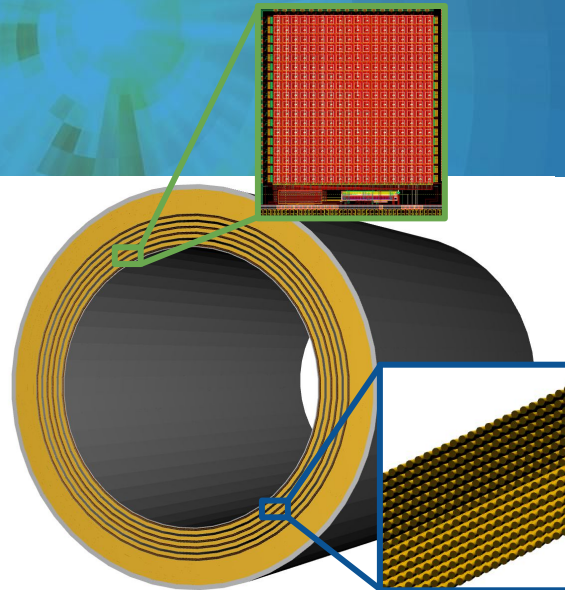


The ePIC Barrel Imaging Calorimeter

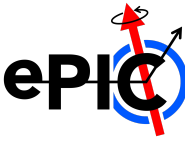
Barrel Imaging Calorimeter: Overview

Jessica Metcalfe
Argonne National Laboratory

4th BIC In-Person Workshop
April 9-11, 2025



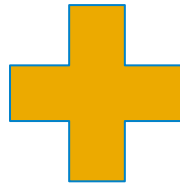
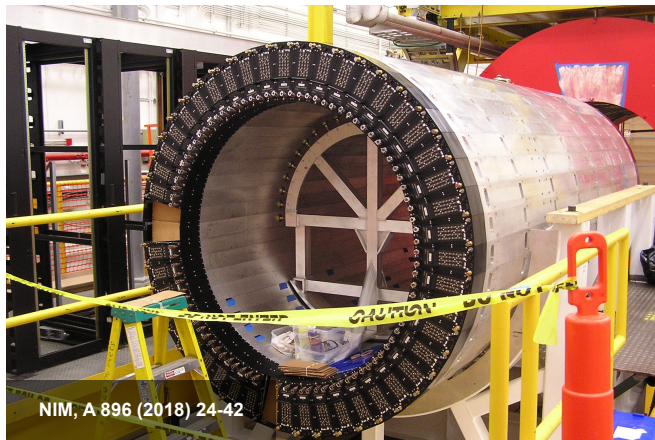
Outline



- BIC Overview
- BIC Test Articles & Schedule
- BIC Organization
- Workshop Agenda

Concept: A Hybrid Imaging Calorimeter

Combination of a high-performance sampling calorimeter with inexpensive silicon sensors for shower profiling



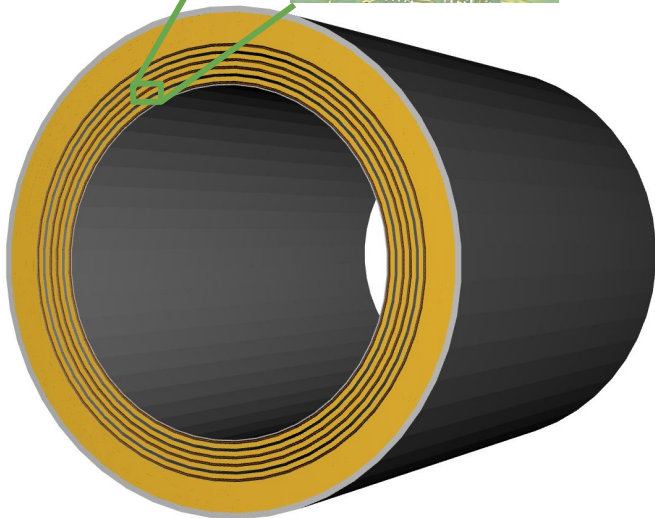
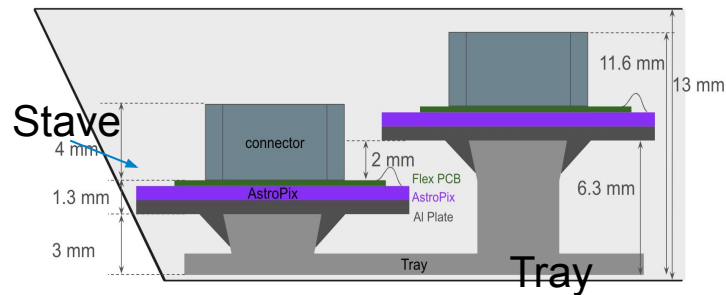
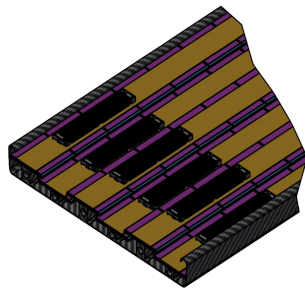
Start from mature layered Pb/ScFi technology with side-readout (same as the GlueX calorimeter) for state-of-the-art sampling calorimeter performance

