MPGD Endcap Tracker

GST Workshop - 03/24/2025

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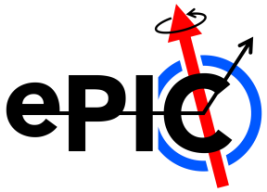
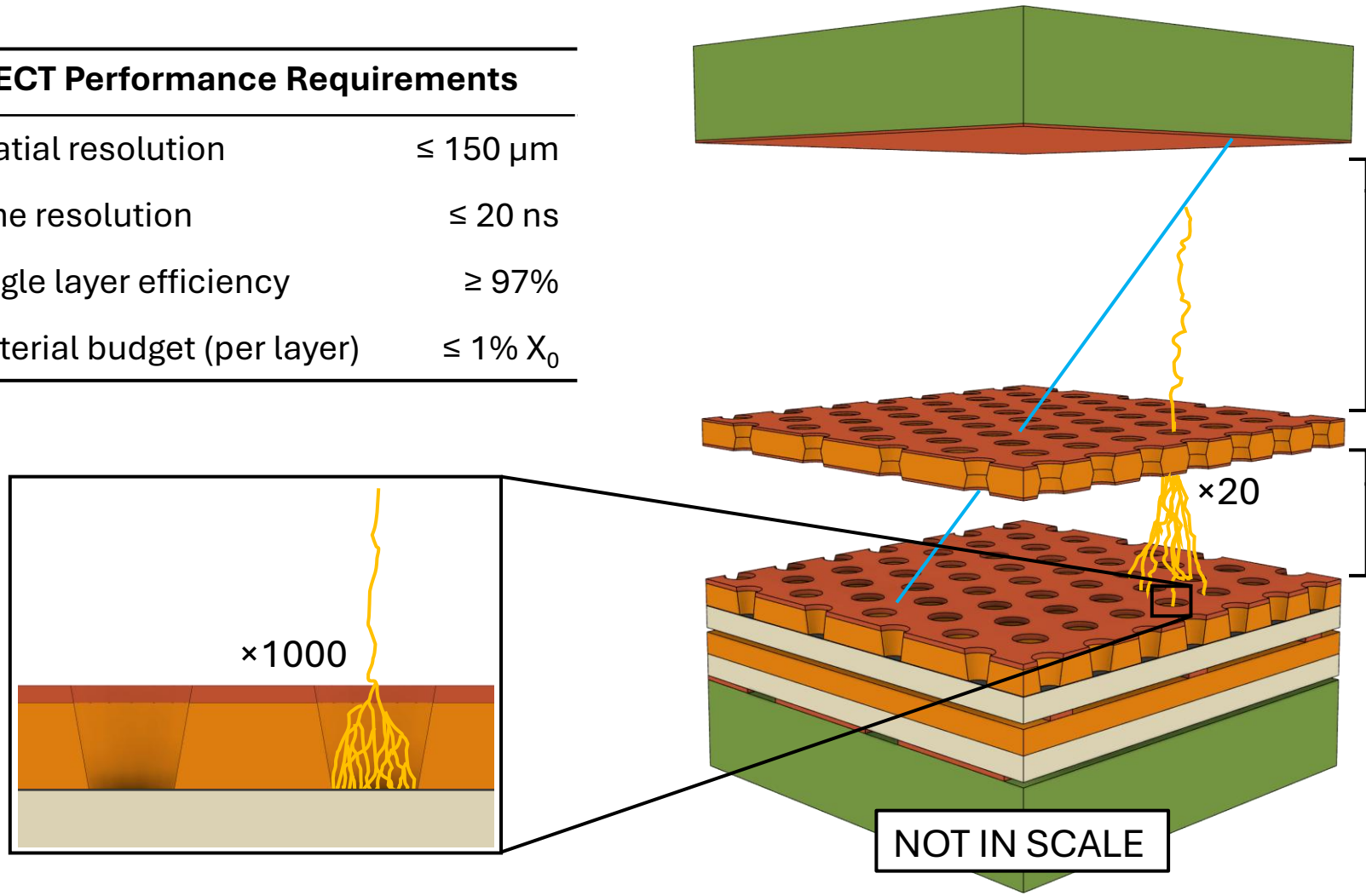


