ePIC MPGDs
Introduction and Overview

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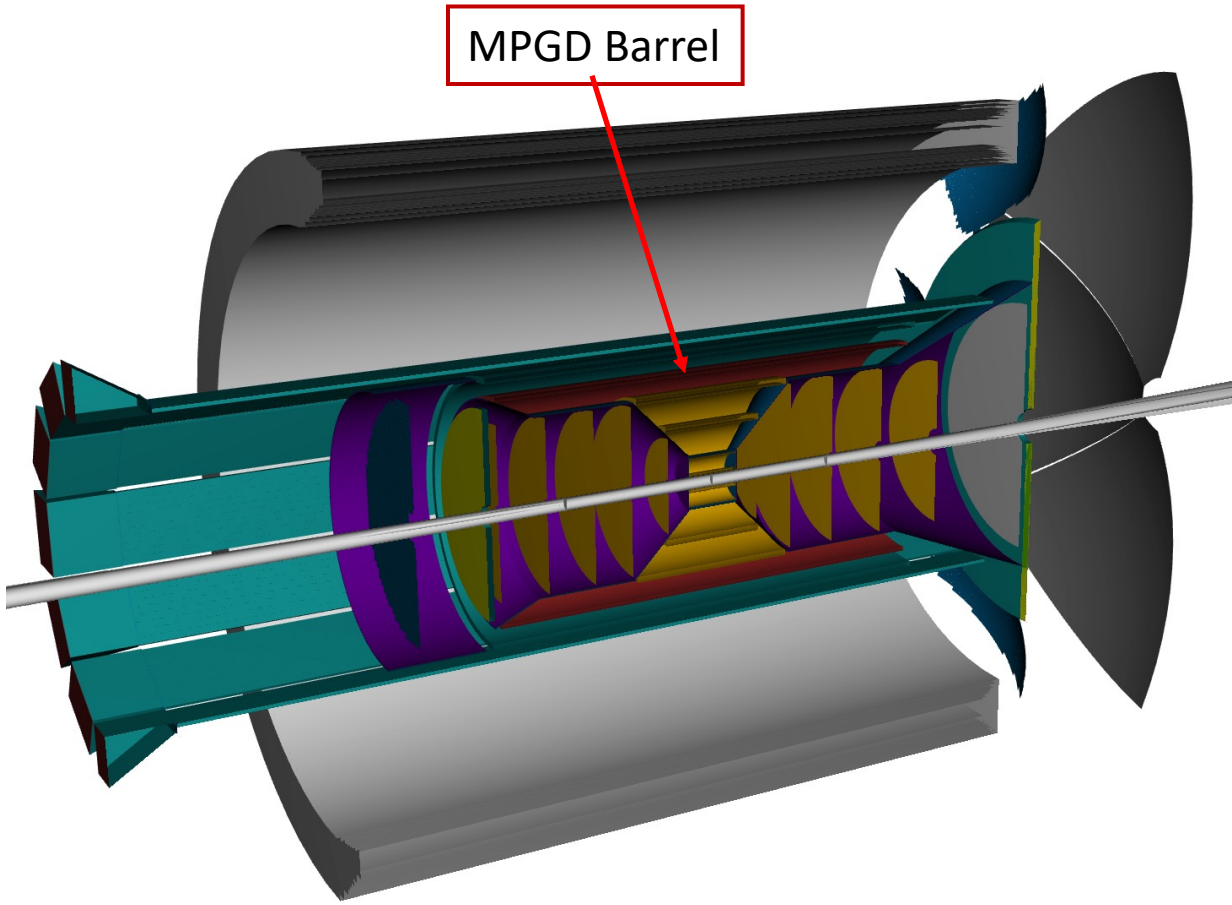
Previous Reference Tracker (Bryce Canyon)

- ePIC Reference Tracking Detector
  - Bryce Canyon served as official ePIC reference tracking detector from ePIC formation until June 2023
  - Only 1 curved MPGD layer implemented ~ 8 m^2
  - Concerns
    - Not enough hit measurements for track reconstruction, in particular in the $|\eta| > 1$ regions
    - Not enough fast timing hits for matching events to bunches and signal/background discrimination
    - Service routing
  - Consequently ePIC added MPGDs to the design in June 2023; now implemented in current Crater Lake geometry



