	738					Good	Good	Good	Select	
	G06	2.94324								Good	Good	Good	Select	
	G07	2.93336	30157.02	30030.08	738					Good	Good	Good	Select	
	G08	2.93726	30059.82	30171.34	738					Good	Good	Good	Select	
	G09	2.93460	30151.07	30027.42	740					Good	Good	Good	Select	
	G10	2.93502	30030.82	30030.30	740					Good	Good	Good	Select	
	G11	2.93434	30050.30	30026.20	741					Good	Good	Good	Select	
	G12	2.93364	30031.61	30024.27	740					Good	Good	Good	Select	
W102	G01	2.93172								Good	Good	Good	Select	
	G02	2.93163	30050.43	30028.68	737					Good	Good	Good	Select	
	G03	2.93015	30051.74	30024.53	737					Good	Good	Good	Select	Right edge of damaged area
	G04	2.93088	30050.94	30027.77	738					Good	Good	Good	Select	Minor chipping
	G05	2.93068	30051.73	30027.60	737					Good	Good	Good	Select	Some chipping
	G06	2.93125	30151.07	30026.20	740					Good	Good	Good	Select	Can't see left edge of this area
	G07	2.93042	30150.76	30019.38	738					Good	Good	Good	Select	Chipped near left edge of this area
	G08	2.93079	30151.07	30026.20	740					Good	Good	Good	Select	Chipped near left edge of this area
	G09	2.93104	30050.46	30028.02	738					Good	Good	Good	Select	
	G10	2.93154	30050.97	30029.72	738					Good	Good	Good	Select	
	G11	2.93072	30050.82	30027.60	738					Good	Good	Good	Select	
	G12	2.93110	30077.03	30022.58	738					Good	Good	Good	Select	
W103	G01	2.93221								Good	Good	Good	Select	
	G02	2.93156	30037.34	30024.18	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G03	2.93147	30039.83	30019.83	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G04	2.93178	30031.13	30019.12	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G05	2.93282								Good	Good	Good	Select	
	G06	2.93281								Good	Good	Good	Select	
	G07	2.93261	30037.43	30022.58	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G08	2.93298	30037.54	30020.47	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G09	2.93282	30037.55	30022.40	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G10	2.93251	30038.24	30021.66	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G11	2.93253	30031.13	30022.40	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	
	G12	2.93215	30035.34	30020.47	761	6	Default points	Automat_BM_v1.gcf	Autom3_M3_B3_M3_v1.gcf	Good	Good	Good	Select	Originally damaged

- 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

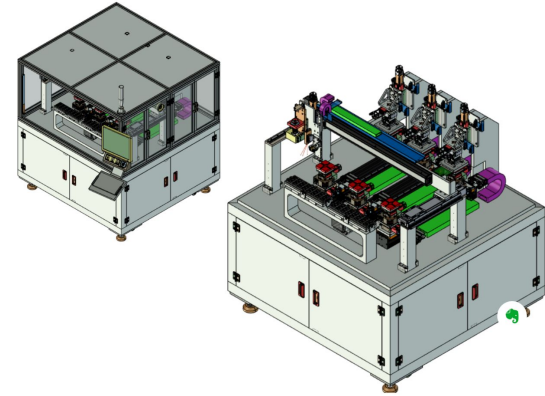
AstroPix testing in South Korea

Introduction to Equipment

- Chip testing station design
- Full presentation [link](#)