Insert layers of monolithic AstroPix sensors (inexpensive ultra-low-power silicon sensor developed for NASA) in the first half of the calorimeter to capture a 3D image of the developing shower

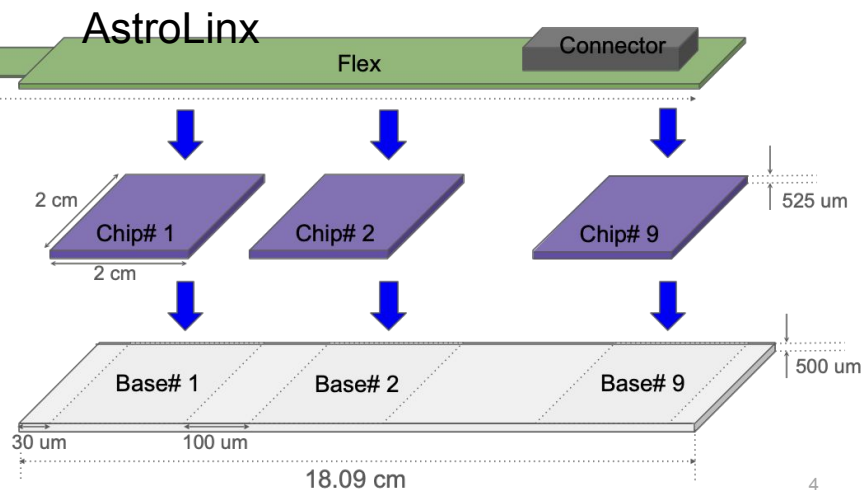
Barrel Imaging Calorimeter

AstroPix Wafers & Modules

AstroPix: silicon
sensor with
 $500 \times 500 \mu\text{m}^2$
pixel size

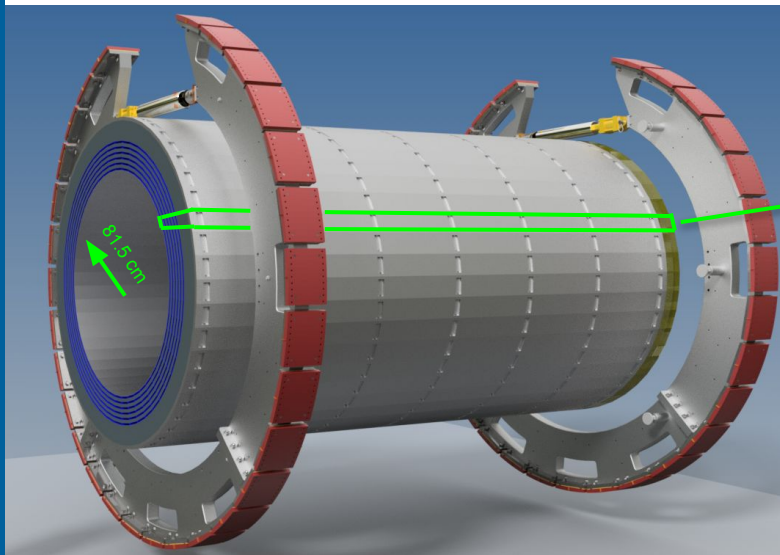


Module:

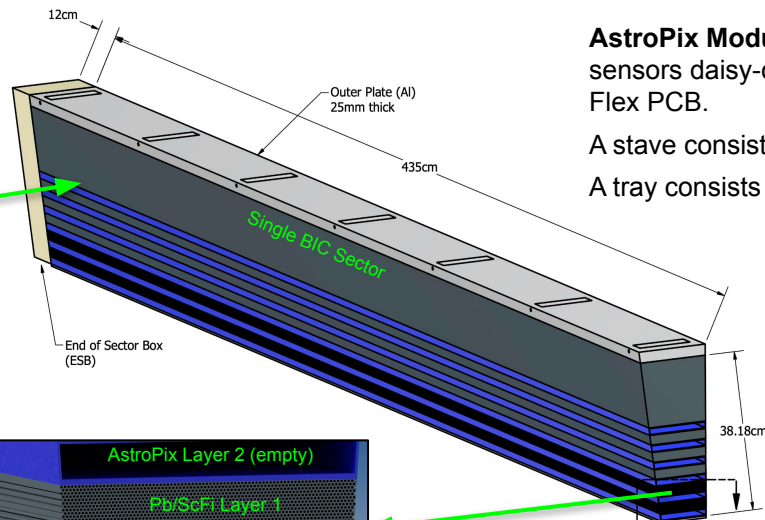
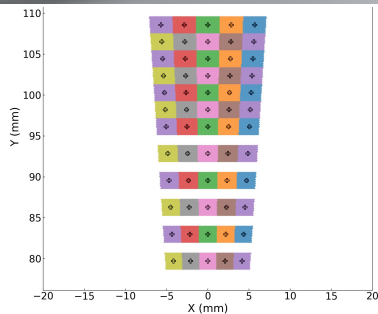