Introduction: G-RWELL Technology

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



CATHODE
~ 3 mm lightweight support
5 μm copper

DRIFT
6 mm

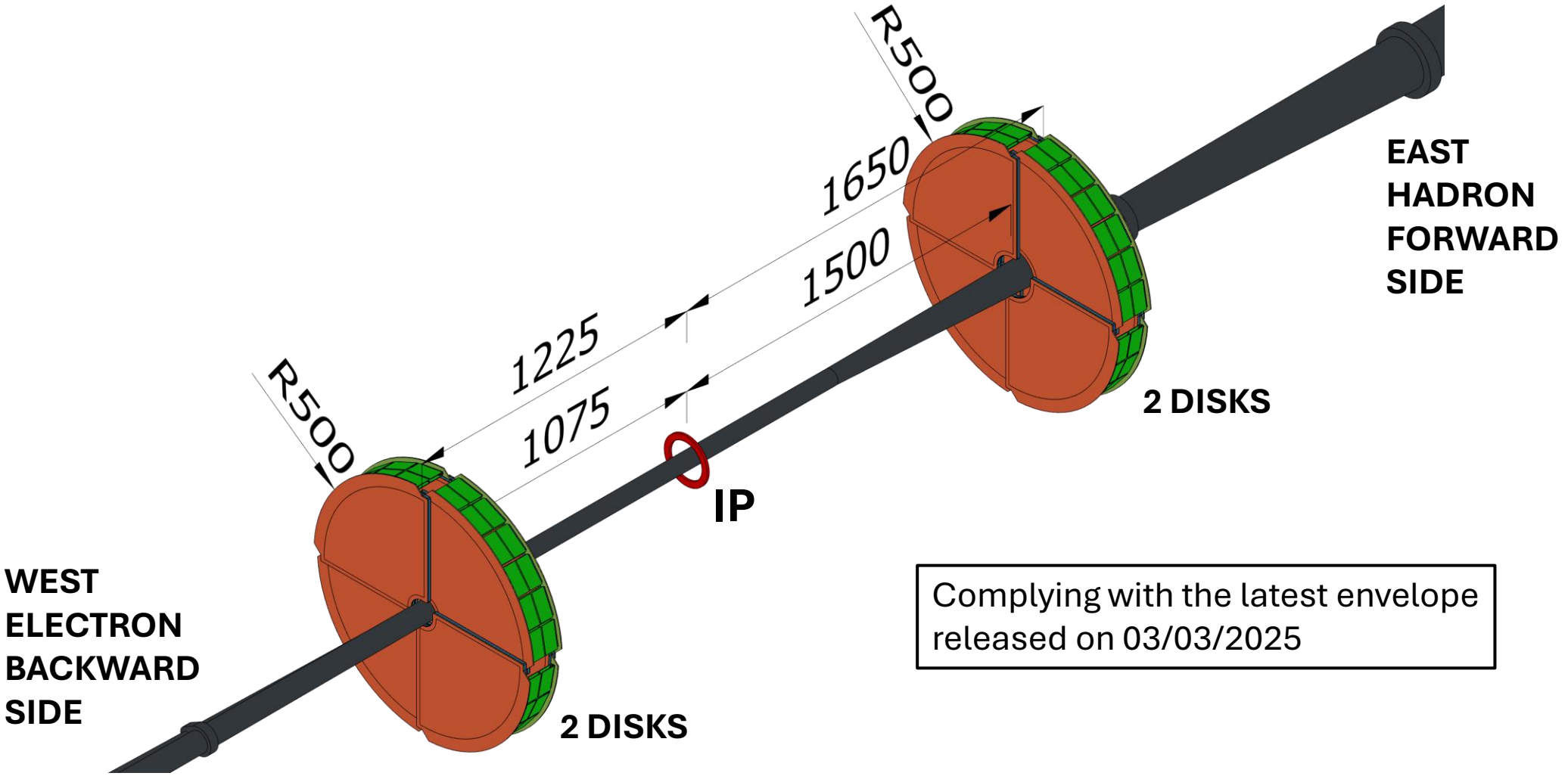
GEM
5 μm Copper
50 μm Kapton
5 μm Copper

