Brookhaven National Laboratory

Jefferson Lab

U.S. DEPARTMENT OF ENERGY

MPGD Endcap Tracker (ECT)

Triple I Engineering Meeting Update

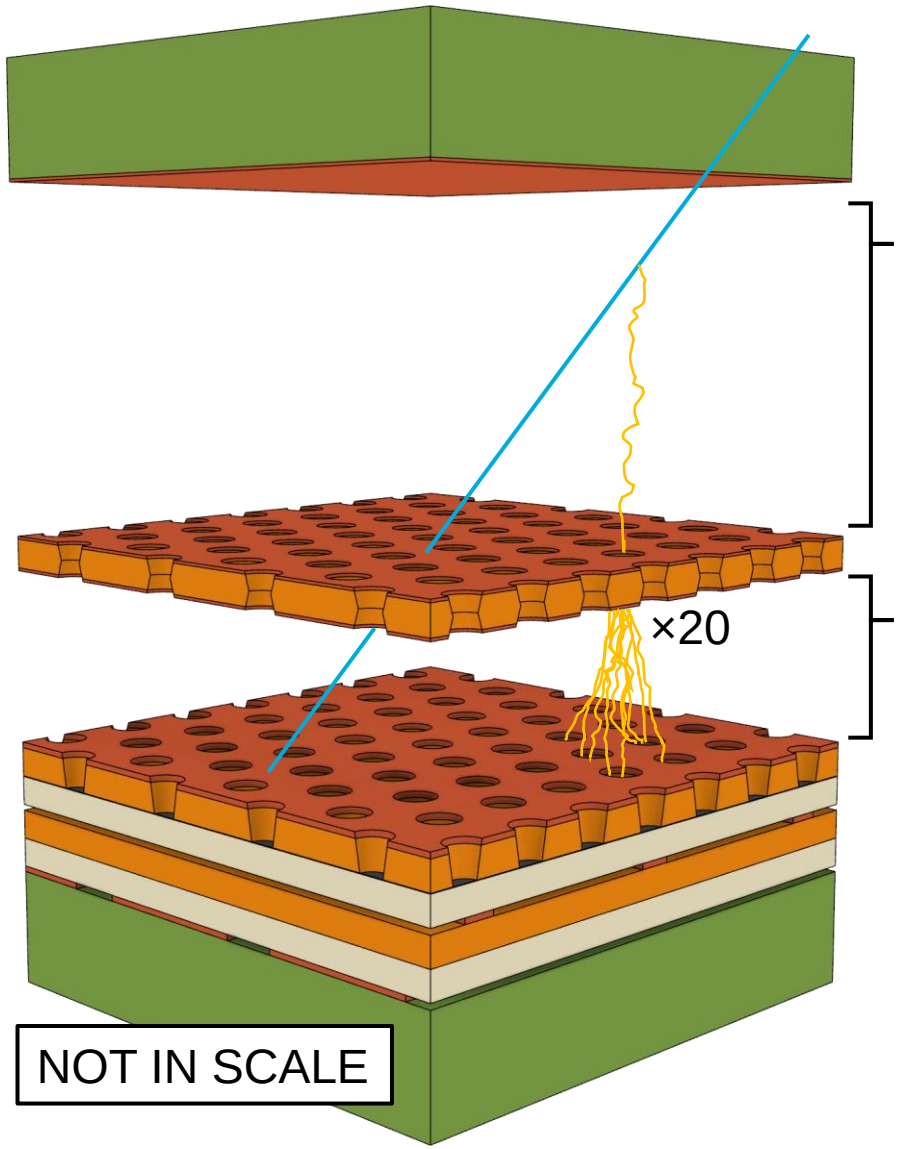
Stefano Gramigna

Annalisa D'Angelo (project manager)

Seungjoon Lee (lead engineer)