Barrel Imaging Calorimeter

Sector Mechanics



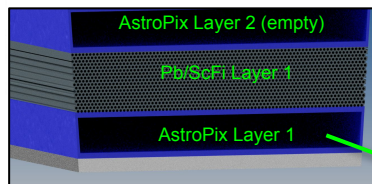
Active Length: 435 cm
Inner Radius: 81.5 cm
Structure: 48 sectors
 η Range: $-1.71 < \eta < 1.31$



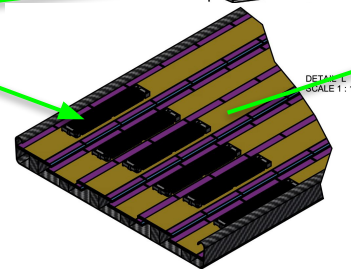
AstroPix Module - Nine AstroPix sensors daisy-chained together on Flex PCB.

A stave consists of 12 modules.

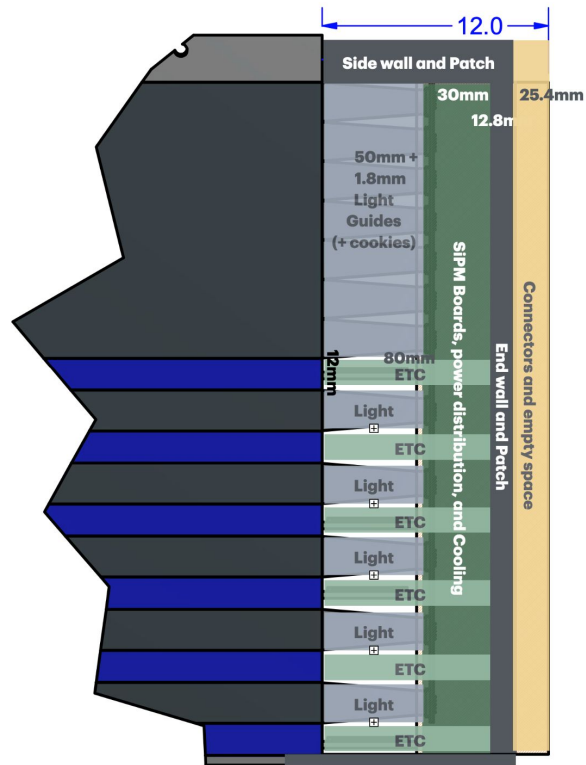
A tray consists of 6-8 staves.



Pb/SciFi Layer - Consists of 17 rows of fiber between corrugated lead.
 Each sector has 12 Pb/ScFi layers.
 Individual light guides divide each layer in 5 readout cells.