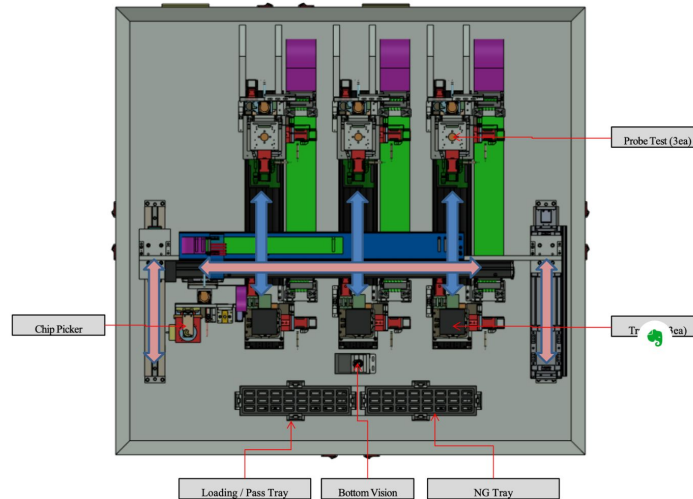
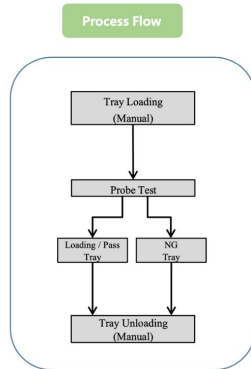
➤ Description

- 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



CONTECH
(주) 컨텍

Process Flow (A TYPE)



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

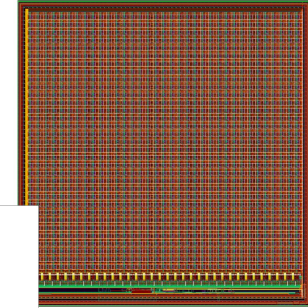
Pixel Matrix:

- 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:

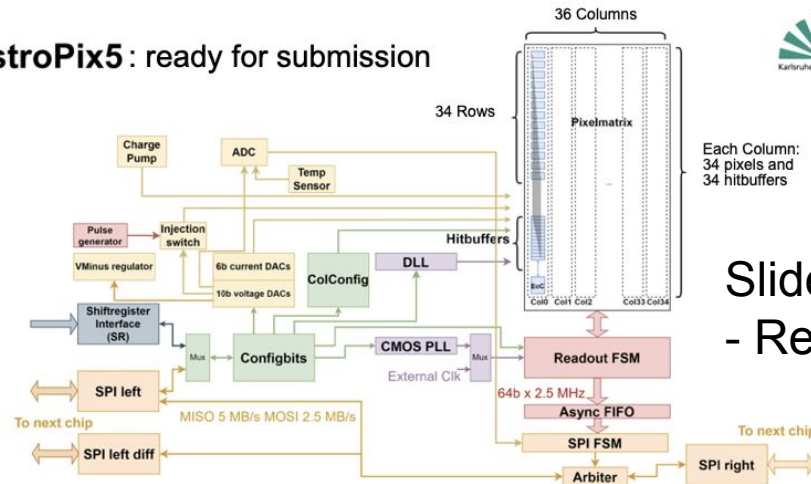
- Pixel 4.6 uW
- Pixel matrix 5.3 mW
- Digital 2.2 mW
- 700 uW DigitalTop

