MPGD Endcap Tracker

Conceptual design, Engineering Test Article, and Production Tooling

ePIC Italia Meeting - 14/03/2025

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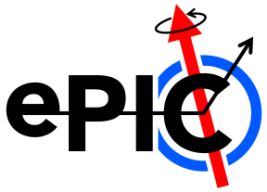

Outline

- Introduction: G-RWELL Technology
- MPGD Endcap Tracker Concept
- ECT Quadrant and Engineering Test Article
- Production Tooling

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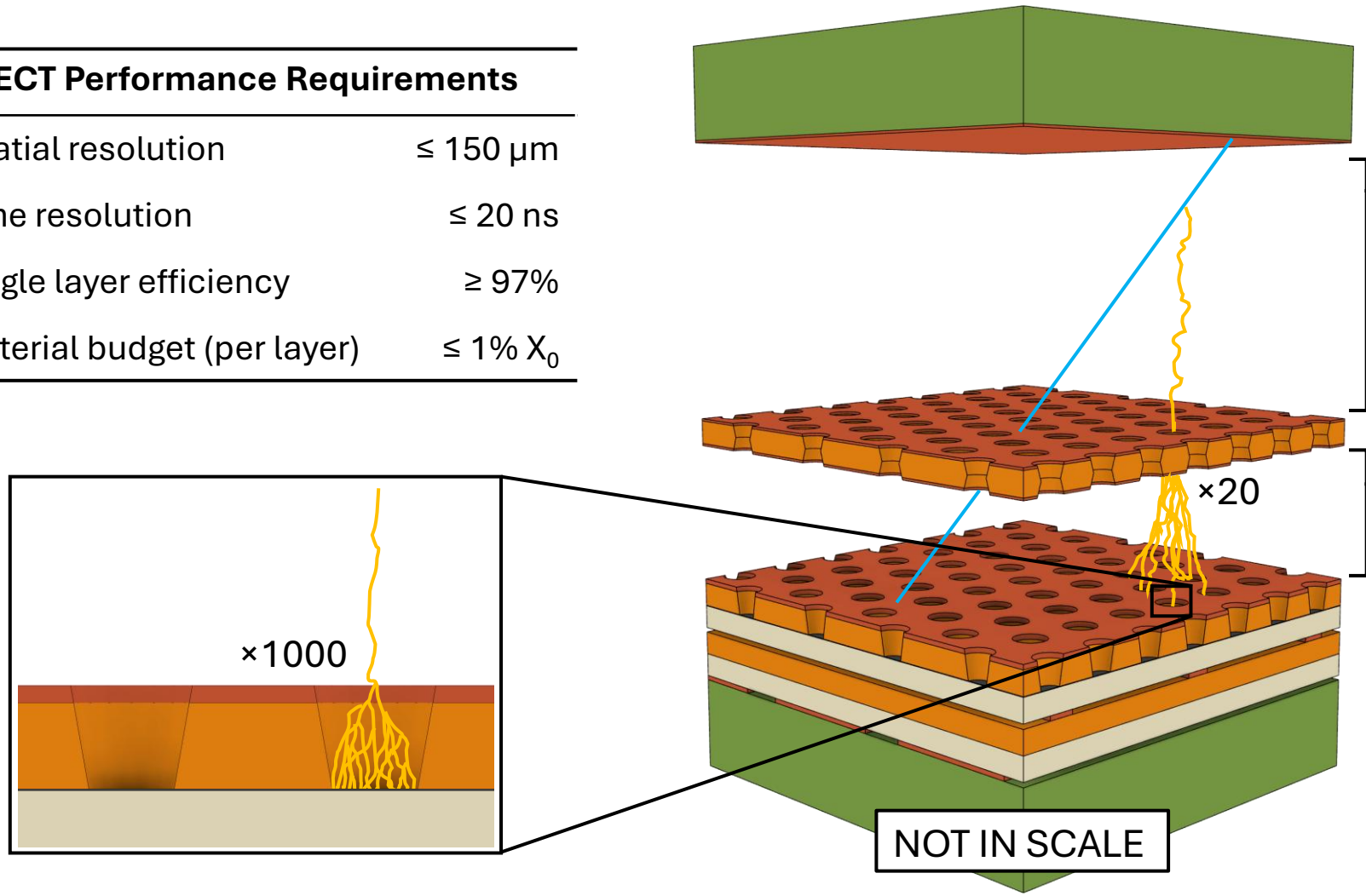
Introduction: G-RWELL Technology