Electron-Ion Collider

Introduction: Hybrid GEM + µ-RWELL Detector Technology



CATHODE
~ 3 mm lightweight support
5 µm copper

DRIFT
6 mm

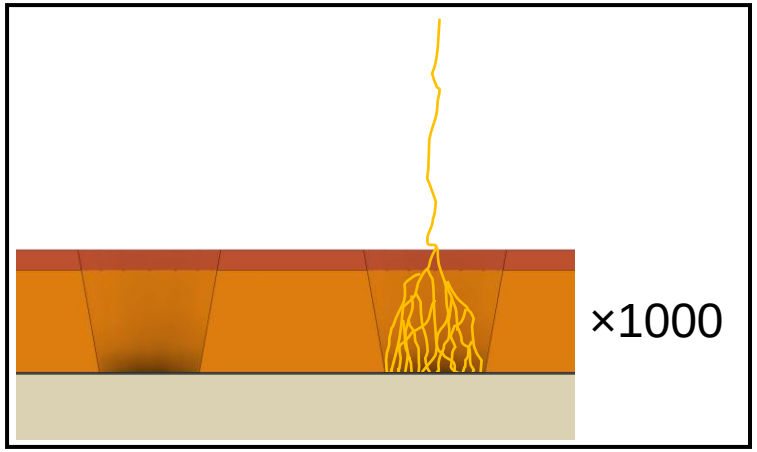
GEM
5 µm Copper
50 µm Kapton
5 µm Copper

TRANSFER
3 mm → 2 mm in the future?

µ-RWELL
10 µm copper
50 µm Kapton
~ 100 nm DLC

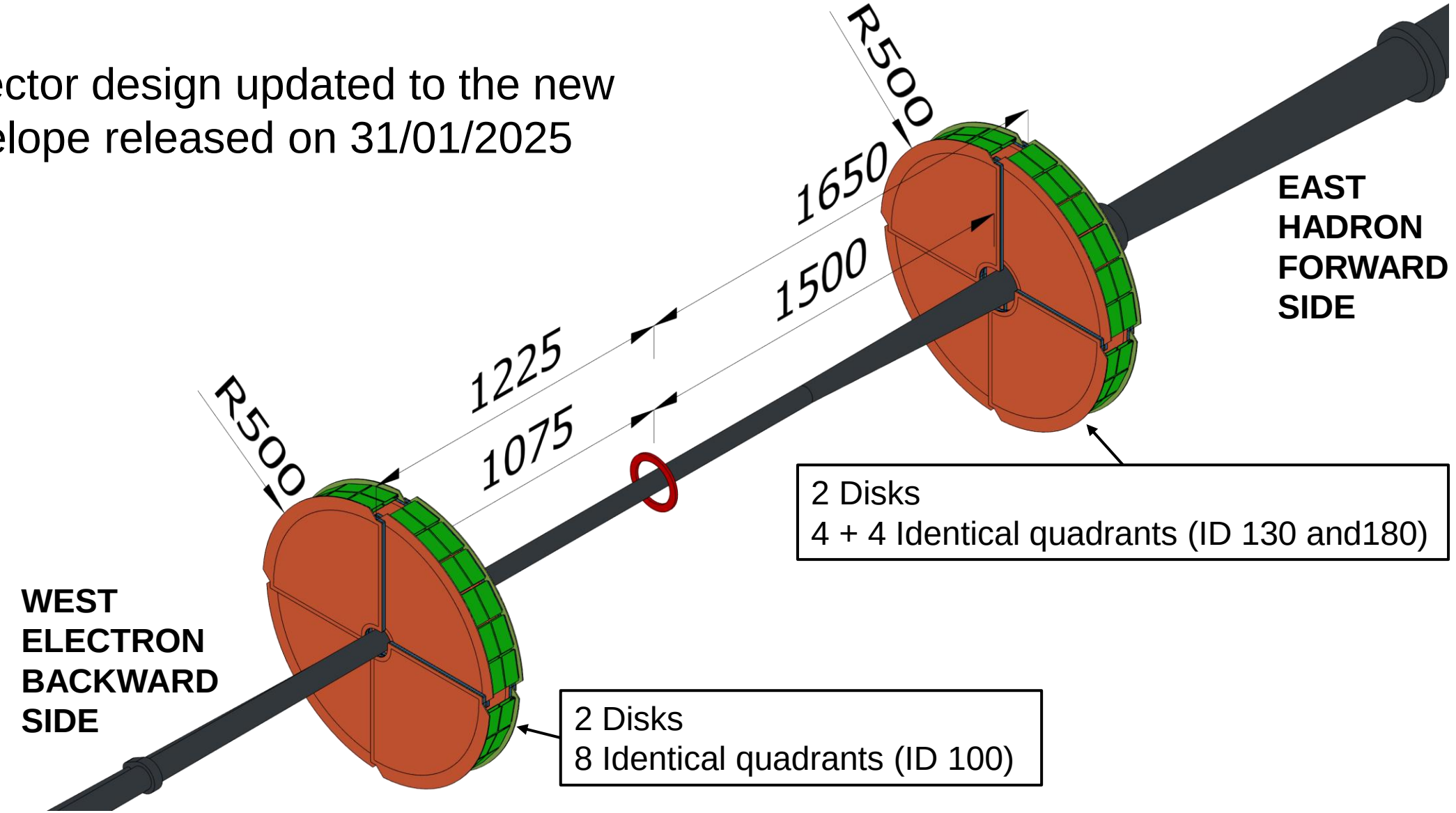
R/O
2D strip layout, 600 µm pitch
~ 3 mm lightweight support