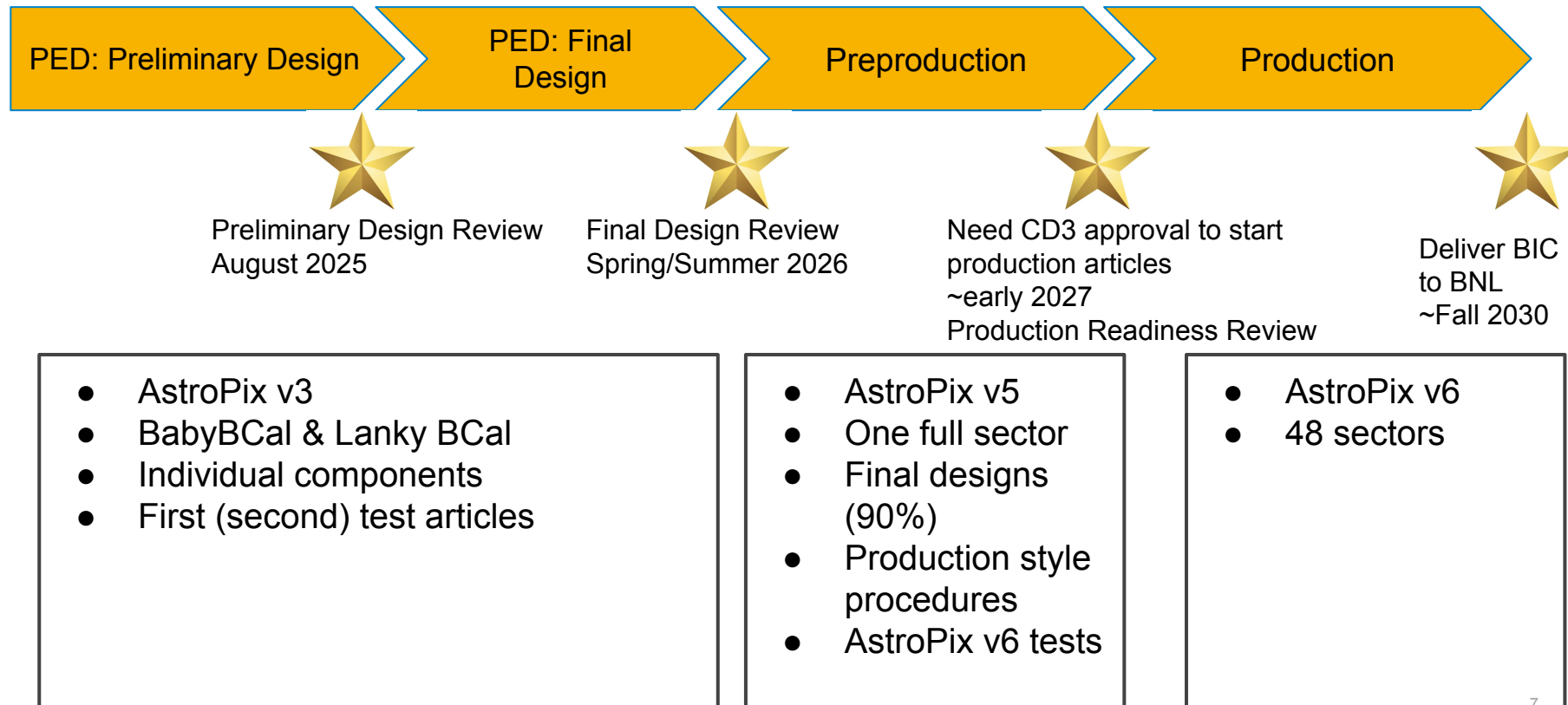


Tray - Structure holding the AstroPix staves for a single layer (217.5 cm long).