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 Concept

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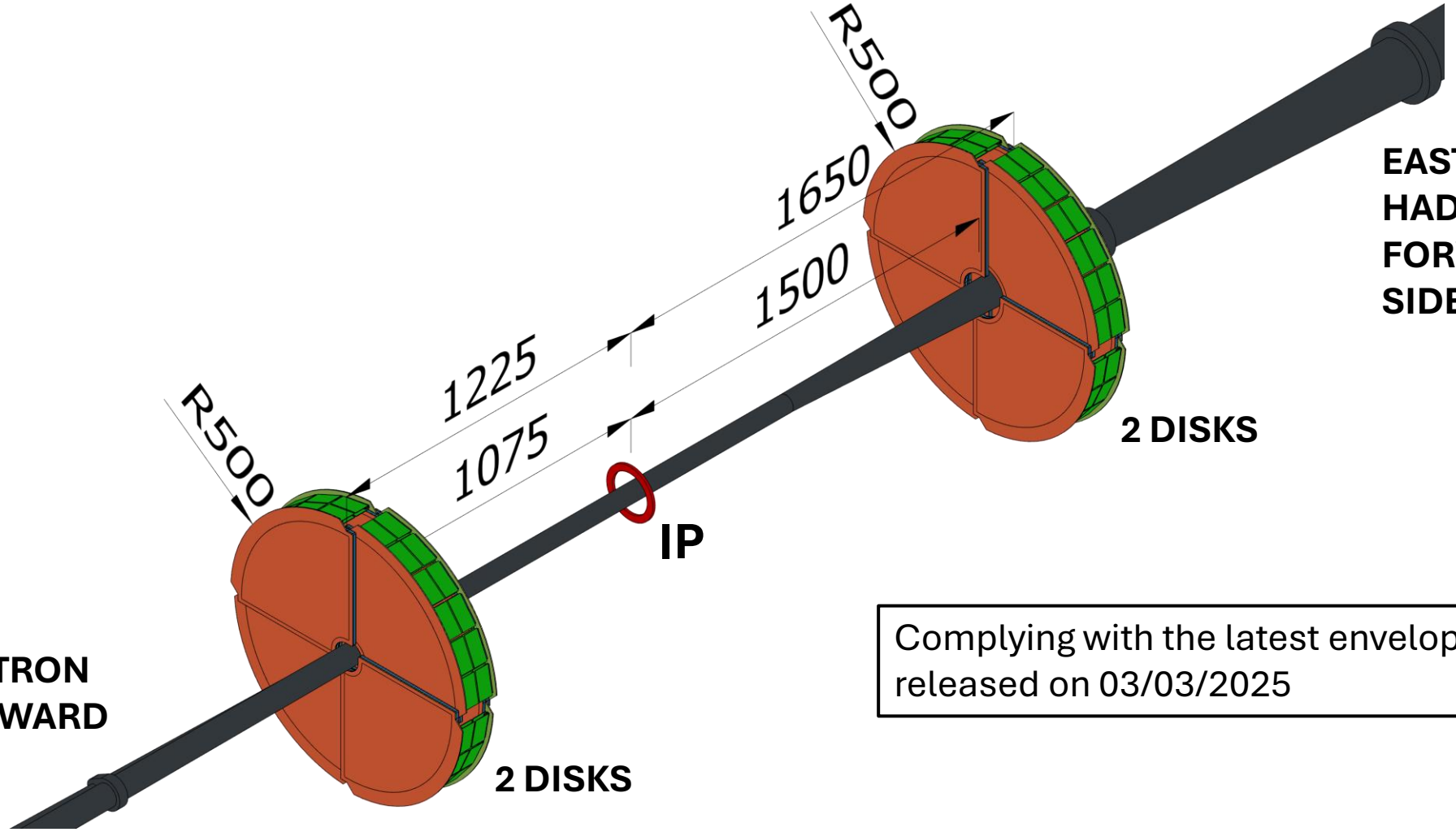
MPGD Endcap Tracker Overview



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

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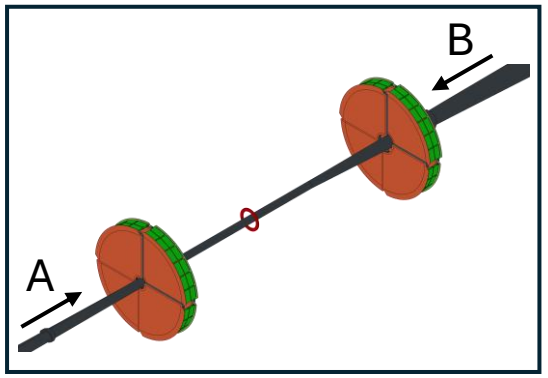
Arrangement of the Quadrants



3 quadrant designs overall:

