



DE LA RECHERCHE À L'INDUSTRIE

cea

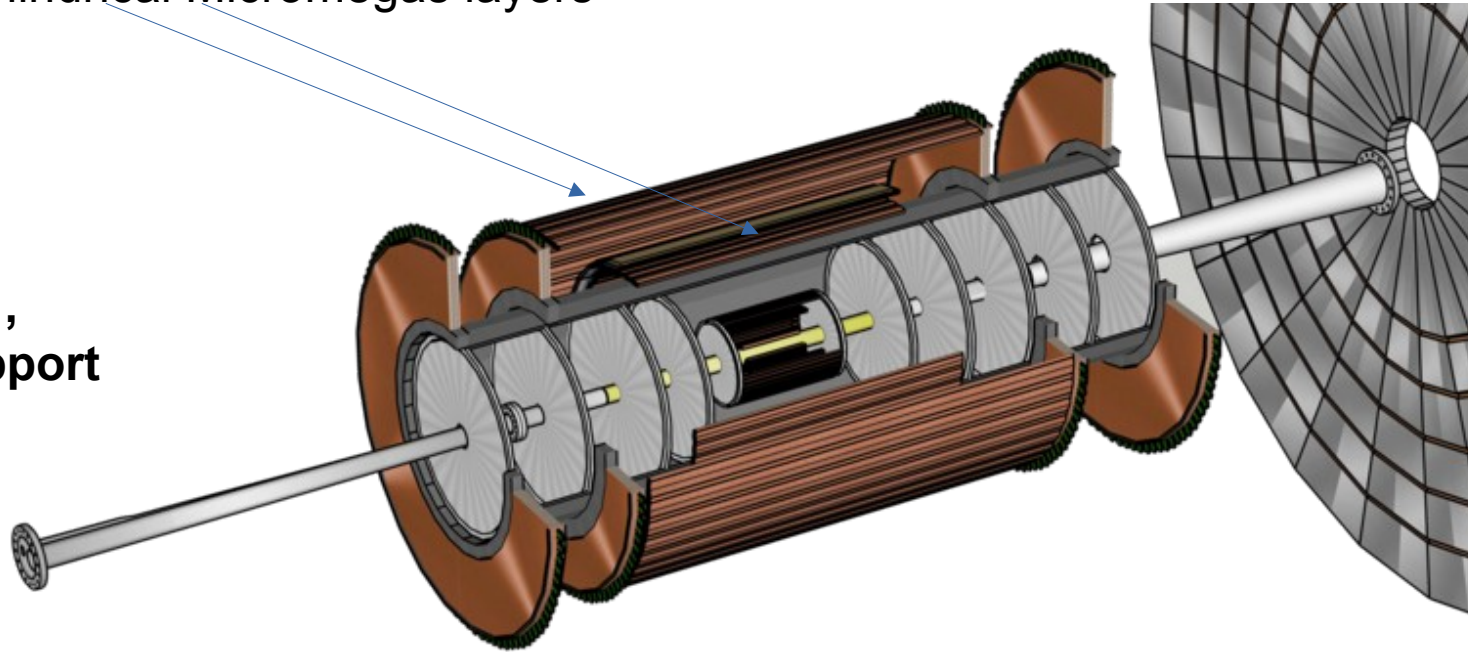


Barrel Micromegas preliminary CAD design

A. Arhancet, S. Aune, F. Bossù, I. Mandjavidze, D. Neyret
March 8th, 2022

- The tracking system in the barrel of the ATHENA's proposal consists of:
 - ~ 3 Silicon vertex layers (close to the beam pipe)
 - ~ 2 Silicon tracking layers
 - ~ 2 pairs of cylindrical Micromegas layers