- readout
AstroPix

BIC Project Phases



BIC Organization

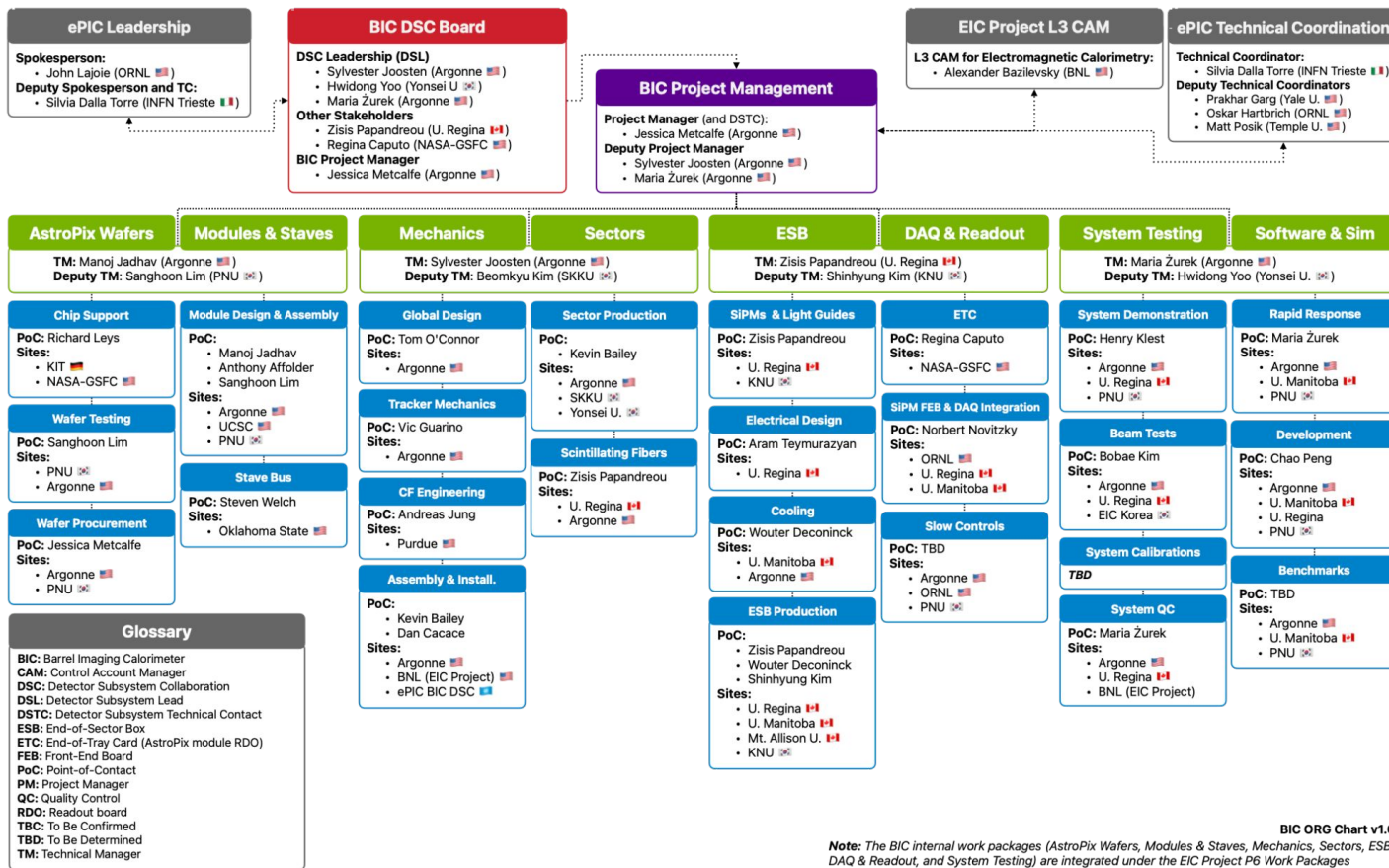
Bio Page

Jessica Metcalfe

- High Energy Physics Division @Argonne
- ATLAS member since 2004
- Silicon detectors
- US HL-LHC Pixel deputy since 2016
- ITk Pixel Module coordinator 2018-2024
- Started AstroPix with Regina ~2016



BIC Organization Chart



BIC ORG Chart v1.0

Note: The BIC internal work packages (AstroPix Wafers, Modules & Staves, Mechanics, Sectors, ESB, DAQ & Readout, and System Testing) are integrated under the EIC Project P6 Work Packages

BIC Organization Chart



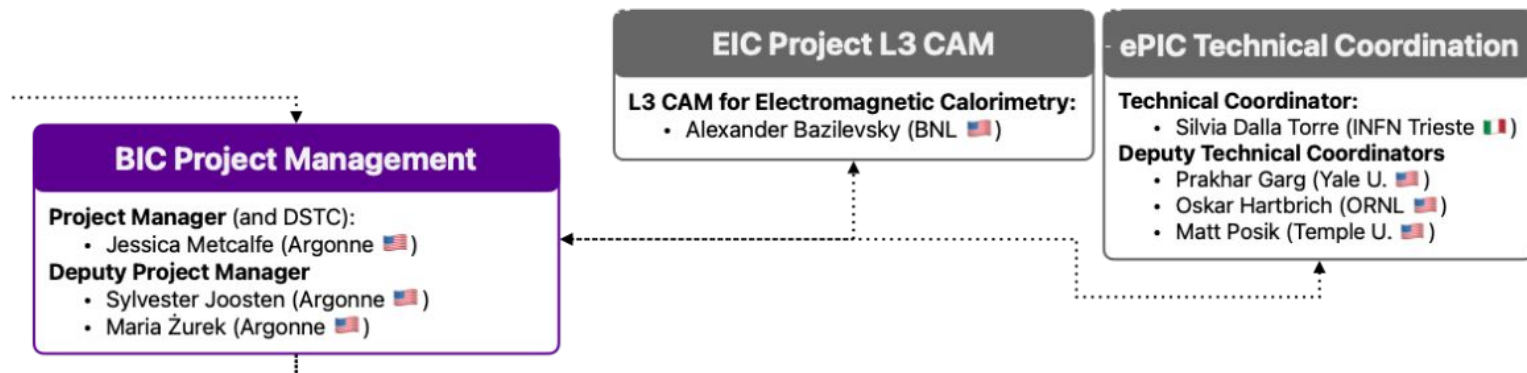
ePIC Collaboration:

- international user organization
- responsible for community needs, physics performance
- Detector Subsystem Collaboration → Red Team
 - DSL's Detector Subsystem Leads
 - provide oversight to the BIC collaboration
- Detector Subsystem Technical Contact
 - also BIC project manager

Glossary

BIC: Barrel Imaging Calorimeter
CAM: Control Account Manager
DSC: Detector Subsystem Collaboration
DSL: Detector Subsystem Lead
DSTC: Detector Subsystem Technical Contact
ESB: End-of-Sector Box
ETC: End-of-Tray Card (AstroPix module RDO)
FEB: Front-End Board
PoC: Point-of-Contact
PM: Project Manager
QC: Quality Control
RDO: Readout board
TBC: To Be Confirmed
TBD: To Be Determined
TM: Technical Manager

BIC Organization Chart



EIC Project:

- DOE funded project
 - accelerator & detector
 - responsible for building/delivering
 - US funds for the project are controlled by the Project
- BIC reports to the EM Calorimeter Control Account Manager (CAM)
 - Institutes receive funds via a contract with Statement of Work (SOW)