Reference Tracker (up to June) Bryce Canyon

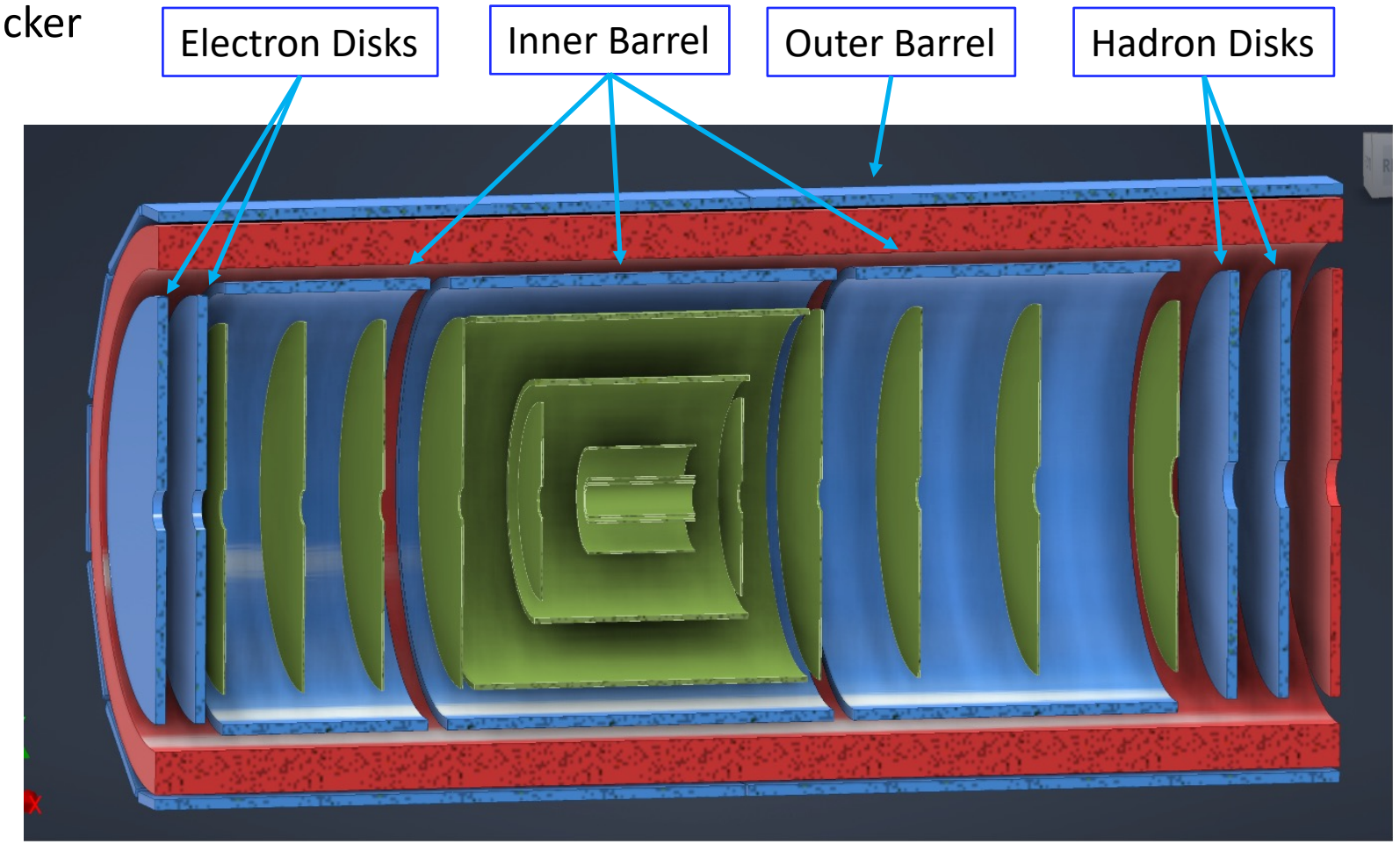
Role of MPGDs

- Role of MPGDs in ePIC
  - Located in outer tracking volume to provide
    - Additional hit points for track reconstruction
    - Fast timing hits for signal/background discrimination (~10-20 ns)
    - Implement enough fast timing layers to from tracklets between (MPGDs and AC-LGADs)
    - Provide precision hit point over large angular range for PID detectors (~$150\ \mu m$)