Performance Requirements	
Spatial resolution	≤ 150 µm
Time resolution	≤ 20 ns
Single layer efficiency	≥ 97%
Material budget (per layer)	≤ 1% X_0

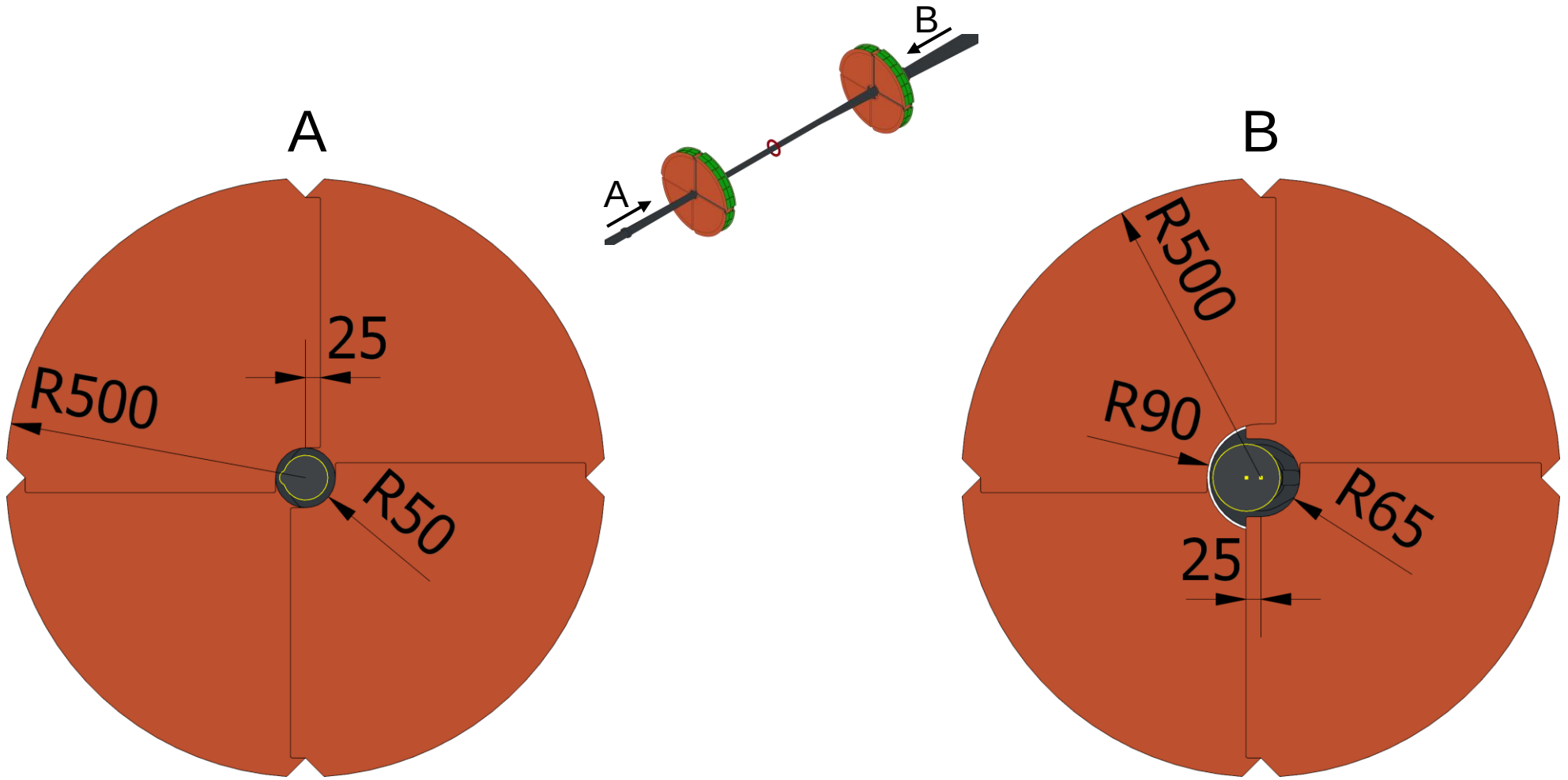


Ensemble and Envelope, Isometric View