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

MPGD Endcap Tracker Overview



Complying with the latest envelope released on 03/03/2025

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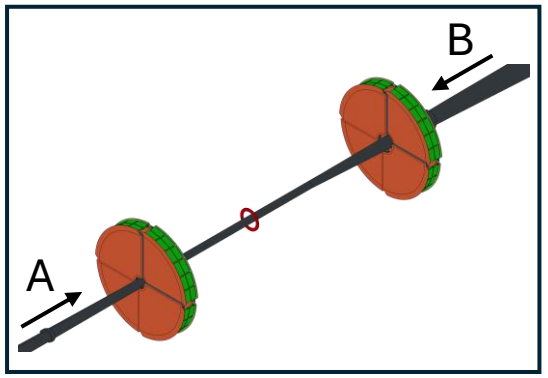
Arrangement of the Quadrants Pt. 1



3 quadrant designs overall:

Electron side

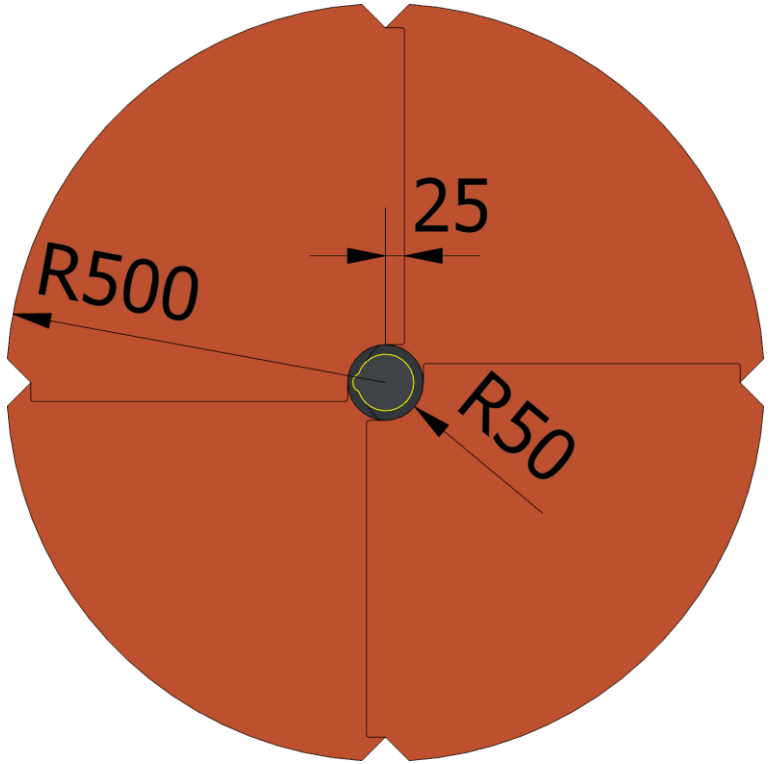