- New Reference Detector: Crater Lake
  - Updated configuration converged in early June
  - Implemented into ePIC simulation in time for July campaign
  - First performance looks in late July
  - Possible due to the hard work of many

ePIC Reference Detector

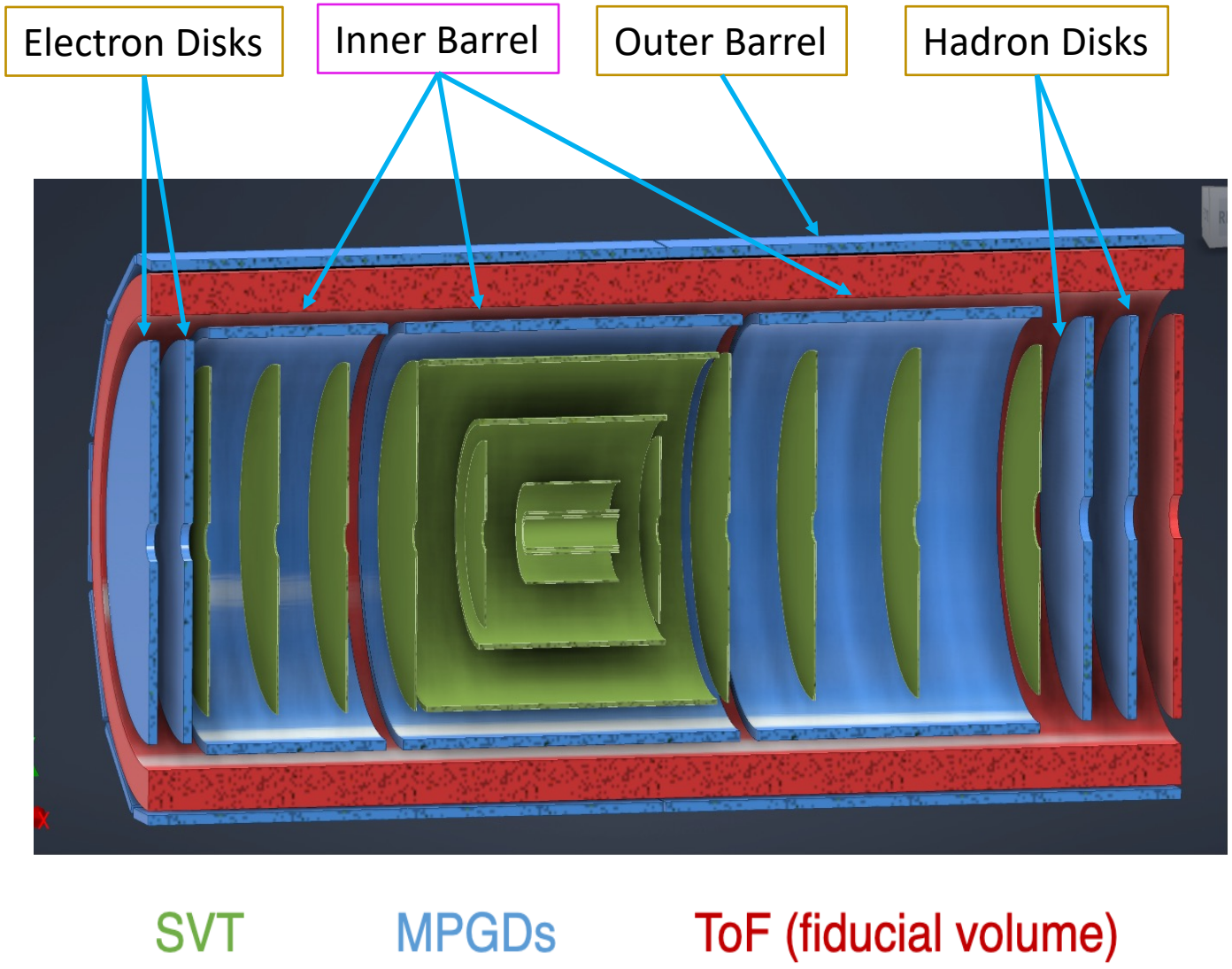
- MPGD changes from past reference tracker
  - Split inner MPGD barrel to better accommodate service routing
  - Outer MPGD barrel layer just in front of hpDIRC
  - Two additional MPGD disks in the electron direction
  - Two additional MPGD disks in the hadron direction
  - Added an additional 18 m^2 of MPGDs