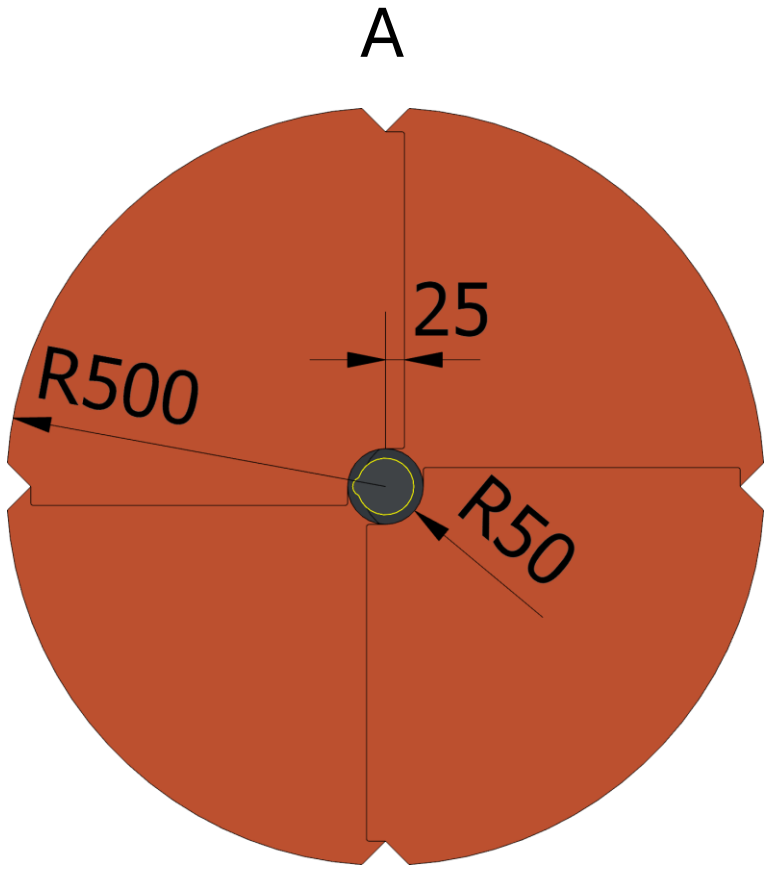
Electron side

1 design → 8 quadrants

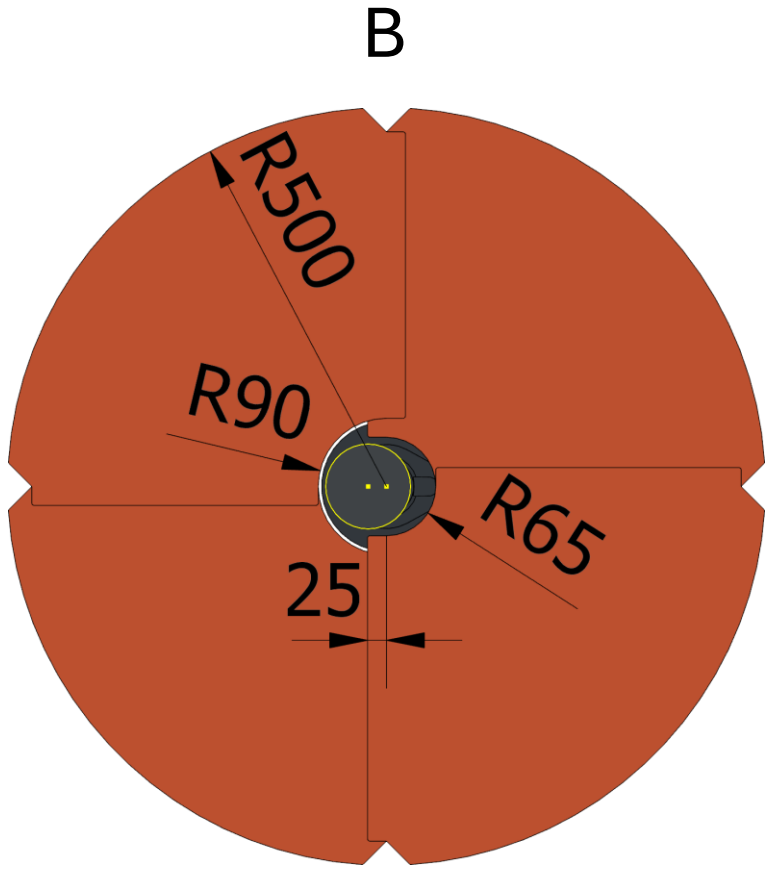
Hadron side

2 designs → 4 + 4 quadrants

Quadrants **overlap** to achieve total azimuthal coverage