**Regions $\eta = \pm 1.1$,
dedicated to support
and services**



ATHENA's tracking system as in the DD4Hep model

CYlindrical Micromegas BARREL

Cymbal 3D cad V1.0, for the ATHENA's proposal

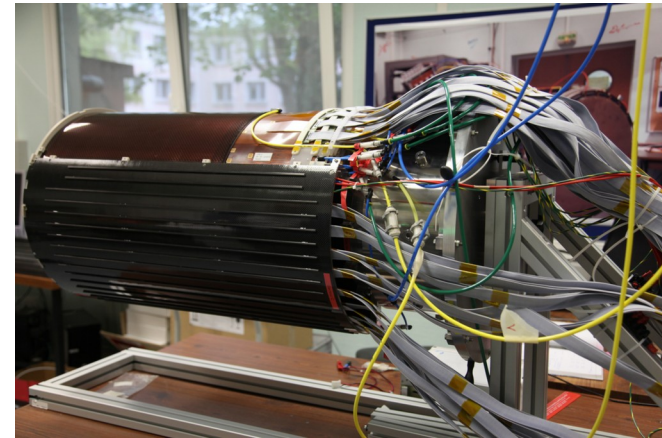
- Detectors from CLAS12 MVT know-how with improvement
- Detectors covering
 - Tile
 - Sector
 - Barrel
 - Full tracker
 - Detector and electronics structures concept
- Full view in Athena

Technology:

- Based on CLAS12 cylindrical MM
- Focused R&D: 2D readout

Design considerations:

- Simplification of the production line
 - ~ Few (possibly one) basic module, bent at different radii
 - ~ Basic module: $\sim 50 \times 70 \text{ cm}^2$ (current maximum size at Saclay)
- No acceptance gaps
- Compactness, lightweight support structure, interplay with FEE



Front-end boards:

- Placed in the cone close to detector sides
- 2 boards per detector, 384 channels each

Service for each front-end board

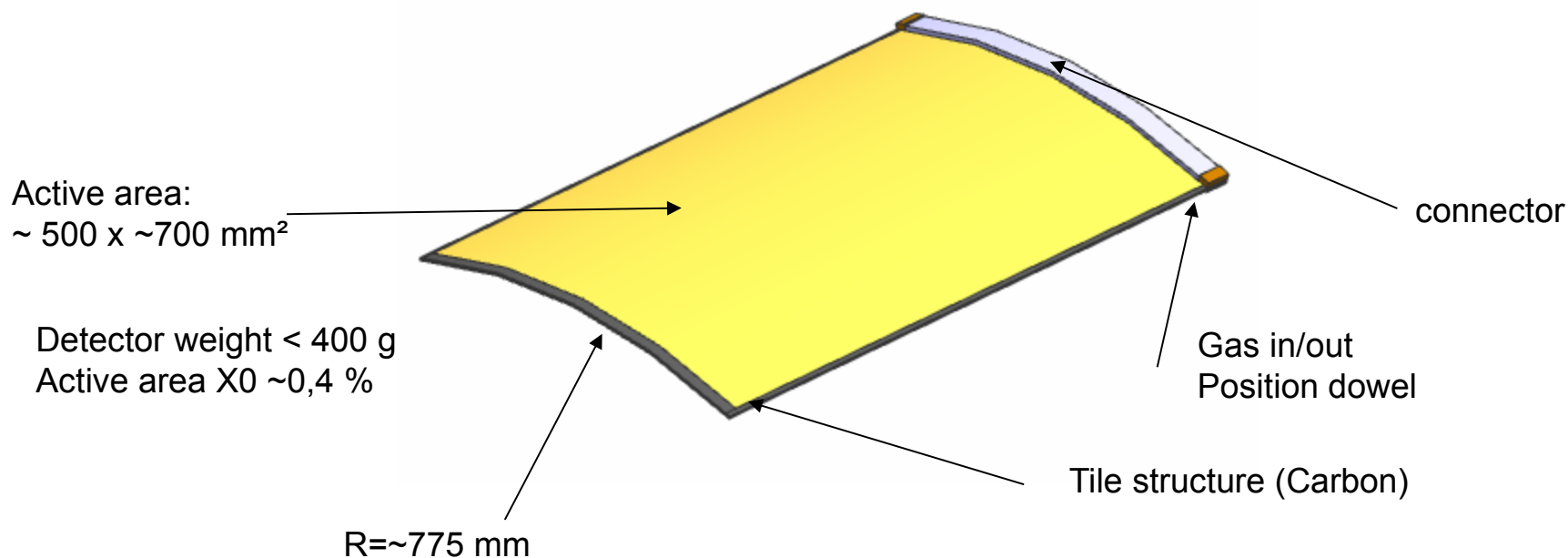
- Ground cable
- LV: + and -5V, 2A (considering about 15mW/ch, very first estimate)
- 1 fiber pair
- Liquid cooling pipe pair

