Design, Prototyping, and Construction of a Cylindrical $\mu$ Resistive-WELL Detector

Pietro Iapozzuto, Dr. Marcus Hohlmann
for the EIC eRD108 Consortium

4/26/2023
piapozzuto2015@my.fit.edu
Motivations for a Cylindrical µ-RWELL Detectors

eRD108 has been working on central tracking with Micropattern Gaseous detectors (MPGDs) for EIC and Future Detectors

The AIM:

The R&D on MPGD type called µ-RWELL will serve as a proof of concept for future detectors
How a Planar Micro-Resistive-Well (µRWELL) detector works

The µ-RWELL is composed of two elements the µ-RWELL-PCB and Cathode

The µ-RWELL-PCB couples a
- “well pattern” kapton foil as the amplification stage
- a resistive layer for discharge suppression
- PCB for readout
Design of uRWELL / 2D readout 

Composite foil structure

Panasonic connectors to the APV25-SRS FE electronics

Different types of readout

Single foil design, same μRWELL amplification, two different U-V readout structures

- 2D zigzag readout @ BNL and Capacitive-sharing straight strip @ JLab

Common readout template design: Strip pitch: 1.35 mm² total of 768 strips / half cylinder
The Dream & Vision

Thinking outside of the square and into a cylinder
Design Of A Cylindrical μRWell
Design Of A Cylindrical μR WELL

Prototype consists of 2 half-cylinder chambers with different readout structures

Set of three support frames per half-cylinder (main frame + 2 clamps)
Half-Cylinder Design

Part A: Inner Frame
Part B: Main Frame
Part C: Outer Frame

Electronics Connections
Active Detection Area
Features: Gas, O-Ring, High Voltage Box

Part A: Inner Clamp
Part B: Main Frame
Part C: Outer

Gas Inlet Hole
O Ring Groove
Electrical HV Box
3D-Printed Prototype Parts

Part A: Inner Clamp
Part B: Main Frame
Part C: Outer
Part C: Mylar Foil
HV Shield Cover
Cathode Drift Foil Assembly

Pre-Gluing Frame  25 micron unstretched  Stretching

125 micron Aluminized Mylar foil  Assembly
Conclusion:

- A prototype cylindrical micro-Resistive-Well (µRWell) detector, has been developed!
  - Components include kapton drift foil, a main frame (provides a 3mm drift gap), inner, and outer frame, µRWell/readout foil
- Designing & prototyping was rather tricky with 3d printed frames yet successful
  - Plans to minimize material and scaled up version
- Plans to go to Fermilab Test beam on June 21st 2023!
The End

References:

M. Poli Lener, LNF-INFN - CepC Workshop

The micro-Resistive WELL detector: a compact spark-protected single amplification-stage MPGDG. Bencivenni,a,1 R. De Oliveira,b G. Morelloa and M. Poli Lenera 2015

Micropattern Gaseous detectors : F Sauli, A Sharma - Annual Review of Nuclear and Particle Science, 1999

A. Accardi et al., Electron Ion Collider: The Next QCD Frontier - Understanding the glue that binds us all," arXiv:1212.1701 [nucl-ex].


Gaseous radiation detectors: fundamentals and applications , F Sauli - 2015

Special Thanks to Florida Tech Undergrads:

Matthew Romano , Adam Lastowka , Andrew Capalbo, Zackery Wihela