WEST/ELECTRON/BACKWARD SIDE



EAST/HADRON/FORWARD SIDE

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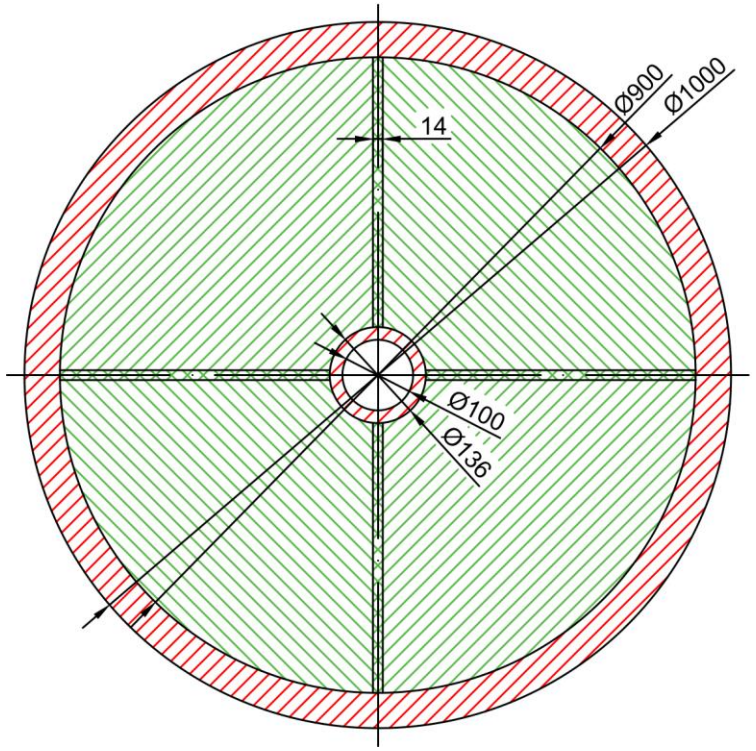
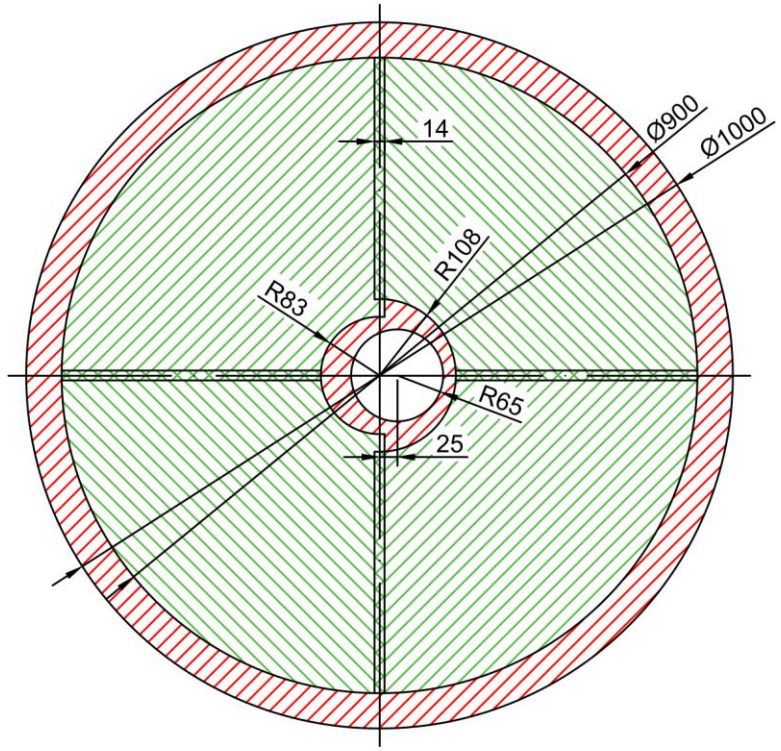
Active Area Coverage