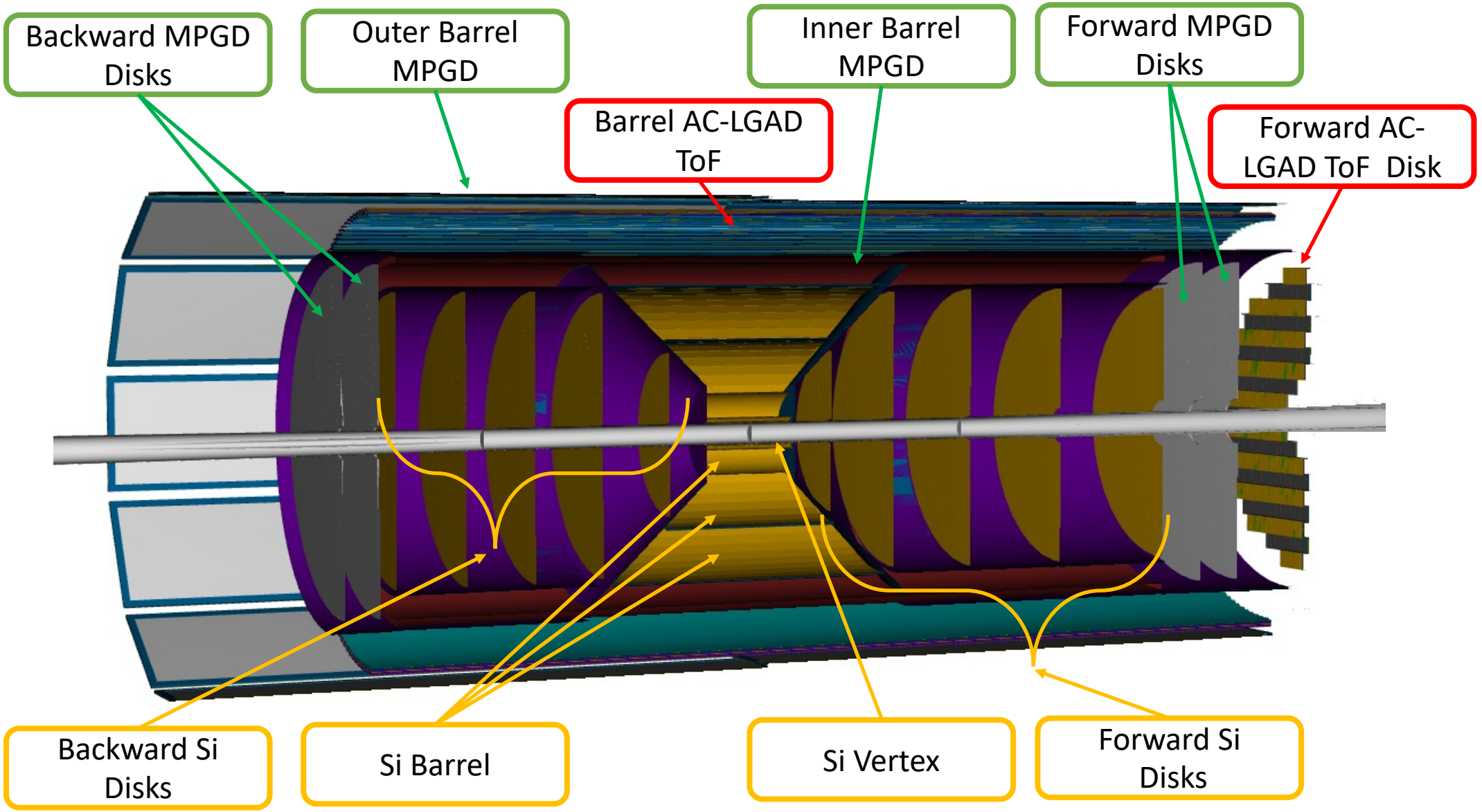
MPGD Technologies

- MPGD Technologies
  - Curved layers → MicroMegas (MM)
  - Planar layers → $\mu RWELL$