Total: ~2 mW/cm² for 2x2 cm chip



AstroPix v5

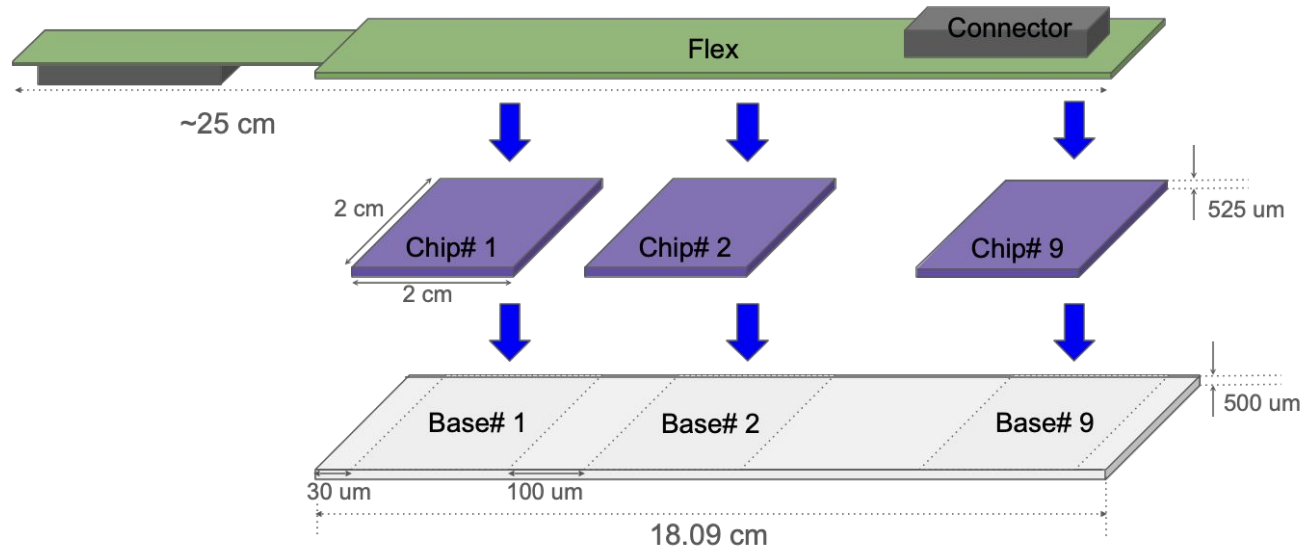
AstroPix5: ready for submission



AstroPix Module

Module design

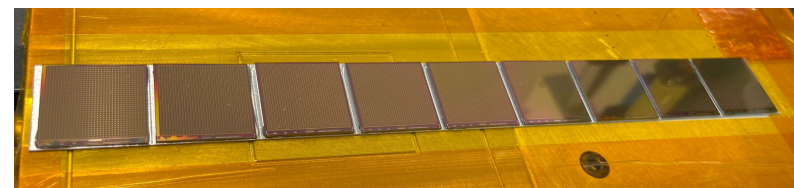
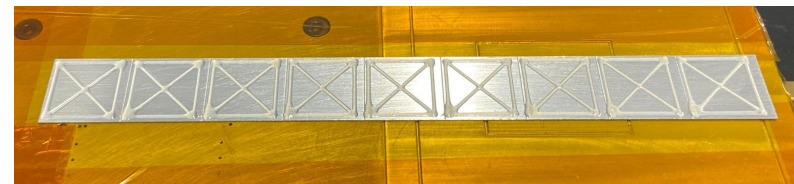
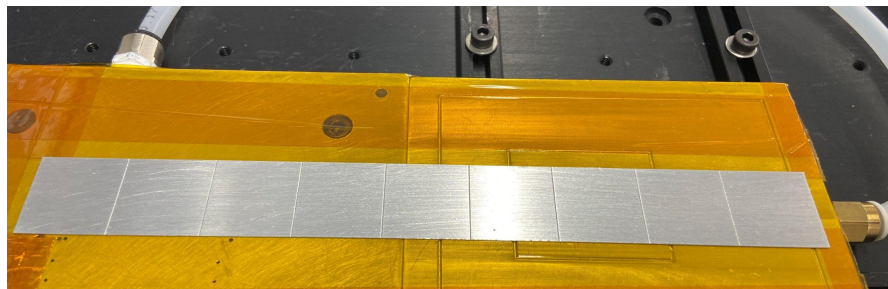
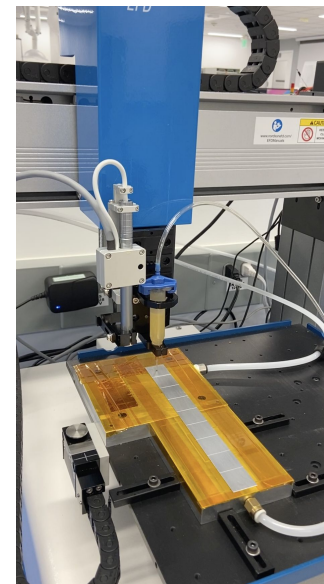
- AstroPix Module comprises of 3 layers/components
 - **Base Plate (Aluminum)**
 - **Nine AstroPix Chips**
 - **Flex PCB**
- **Failsafe design** - easy to rework on Stave