Detector design updated to the new envelope released on 31/01/2025



Quadrants Arrangement, Frontal Views

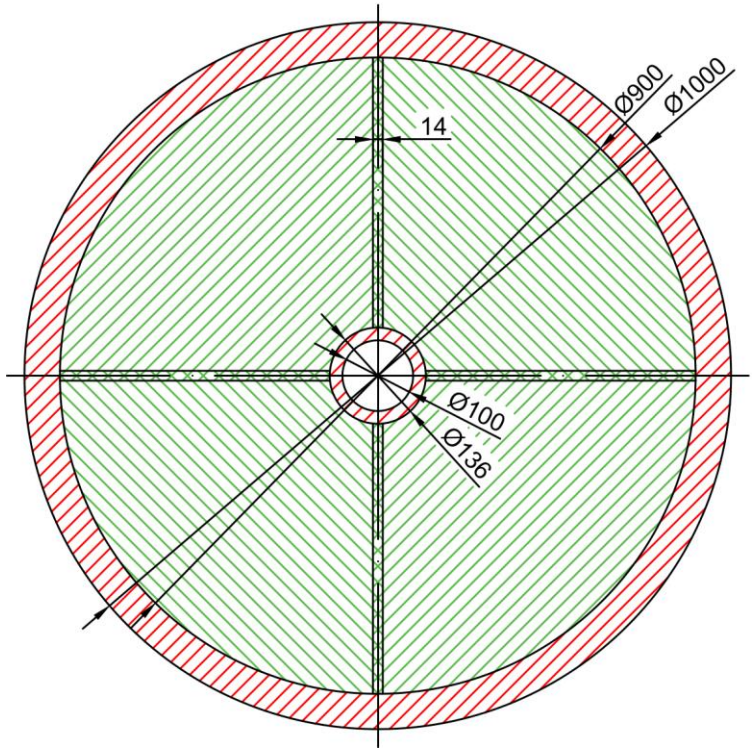


WEST/ELECTRON/BACKWARD SIDE

EAST/HADRON/FORWARD SIDE