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

ECT Quadrant and Engineering Test Article

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Quadrant Design

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

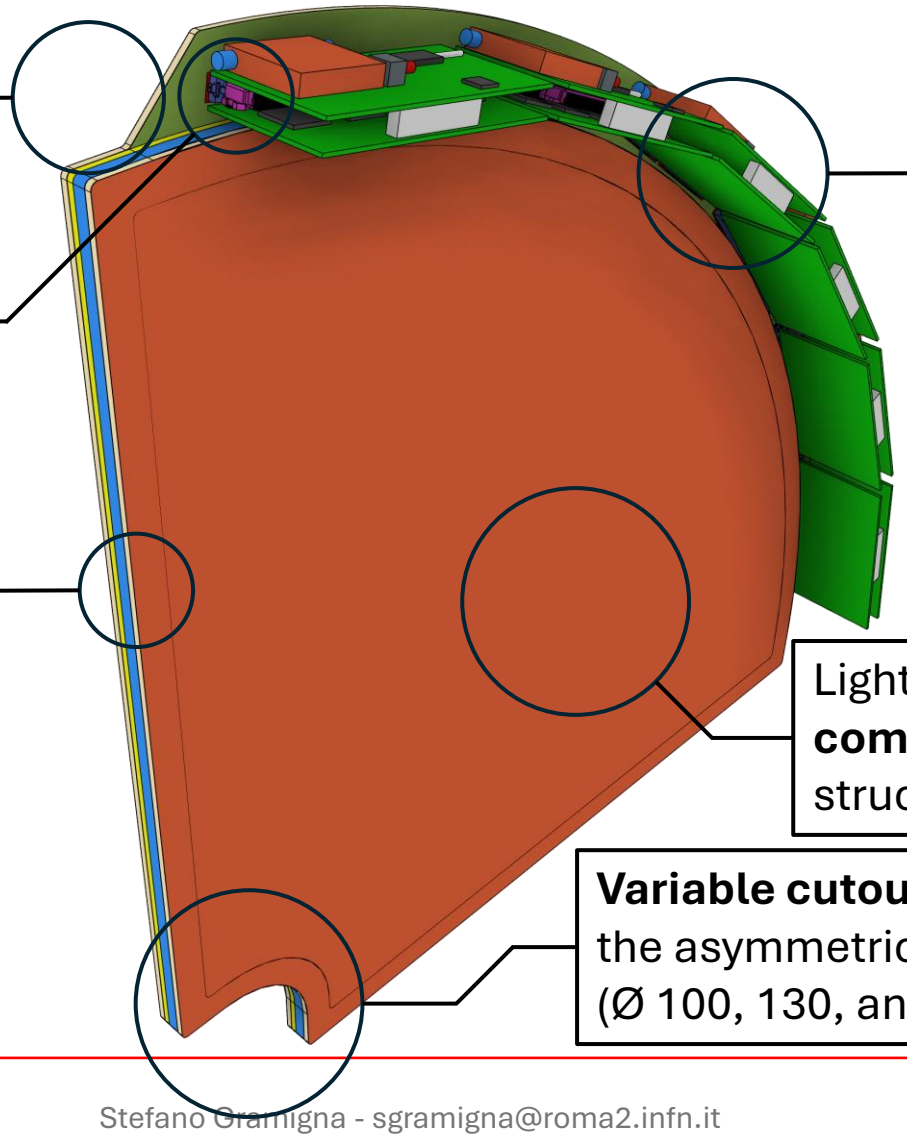
4x **SALSA** ASICs per FEB

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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Engineering Test Article

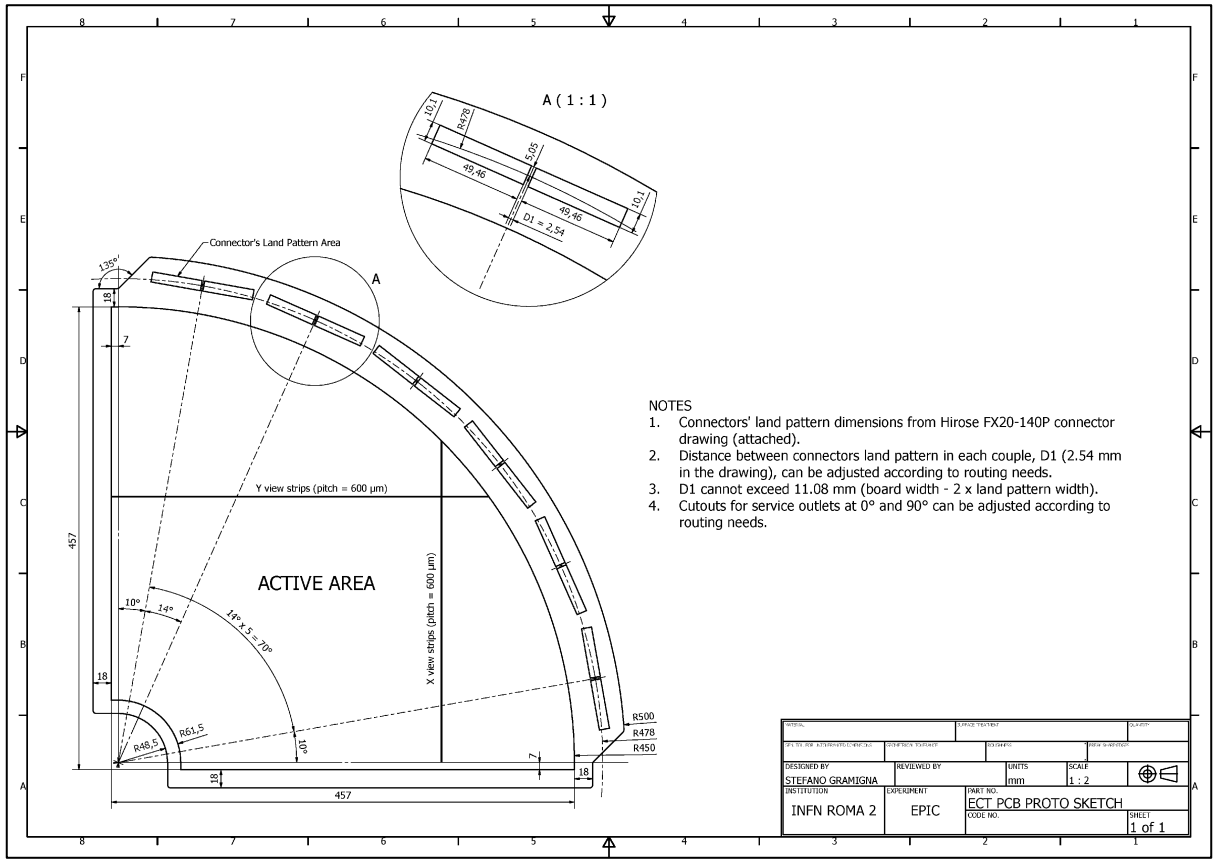
Preliminary sketch sent to Rui to begin the R/O + µ-RWELL PCB design