1 design → 8 quadrants

Hadron side

2 designs → 4 + 4 quadrants

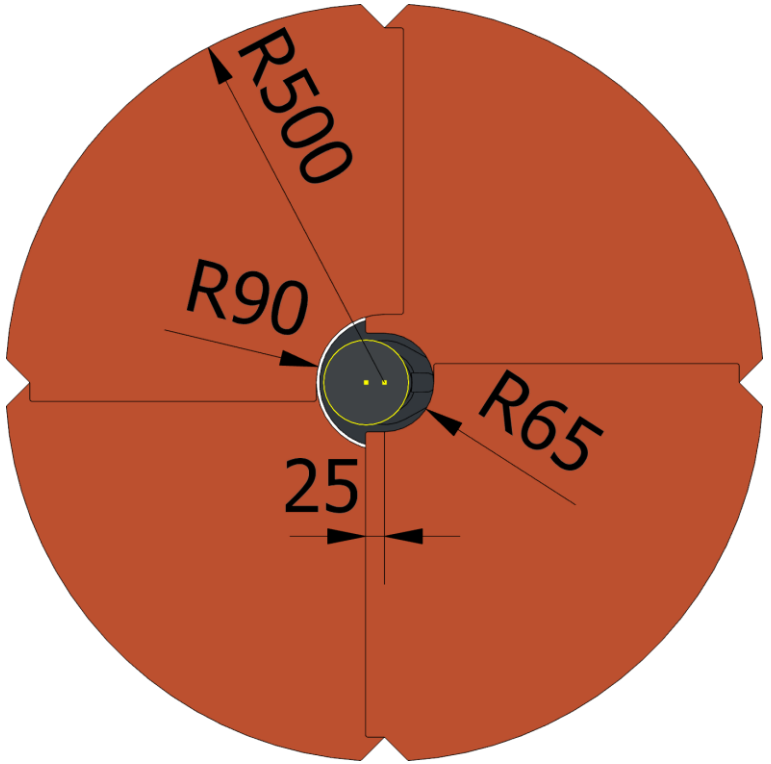
Quadrants **overlap** to achieve total azimuthal coverage

A



WEST/ELECTRON/BACKWARD SIDE

B



EAST/HADRON/FORWARD SIDE

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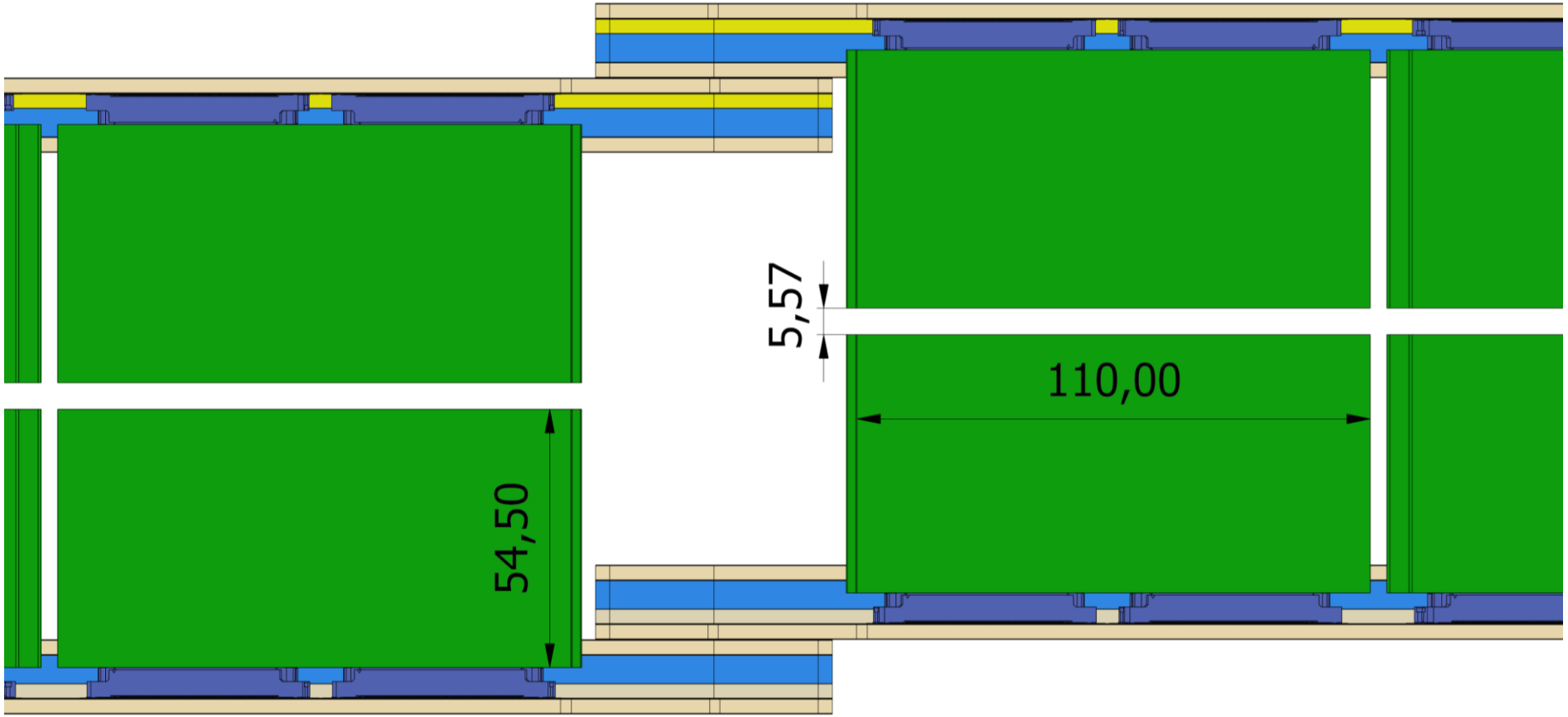
Arrangement of the Quadrants Pt. 2