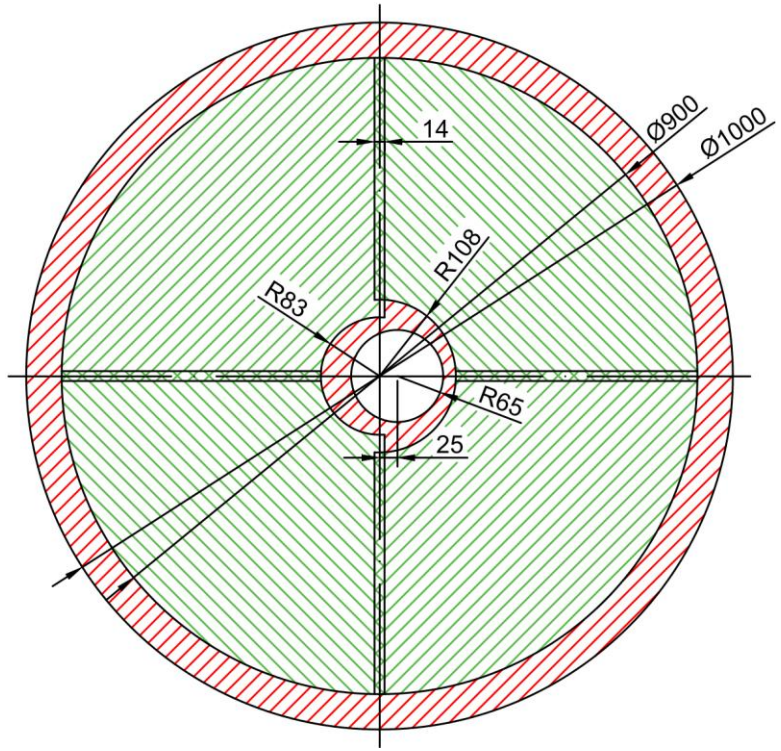
Active Area Coverage

WEST/ELECTRON/BACKWARD SIDE



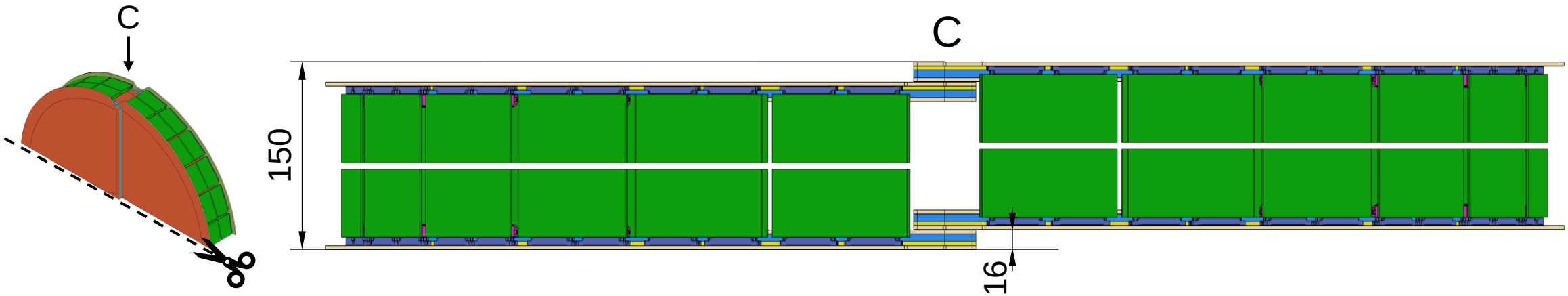
79,95% Coverage

EAST/HADRON/FORWARD SIDE



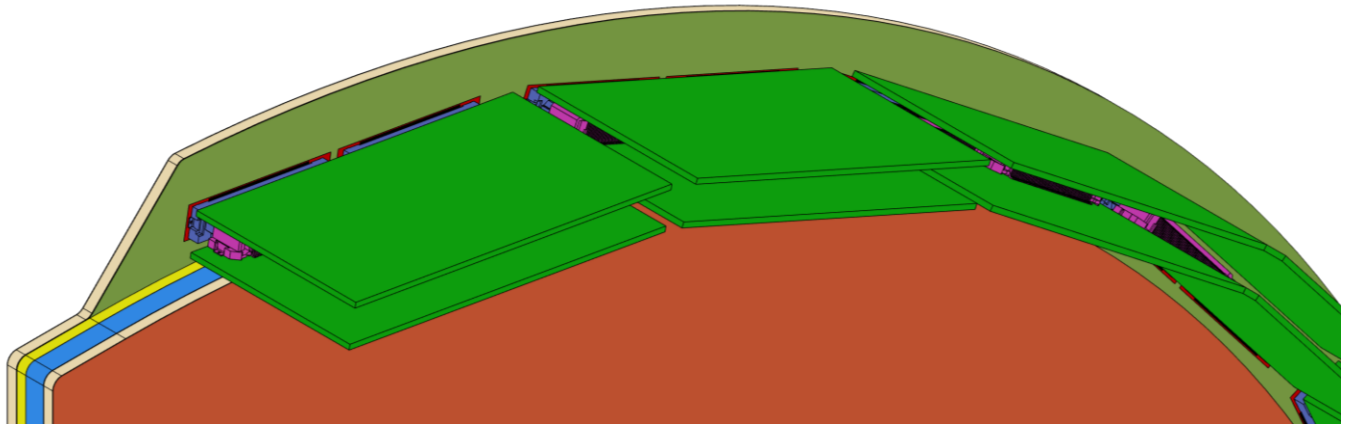
78,62% Coverage