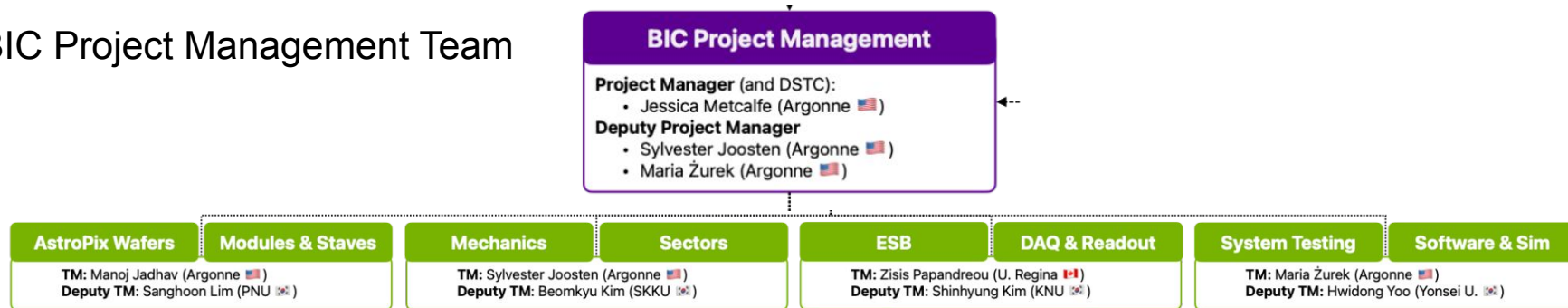
Glossary

BIC: Barrel Imaging Calorimeter
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PoC: Point-of-Contact
PM: Project Manager
QC: Quality Control
RDO: Readout board
TBC: To Be Confirmed
TBD: To Be Determined
TM: Technical Manager

BIC Project Management Team



BIC Project Management Team



Purple Team:

- manage and support the BIC community
- deliver the BIC detector

Green Team Leaders:

- manage a major technical area
- contact for the BIC community in that technical area
- meet key deliverables and milestones within their area

BIC Management Roles & Responsibilities



Meeting Schedule



Green Team or Technical Area Meetings:

Wafers: Manoj

- Mondays at 4 pm Central—bi-weekly

Modules & Staves: Manoj

- Mondays at 4 pm Central—bi-weekly

Mechanics & Sectors: Sylvester

- Fridays at 1 pm Central

ESB, DAQ, & Readout: Zisis

- Tuesday at 8 am Central—bi-weekly

System Test: Maria

- Tuesday at 8 am Central—bi-weekly

Simulations: Maria

- Tuesdays at 2 pm Central

BIC General Meeting:

- ~Monthly
- Fridays at 8 am Central
- Organized by Jessica, Maria, Sylvester

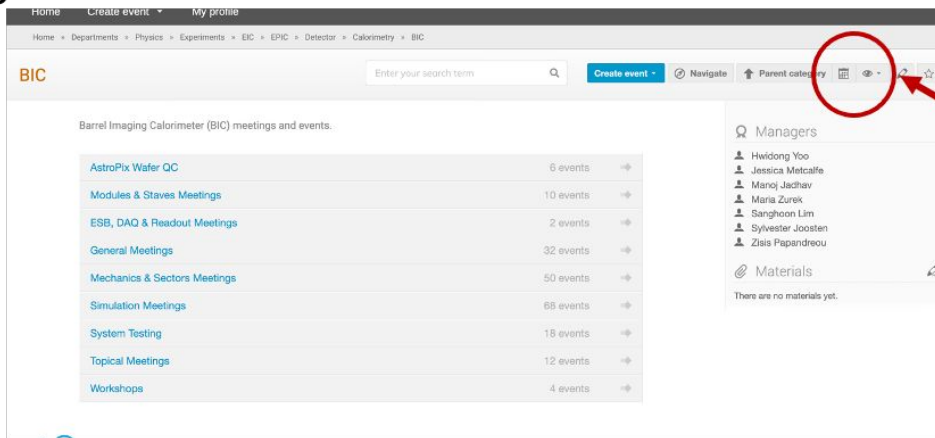
Weekly Summary:

1. Mondays @ 4pm
2. Tuesdays @ 8am
3. Tuesdays @ 2pm
4. Fridays @ 1pm

BIC Meeting Indico Calendar

■ Indico link

- All meetings can be found on indico
- You can add the meetings to your calendar
 - All of the BIC meetings from the BIC category
 - Or some by going to a sub-category and using the calendar link on that page



Calendar link to add (past) future meetings → automatically updates your calendar as new meetings are added

Documents

Zenodo

- ePIC endorsed file management system hosted by CERN
- version controlled
- share with collaboration
- searchable by keywords
- critical to get correct keywords
- epic-eic & bic

BOX

- BOX folder for sharing technical drawings
- Argonne hosted
- request access permissions to anyone in the Purple Team