OVERLAP REGION - TOP VIEW, DETAIL



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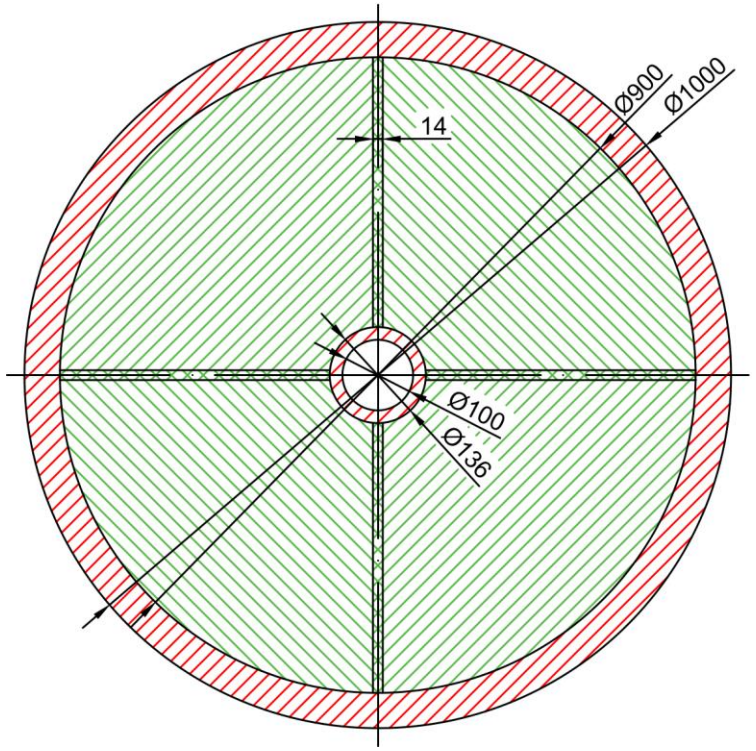
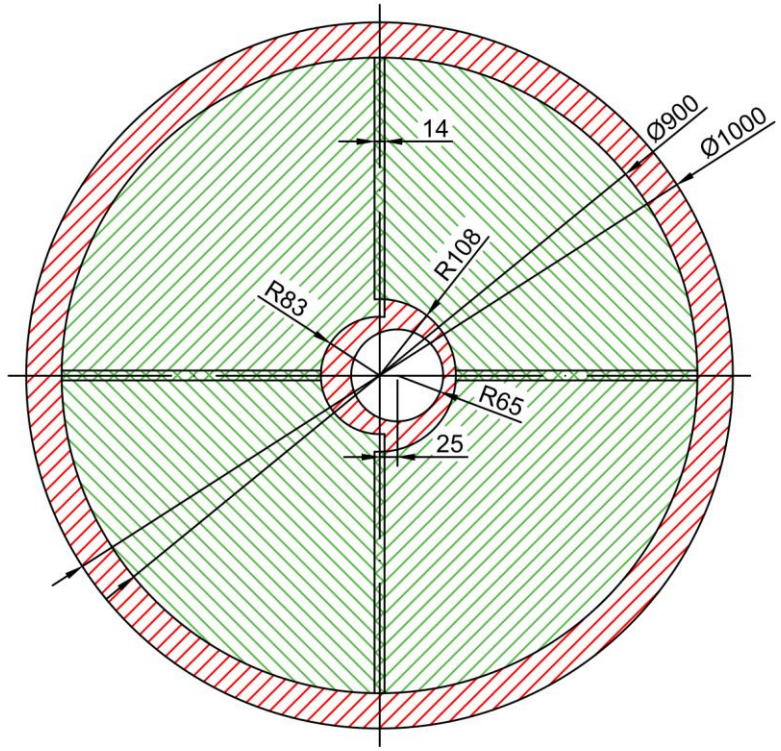
Active Area Coverage