Overlap Region, Top View

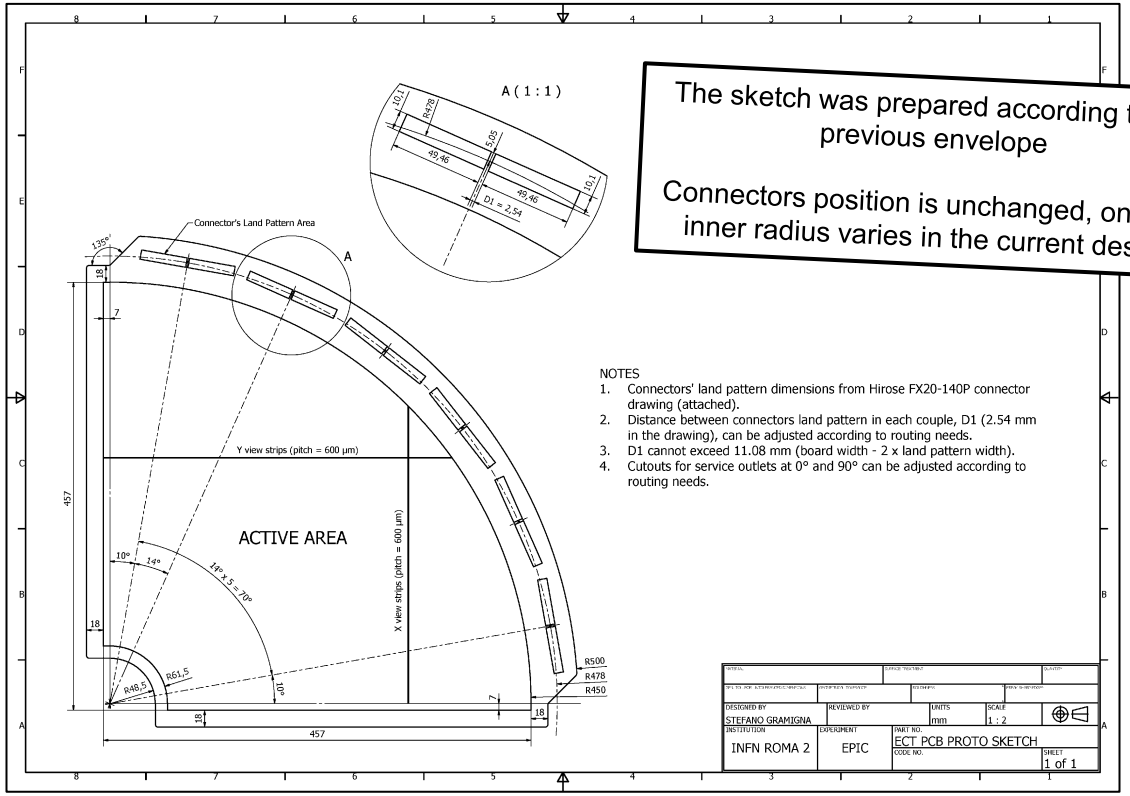


In this view the electron and the hadron side are now identical

Two stacked **110 x 54.5** mm^2 PCBs can fit (5 mm clearance between facing quadrants)