Google Drive

- collaborative documents → shared editing
- presentations for reviews
- reference documents

Design Document Review/Approval



- Review key designs before fabrication
- Review/Approval Log

- 1) Make the design available on the google drive and fill in description, links, and deadline in the log. Define required approvers.
- 2) Present at a relevant meeting that is announced 1 week in advance (prefer if documents ready in advance, but not required)
- 3) Email BIC list and required approvers with request to review by deadline (minimum 1 week after presentation). Provide links to documents, presentation, comment collection document
- 4) Respond to comments
- 5) Final approval is logged

Presentation/Paper Review Process



For ALL BIC (or ePIC/EIC) related presentations or paper that will be shared outside the collaboration:

- review process to ensure the quality and consistency of results
- Instructions:
 - submit document via zenodo
 - request approval in zenodo and send an email notification
 - approvers for BIC should include Green Team Leader and/or Purple Team

Workshop Agenda

Workshop Agenda



Wednesday

Welcome Coffee/Tea			
D172, Building 241			
09:00	BIC Progress and Plans Overview		Jessica Metcalfe
	D172, Building 241		09:00 - 09:40
	Wafers, Modules, & Staves		Manoj Jadhav
10:00	D172, Building 241		09:40 - 10:10
	Break		
	D172, Building 241		10:10 - 10:30
	Mechanics & Sectors		Sylvester Joosten
	D172, Building 241		10:30 - 11:00
11:00	ESB & DAQ		Zisis Papandreou
	D172, Building 241		11:00 - 11:30
	System Test (& Simulations)		Maria Zurek
	D172, Building 241		11:30 - 12:00
12:00	Lunch: Working Lunch, order Panera	Wire bond map, wire bondability, Ha... Forest Martinez-M... D172, Building 241 12:00 - 12:20	ESB Cooling B123, Building 241 12:00 - 12:10
		Handling, Carrier tools Kirsten Altholder et al.	HGCROC Readout B123, Building 241 12:10 - 12:30
		9-chip PCB testing Bobae Kim D172, Building 241 12:40 - 13:00	ETC Design Interfaces Regina Caputo B123, Building 241 12:30 - 12:50
13:00		Overview of AstroPix performance DANIEL P. VIOLE...	Fiber testing B123, Building 241 12:50 - 13:10
	D172, Building 241 12:00 - 13:30		BIC Reconstruction Overview and R... Minho Kim
14:00	Mechanics: Schedule Review Sylvester Joosten	Modules & Wafers: Schedule Review Manoj Jadhav	System Test & Test Beam: Schedule Review Maria Zurek
	A323, Building 241 13:30 - 15:00	D172, Building 241 13:30 - 15:00	D173, Building 123 13:30 - 15:00
15:00	Break: Group Activity		
	D172, Building 241		
16:00	Joint ESB/DAQ & System Test Maria Zurek, Zisis Papandreou		Joint Mechanics & Modules Manoj Jadhav, Sylvester Joosten
17:00	D172, Building 241	16:00 - 17:30	D172, Building 241
			16:00 - 17:30

Thursday

Coffee/Tea			
	D172, Building 241		08:30 - 09:00
09:00	AstroPix Overall Plans and Schedule (NASA, ComPair, AMEGO-X)		Regina Caputo
	D172, Building 241		09:00 - 09:20
	AstroPix v5 Design Overview		Nicolas Strebj
	D172, Building 241		09:20 - 09:40
	Wafer/Chip Testing Progress & Plans		Sanghoon Lim
	D172, Building 241		09:40 - 10:00
10:00	Break		
	D172, Building 241		
	AstroLinx		
	D172, Building 241		
11:00	System Testing: R&D Program Accomplishments		
	D172, Building 241		
	Beam Tests: Accomplishments from FNAL Beam Test FY24		
	D172, Building 241		
	Beam Tests: KEK and CERN Tests Accomplishments		
	D172, Building 241		
12:00	Lunch		
13:00	D172, Building 241		
	Joint Modules & System Test Manoj Jadhav, Maria Zurek Joint: Mechanics & ESB Sylvester Joosten, Zisis Papandreou		
14:00	D172, Building 241 13:30 - 15:00 A323, Building 241 13:30 - 15:00		
15:00	Break		
	D172, Building 241		
	Modules: & Wafers Manoj Jadhav	Mechanics Sylvester Joosten	ESB & DAQ Zisis Papandreou
16:00			System Test & Test Beam Maria Zurek
	D172, Building 241 15:30 - 17:00	A323, Building 241 15:30 - 17:00	B123, Building 241 15:30 - 17:00
17:00			D173, Building 241 15:30 - 17:00