WEST/ELECTRON/BACKWARD SIDE



79,95% envelope coverage
-1,72 > η > -3,46

EAST/HADRON/FORWARD SIDE



78,62% envelope coverage
2,01 < η < 3,59/3,33

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Quadrant Design

Cutouts for services
At 0°, 90°, 180°, and 270°

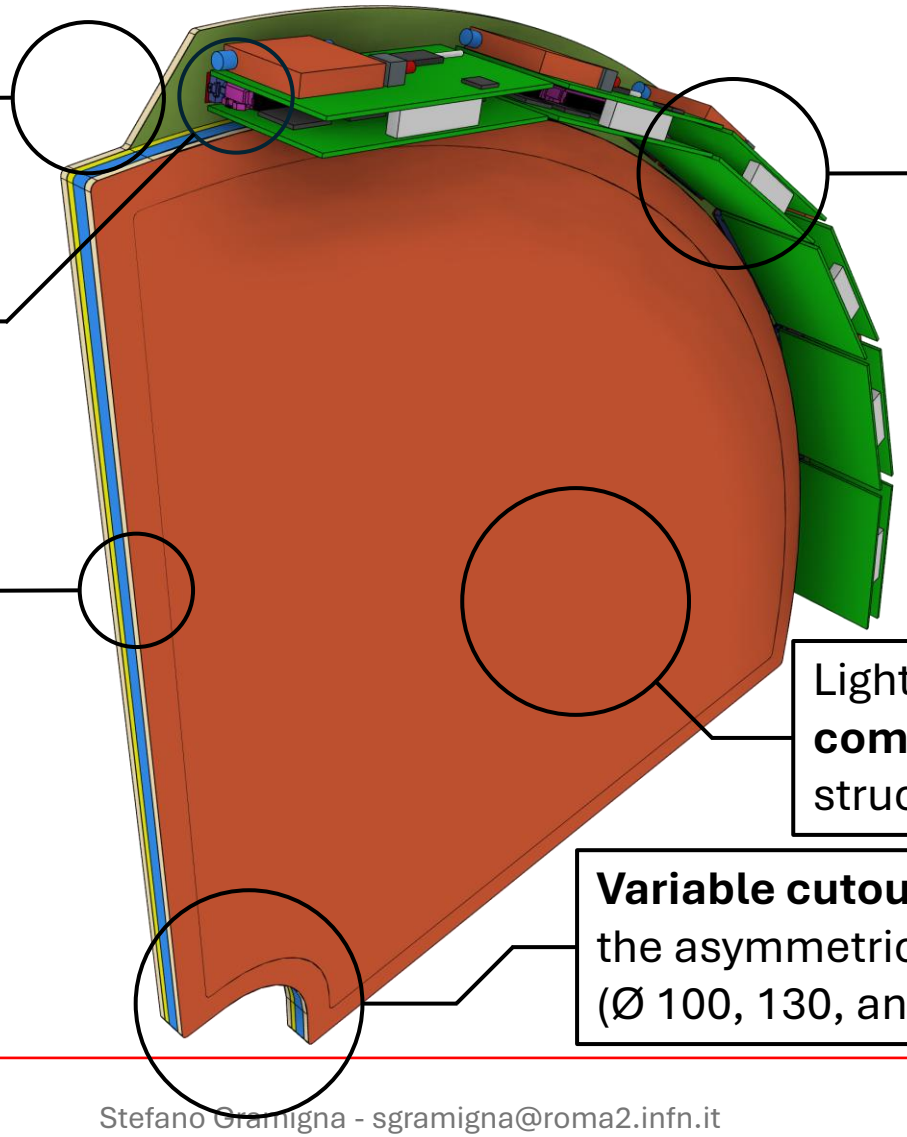
4x **SALSA** ASICs per FEB

2x **Hirose FX20-140P** Connectors per FEB

15 mm wide **PEEK** frames to define gas gaps

Fiberglass frames for outer support structures