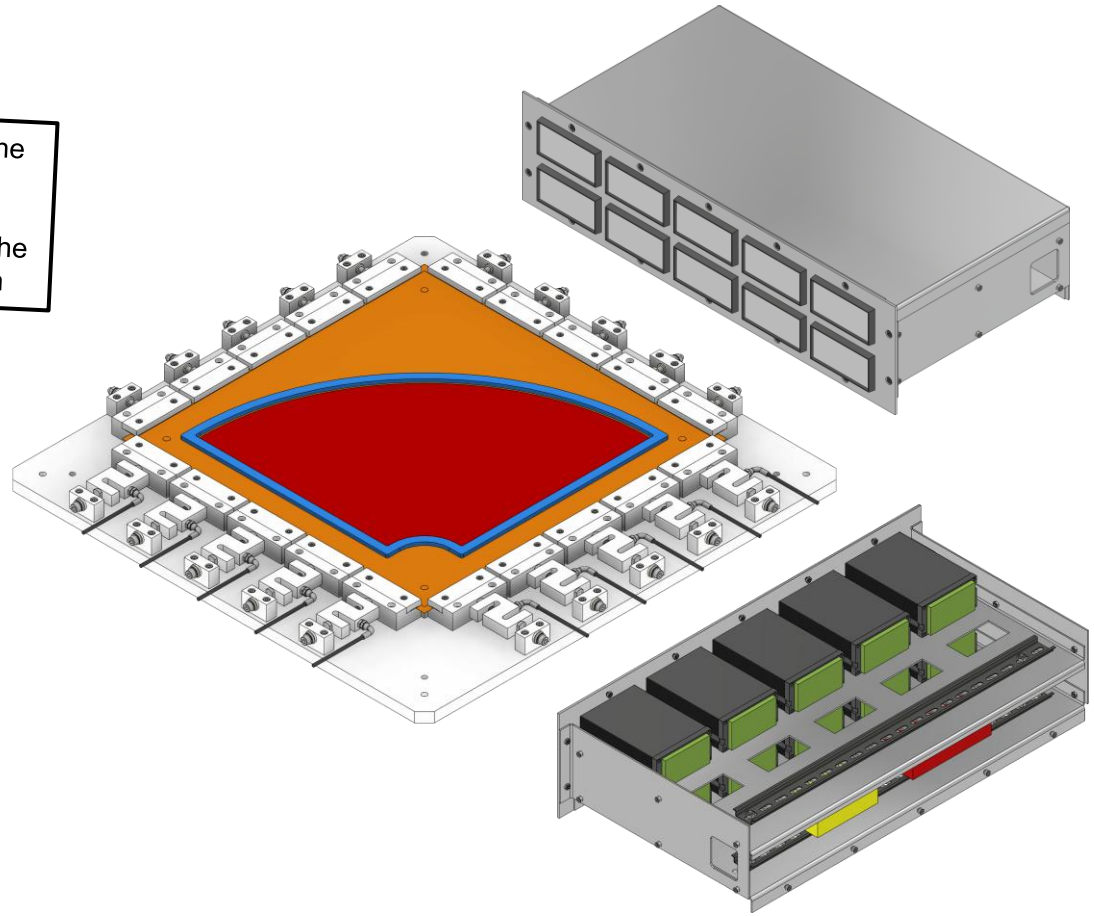


Status / Updates



The sketch was prepared according to the previous envelope

Connectors position is unchanged, only the inner radius varies in the current design



Sketch of the Active area submitted to CERN to begin the design of the engineering test article's R/O PCB

First PCB drawing expected within the week

Materials procurement for the GEM stretching tool is underway

Plans Towards PDR

Detector R&D

First Engineering Test Article

Objectives:

- Validate **scalability of G-RWELL** technology
- Practice **operation** of a large area detector
- Advance towards **final AA and routing scheme**

Features:

- **Reliable** mechanics
  - FR4 supports for anodes and cathodes
  - Wider, sturdier frames if necessary
- **Recoverable** design:
  - O-ring and screw closure or hybrid solution
  - Glue reservoirs for eventual sealing
- **Semi-final routing** with Hirose connectors
- **Convenient** mounting points and form factor for testing
  - Test beam and cosmic ray telescope

Mechanics R&D

Mechanical mock-up(s)

Objectives:

- Study **lightweight** mechanical solutions
  - Sandwich-structured composites
- Study **gas tightness** solutions
  - Full epoxy sealing or hybrid solutions
- Study **gas distribution** solutions*
- Practice **production techniques**
- Finalize **construction tooling**

Services Estimates

Service	# lines	Flow	Material	Dimensions	Comment
Gas	4	IN	SS316/Cu	Ø8	1 per disk, **manifold for distribution near the disks**
	4	OUT	SS316/Cu	Ø8	1 per disk, **manifold for distribution near the disks**
Cooling	4	IN	PU	Ø12	1 per disk, **manifold for distribution near the disks**
	4	OUT	PU	Ø12	1 per disk, **manifold for distribution near the disks**
Dry air	4	IN	PU	Ø8	1 per disk, **manifold for distribution near the disks** (if humidity not controlled otherwise)
Data	96		Fiber optics	Ø2(?)	1 per FEB, 24 FEBs per disk
LV	96		Cable	Ø8(?)	1 per FEB, 24 FEBs per disk
HV	16		Multi-channel Cable	Ø10(?)	1 per quadrant (4 HV channels per quadrant, 16 per disk)
GND	2		Copper braid	70 mm2	1 per side, if not provided otherwise
ENV	8		Cable + sensor	Ø4	4 per side, 2 temperature + 2 humidity

Water cooling is assumed for FEBs

A **patch panel** may reduce DATA, LV and HV lines' occupancy near the detectors

Questions & Comments