2x to be produced by mid September (best case scenario)

600 µm pitch → ~1500 channels per quadrant (both views)

Strip routing impacts sealing strategy (Epoxy VS screws and O-rings or hybrid solutions)

Internal spacers, HV segmentation, and gas distribution design yet to be finalized



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:

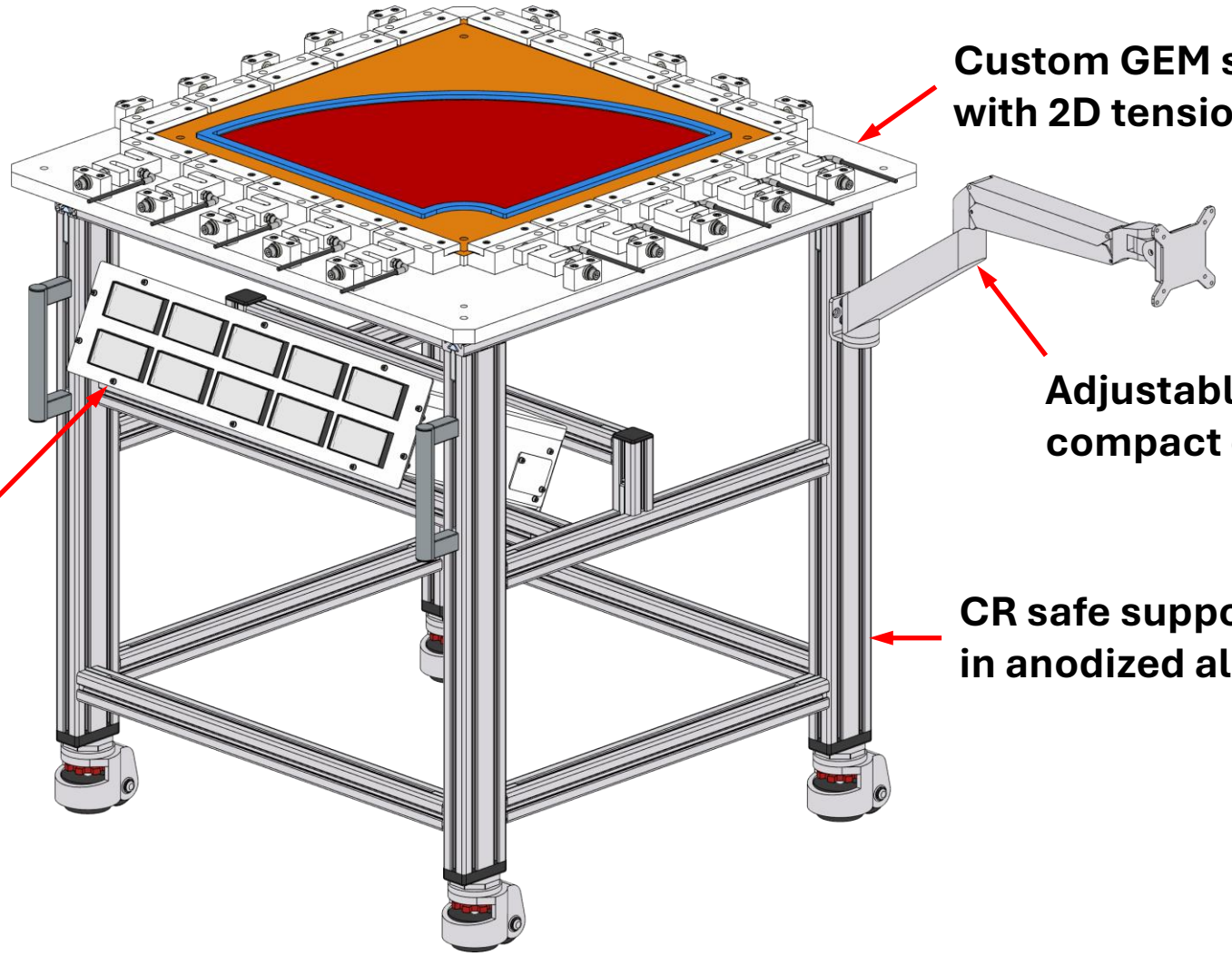
- Study **lightweight** mechanical solutions
  - Sandwich-structured composites
- Study **gas tightness** solutions
  - Full epoxy sealing or hybrid solutions
- Study **gas distribution** solutions*
- Study **Vibration resistance** and resonance studies*
- Practice **production techniques**
- Finalize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