Friday

Coffee/Tea				
	D172, Building 241			08:30 - 09:00
09:00	Modules: & Wafers	Mechanics	ESB & DAQ	System Test & Test Beam
	D172, Building 241	A323, Building 241	B123, Building 241	D173, Building 241
	09:00 - 10:00	09:00 - 10:00	09:00 - 10:00	09:00 - 10:00
10:00	Break			
	D172, Building 241			10:00 - 10:30
	Wafers & Modules			
	D172, Building 241			Manoj Jadhav
	D172, Building 241			10:30 - 10:45
	Mechanics			Sylvester Joosten
	D172, Building 241			10:45 - 11:00
11:00	ESB & DAQ			Zisis Papandreou
	D172, Building 241			11:00 - 11:15
	System Test & Test Beam & Simulations			Maria Zurek
	D172, Building 241			11:15 - 11:30
	Schedule and Deliverable Discussion & Closeout			
	D172, Building 241			11:30 - 12:00
12:00				

Workshop Agenda

Wednesday



Welcome Coffee/Tea			
D172, Building 241			
08:30 - 09:00			
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	D172, Building 241		
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	System Test (& Simulations)		Maria Zurek
	D172, Building 241		11:30 - 12:00
12:00	Lunch: Working Lunch, order Panera		
	D172, Building 241		
	12:00 - 12:30		
	Wire bond map, wire bondability, Ha...		
	D172, Building 241		
	12:00 - 12:10		
	ESB Cooling		
	B123, Building 241		
	12:00 - 12:10		
	HSCROC Readout		
	B123, Building 241		
	12:10 - 12:30		
	ETC Design Interfaces		
	B123, Building 241		
	12:30 - 12:50		
	Fiber testing		
	B123, Building 241		
	12:50 - 13:10		
	BIC Reconstruction Overview and R...		
	D172, Building 241		
	12:00 - 13:30		
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	Sylvester Joosten		
	Modules: & Wafers: Schedule Review		
	Manoj Jadhav		
	ESB & DAQ: Schedule Review		
	Zisis Papandreou		
	System Test & Test Beam: Schedule Review		
	Maria Zurek		
	A323, Building 241		
	D172, Building 241		
	B123, Building 241		
	D173, Building 123		
	13:30 - 15:00		
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	Maria Zurek, Zisis Papandreou		
	Joint Mechanics & Modules		
	Manoj Jadhav, Sylvester Joosten		
	D172, Building 241		
	16:00 - 17:30		
17:00	D172, Building 241		
	16:00 - 17:30		

- Plenary: overview of GTL areas
- Lunch: parallel sessions with lunch brought in from Panera
 - Please contribute \$20 if you want lunch
 - Head count for people that want lunch
- Separate rooms for parallel sessions on indico → all in this building, one is upstairs
- GTL parallel session to review the schedule in Merlin (software)
 - your input is needed to build a credible schedule
- Cross-GTL discussions
 - focus on technical topics and schedule/deliverables
 - details in description
- Team Building @ Skeleton Key Brewery
 - Brought games
 - can order pizza

Workshop Agenda



Thursday

Coffee/Tea	
D172, Building 241	08:30 - 09:00
09:00	AstroPix Overall Plans and Schedule (NASA, ComPair, AMEGO-X) D172, Building 241 Regina Caputo 09:00 - 09:20
	AstroPix v5 Design Overview D172, Building 241 Nicolas Strebeg 09:20 - 09:40
	Wafer/Chip Testing Progress & Plans D172, Building 241 Sanghoon Lim 09:40 - 10:00
Break	
D172, Building 241	10:00 - 10:30
	AstroLink D172, Building 241 Blake Beauchamp et al. 10:30 - 10:50
11:00	System Testing: R&D Program Accomplishments D172, Building 241 Bobae Kim 10:50 - 11:10
	Beam Tests: Accomplishments from FNAL Beam Test FY24 D172, Building 241 Henry Klest 11:10 - 11:30
	Beam Tests: KEK and CERN Tests Accomplishments D172, Building 241 11:30 - 11:50
Lunch	
D172, Building 241	12:00 - 13:30
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	Joint: Mechanics & ESB D172, Building 241 Sylvester Joosten, Zisis Papandreou 13:30 - 15:00
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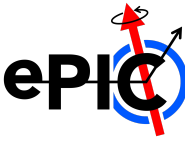
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	System Test & Test Beam & Simulations D172, Building 241 Maria Zurek 11:15 - 11:30
	Schedule and Deliverable Discussion & Closeout D172, Building 241 11:30 - 12:00
12:00	

- Plenary: AstroPix & Testing Focus
- Lunch: Argonne cafeteria across the street
- Thursday: more GTL & cross-GTL parallel discussion sessions
- Thursday Dinner: Goat & Vine Restaurant
- Friday GTL parallel sessions to write summary slides
- Friday plenary for summary slides

Backup

Reference Documents



- BIC Management Roles & Responsibilities
- Interface Document
- Organization Chart
- Risk Register/RAID log
- Presentation/Paper Approval Instructions
- Design Review/Approval Log