- Inner Barrel: ~8 m^2/ ~30k channels, MicroMegas
- Outer Barrel: ~15 m^2/ ~140k channels, $\mu RWELL$
- Electron Disks: ~1.6 m^2/ ~16k channels $\mu RWELL$
- Hadron Disks: ~1.6 m^2/ ~16k channels, $\mu RWELL$



ePIC Reference Detector: DD4HEP



MPGD R&D: Targeted

- eRD108 is the ePIC MPGD R&D program
  - Dedicated to developing MPGD technologies for detectors in the reference detector
  - Program established when only inner barrel MPGD was part of the reference detector
    - Focus was on curved MPGDs
    - no planar MPGDs were part of reference detector

EIC Detector R&D Proprosal

The eRD108 Consortium

July 10, 2023

The eRD108 Consortium

Project ID: eRD108

Project Name: Development of EIC ePIC MPGD Trackers.

Brookhaven National Laboratory (BNL): Craig Woody
CEA Saclay: Francesco Bossù, Maxence Vandenbroucke
Florida Institute of Technology (FIT): Marcus Hohlmann
Istituto Nazionale di Fisica Nucleare (INFN Roma Tor Vergata): Annalisa D'Angelo
University of Virginia (UVa): Huong Nguyen, Nilanga Liyanage
Temple University (TU): Matt Posik, Bernd Surrow
Thomas Jefferson National Accelerator Facility (JLab): Kondo Gnanvo
Vanderbilt University (VU): Sourav Tarafdar

MPGD R&D: Generic

- Generic MPGD R&D program geared toward ePIC upgrades/ detector 2
  - Focused on developing thin-gap MPGDs to improve angular resolution over large angular acceptance
  - R&D is critical to current reference detector (Crater Lake) if precision hit points are needed for PID detectors
    - Standard (3 mm drift gap) MPGDs in large magnetic field can not provide precise hit information over large angular acceptance.
  - Should be made part of project R&D program

Development of Double-sided Thin-Gap GEM-μRWELL for Tracking at the EIC

Proposal to the FY23 EIC generic detector R&D program

The Thin Gap MPGD (tg-MPGD) Consortium

Project Name: Development of Double-sided Thin-Gap GEM-μRWELL for Tracking at the EIC

Project Period: from 10/1/2023 to 09/30/2024

PI & Contact Person: Kondo Gnanvo; kagnanvo@jlab.org

Project Members:

FIT: Marcus Hohlmann, Pietro Iapozzuto
JLab: Kondo Gnanvo, Seung Joon Lee
Temple: Jae Nam, Matt Posik, Bernd Surrow
UVa: Huong Nguyen, Nilanga Liyanage
VU: Sourav Tarafdar, J.Velkovska, V.Greene
Yale U.: Nikolai Smirnov

MPGD R&D Interests

- Table compiled based on institutions interests in ePIC eRD108 and generic Thin-Gap MPGD R&D activities
  *Does **not** mean commitment to detector production

Group	MicroMegas	$\mu RWELL$
BNL		✓
CEA Saclay	✓	
FIT		✓
INFN Roma Tor Vergata		✓
JLab		✓
Temple University		✓
UVa		✓
Vanderbilt	✓	✓
Yale	✓	

Benefit of Two Technologies

- 2 MPGD foil production sites (CERN, Saclay)
  - CERN → $\mu RWELL$ PCBs, readout
  - Cea Saclay → MicroMegas detectors
- Reduce demand on a single foil production facility
- Minimize timeline for institutions to assembly and test components from foil production sites
  - Build MicroMegas and $\mu RWELL$ based detectors in parallel
- Maximize involvement of MPGD community and work force

CERN GDD

Cea Saclay

Summary

- Current configuration implemented recently (June-July)
  - Previous reference detector (Bryce Canyon) only had one MPGD layer
  - Micromegas based detectors → curved layers
  - $\mu RWELL$ based detectors → planar layers
- Strong and active EIC detector development community
- Detector R&D program (eRD-108) based on previous reference detector – no planar MPGDs
- There are production and workforce advantages to having two MPGD technologies