* unplanned but possible

Production Tooling

GEM Stretching and Gluing Station Pt. 1

Dimensions:
850x850x920



Custom GEM stretching + gluing table with 2D tension measurement

Adjustable monitor arm for compact operator interface

Custom module for load cell R/O

CR safe support structure in anodized aluminum

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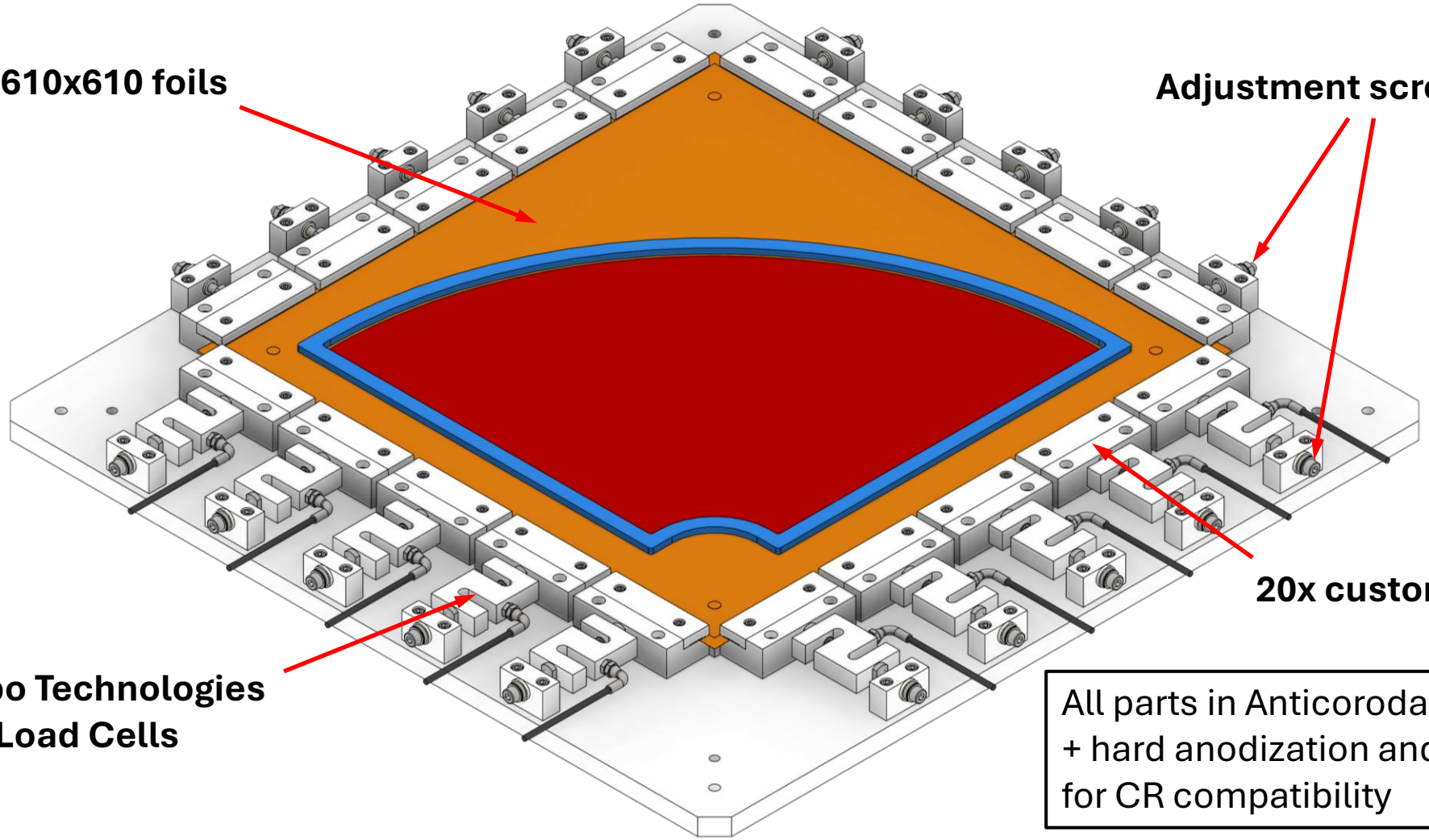
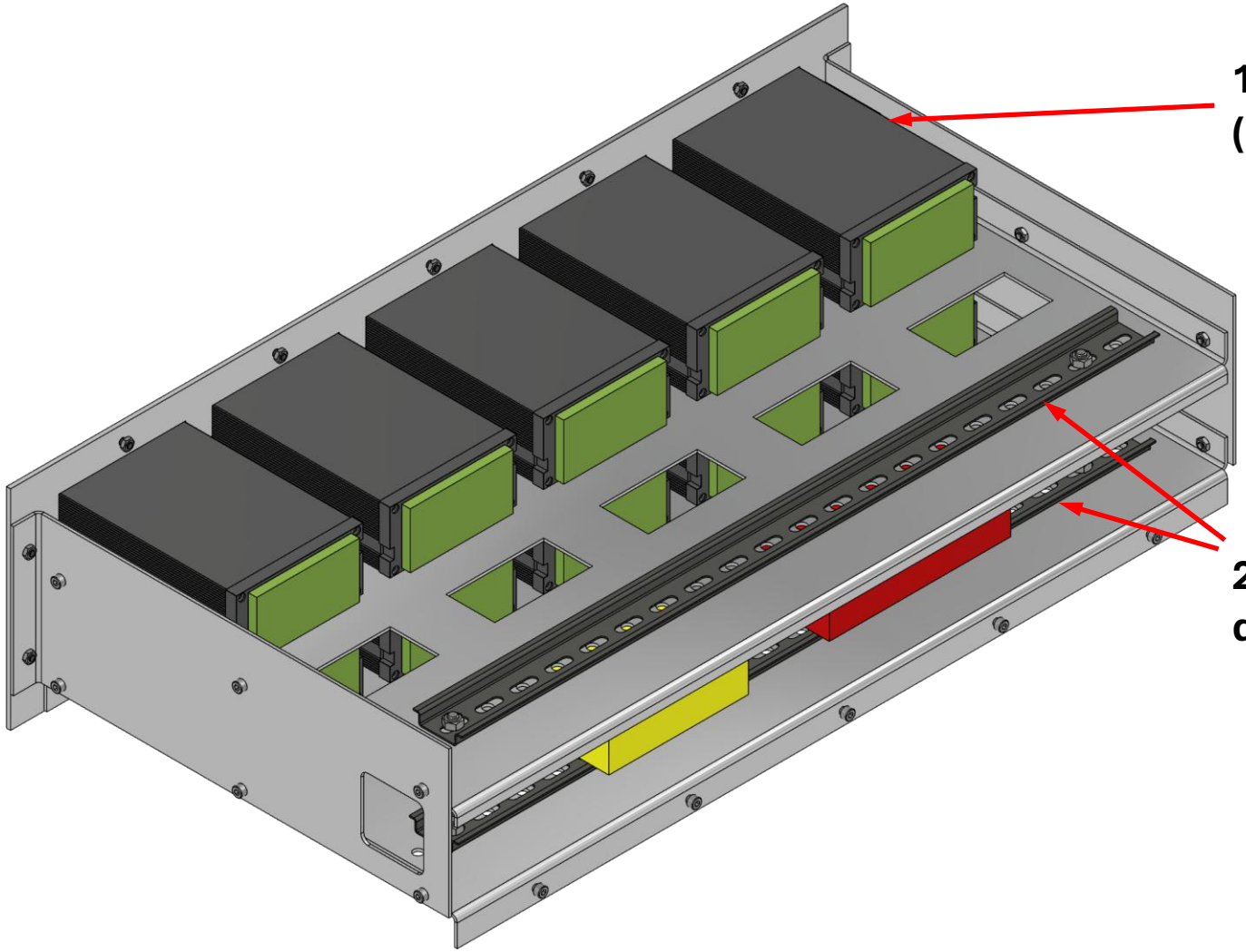
GEM Stretching and Gluing Station Pt. 2



All parts in Anticorodal 6082
+ hard anodization and sealing
for CR compatibility

GEM Stretching and Gluing Station Pt. 3



10x Picotronik PS30 digital indicators (load cell R/O and serial communication)

2x DIN rails for Power and GND distribution + room for feature expansion

All box parts in Peraluman 5083 + hard anodization and sealing for CR compatibility

Conclusion and Outlook

- The **design of the MPGD Endcap Tracker** is **continuing**. Fruitful exchange of information established with project and triple-I groups
- The **design of the first engineering test article** is **being finalized**. 2 prototypes to be produced at CERN by the end of September
- **R&D on detector technology and mechanical solutions** has been **separated** and will be tackled in parallel
- **Design of the GEM stretching station** is **complete**. Parts are about to enter production (both internal and outsourced)
- Dummy foils and frames will be used to test the tooling and study GEM stretching/gluing procedures in the near future

Thanks for your attention and...

Questions?

Backup slides