AstroPix Module Prototyping

Prototype - Aluminum base plate

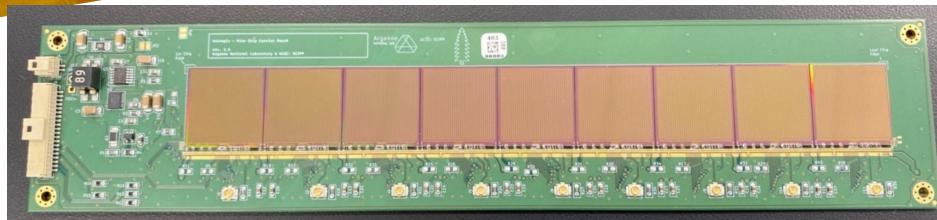
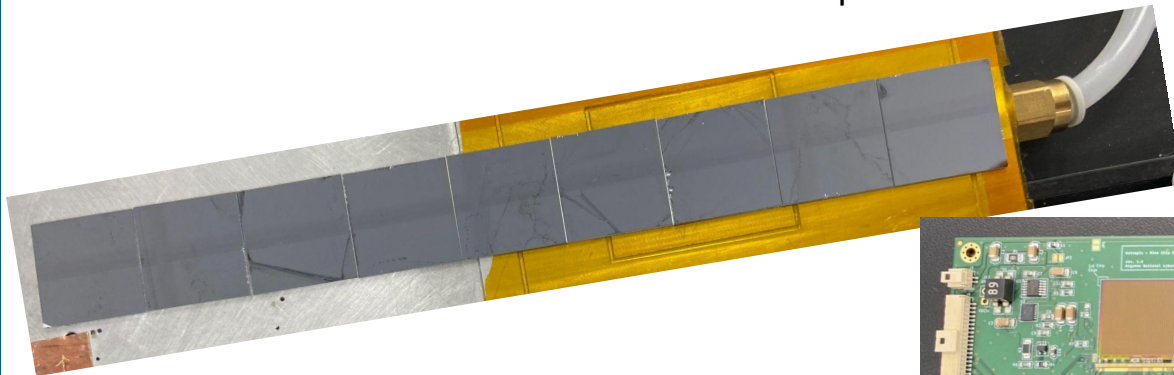
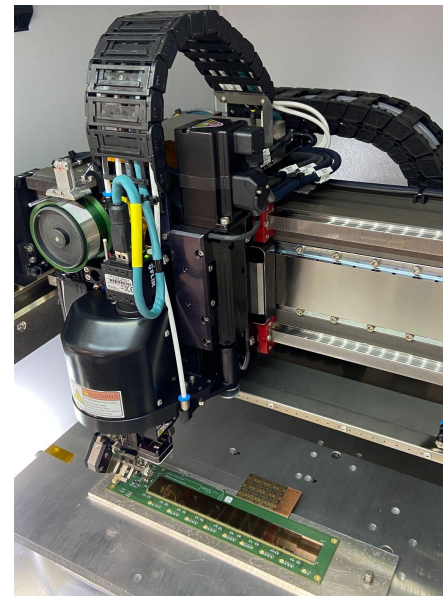
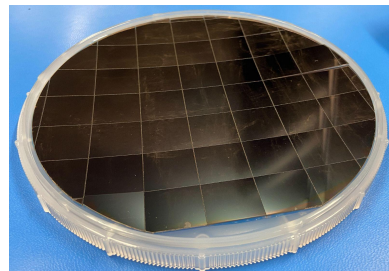
- **Benchmarking** Mechanical support for **AstroPix Module**
- 500 μm thick Al plate with some fiducials
 - Develop assembly procedure
 - first trial for fabrication of base plate
 - locking mechanism still missing (discussion ongoing)
- Trial runs with AstroPix v3 sensors (smaller than final version)
- 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!