Still to implement:
- HV distribution
- Gas distribution
- Interconnection framing
- Integration with GST



6 **FEBs** per quadrant located in the service rim

Lightweight **sandwich-structured composites** for anodes/cathodes' structural supports

Variable cutout to cope with the asymmetric beam pipe (Ø 100, 130, and 180)

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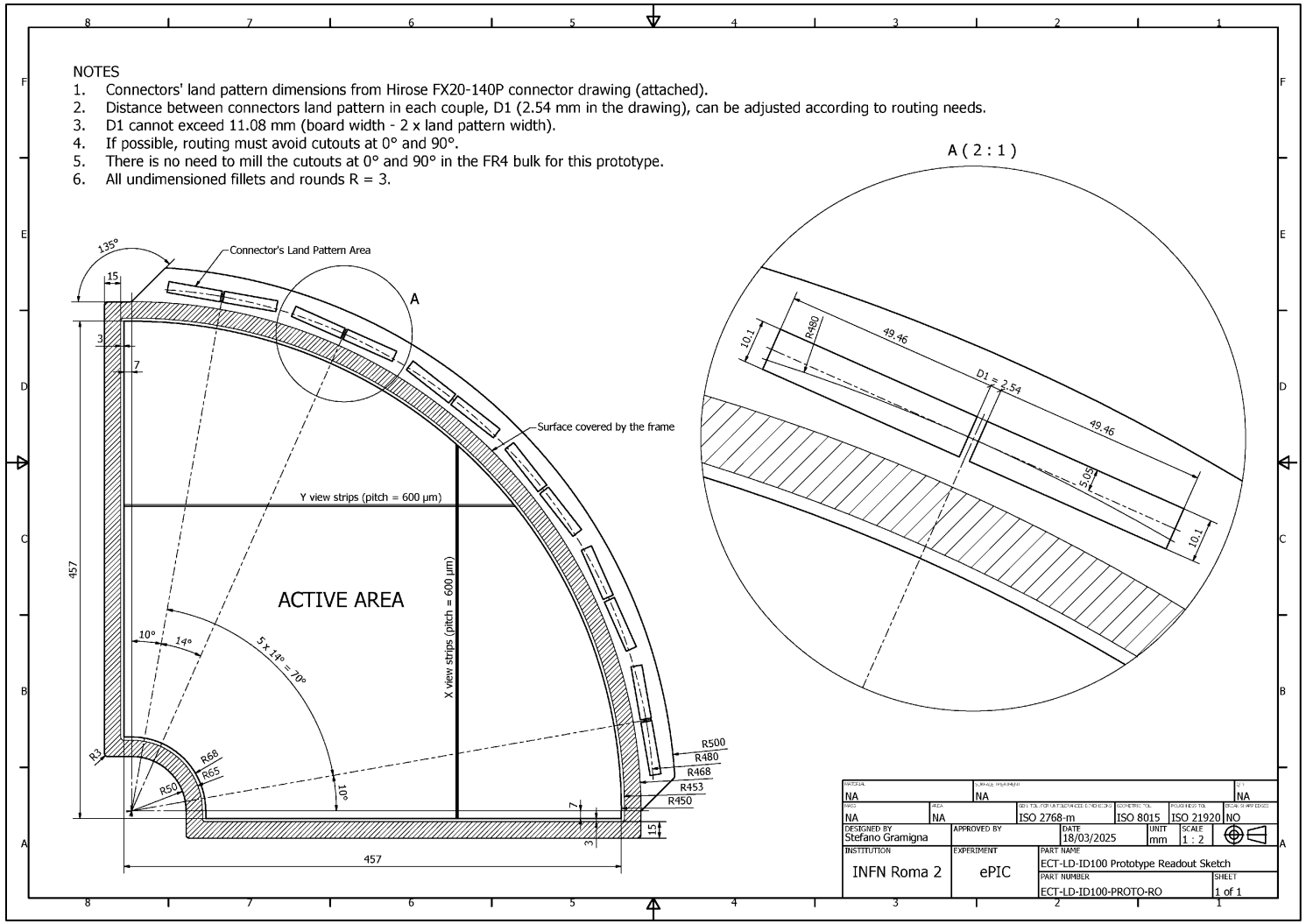
Active Area Sketch