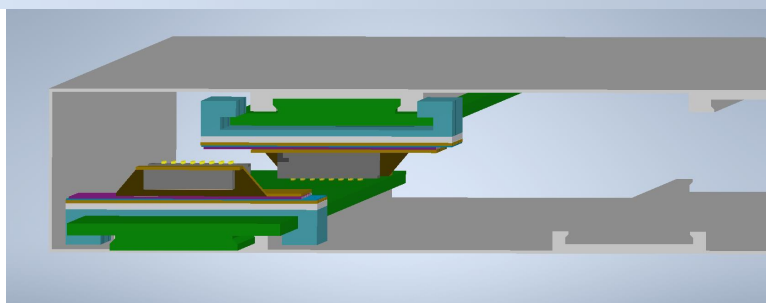
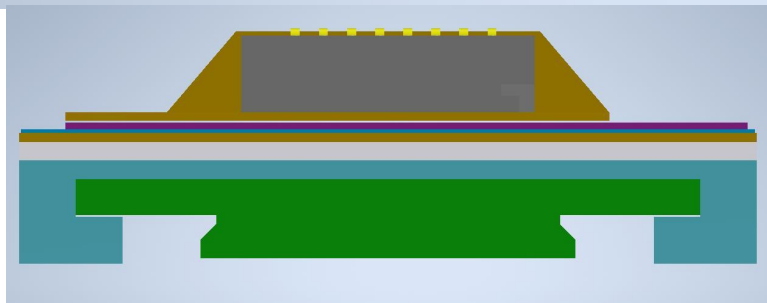
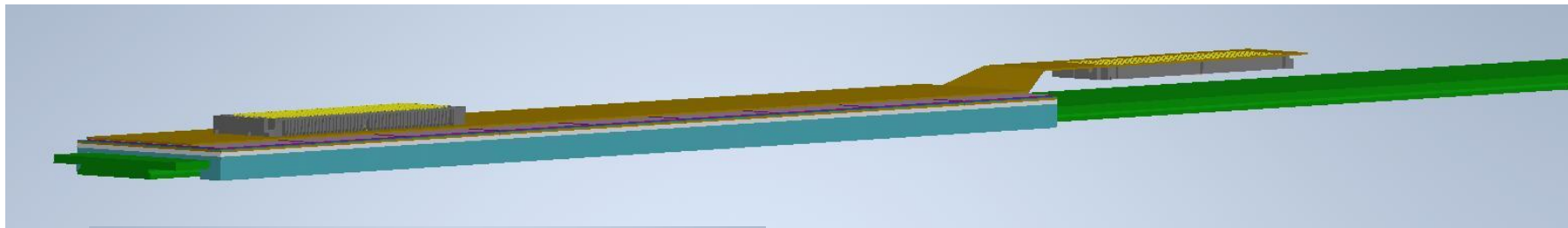
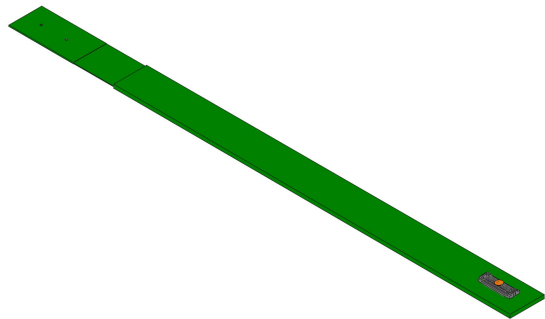
- Module test PCB delivered
- Dummy chips delivered
- **First PCB assembled and wirebonded**
 - Testing will start very soon
- **First assembly of Dummy chips on AI base plate**
 - Will send few dummies and AI base plate to UCSC soon



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