Updated sketch after first feedback from CERN

FEB moved 2 mm outward radially

600 µm pitch both views
→ 1500 channels per quadrant

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Services

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

Integration Constraints and Desiderata

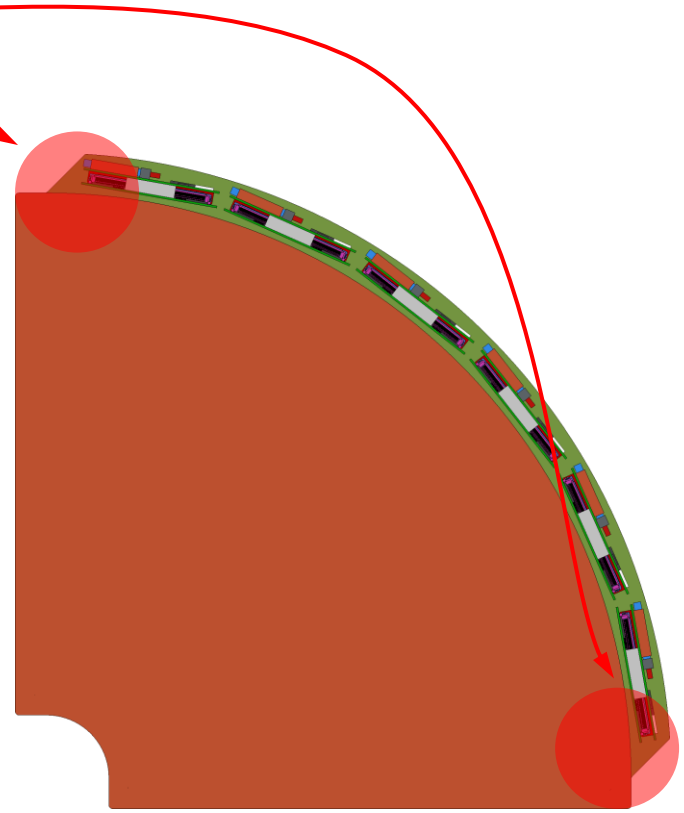
2 Mounting points per quadrant:

- 1 kinematic coupling → to fix position and orientation
- 1 coupling with backlash → to spread the load

Internal framing between quadrants yet to be designed

FEB and services are inaccessible after the detectors are mounted inside the GST
→ Sectors must be installed with cables/services attached (at least short haul up to patch panel/manifolds)

More information about the integration procedure is required



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Thanks for your attention

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Ongoing and Future R&D Plans

Detector R&D

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

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*
- Study **Vibration resistance** and resonance studies*
- Practice **production techniques**
- Finalize **construction tooling**

* unplanned but possible