Optional concentration cards

- Placed close to front-end boards, connected to 4 or 8 of them by flat cables
- Concentrate data of FE boards to one fiber pair
- Requires ground + LV cables, possibly cooling

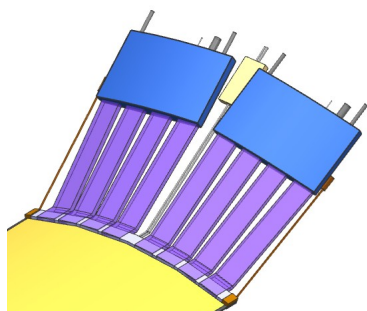
Clas12 tech. with improvement

- 2D strip resistive bulk micromegas (R&D ongoing, test in June 22)
- Material budget reduction (R&D ongoing, test end)
- Full tracker pavement on each layer (no acceptance gaps)
- Reduction of type of detectors



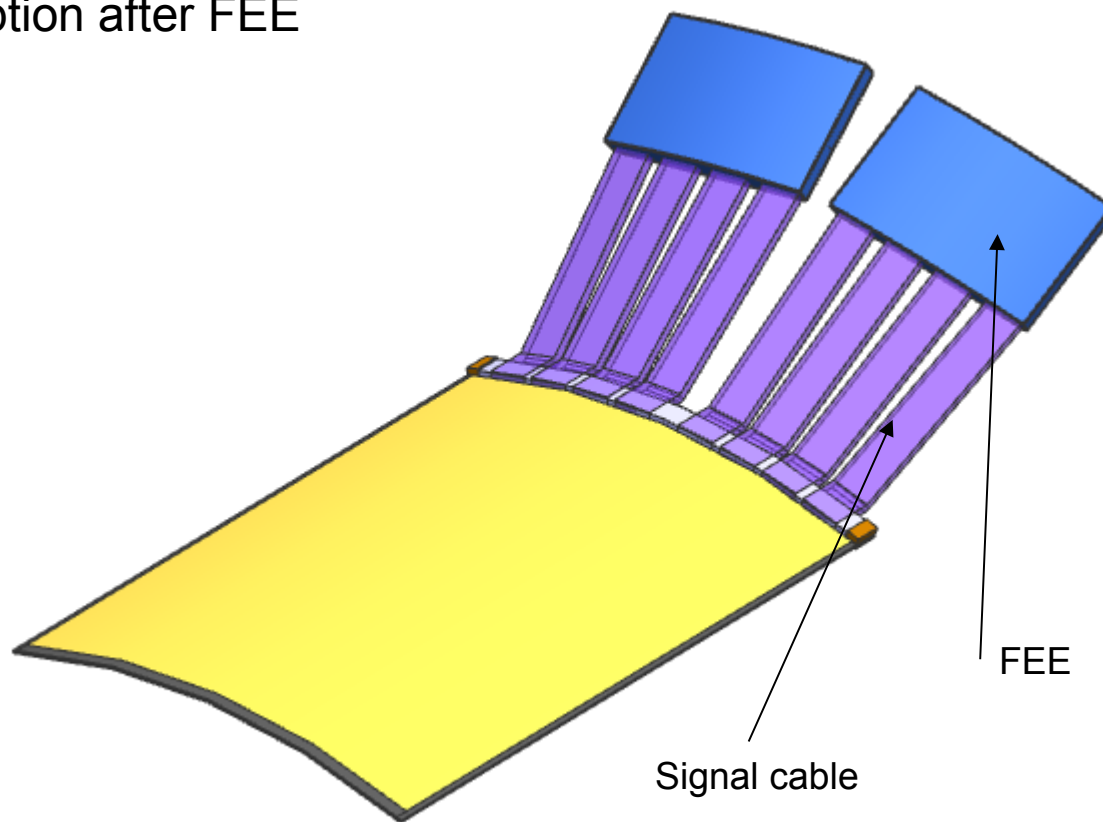
Readout electronics

- Located close to detector with signal cables (~ 2 m max)
- ~1024 channel / detector: ~ 2 Front End Elec board
- ASIC tbd (R&D ongoing for Salsa chip)
- Concentrator card option after FEE



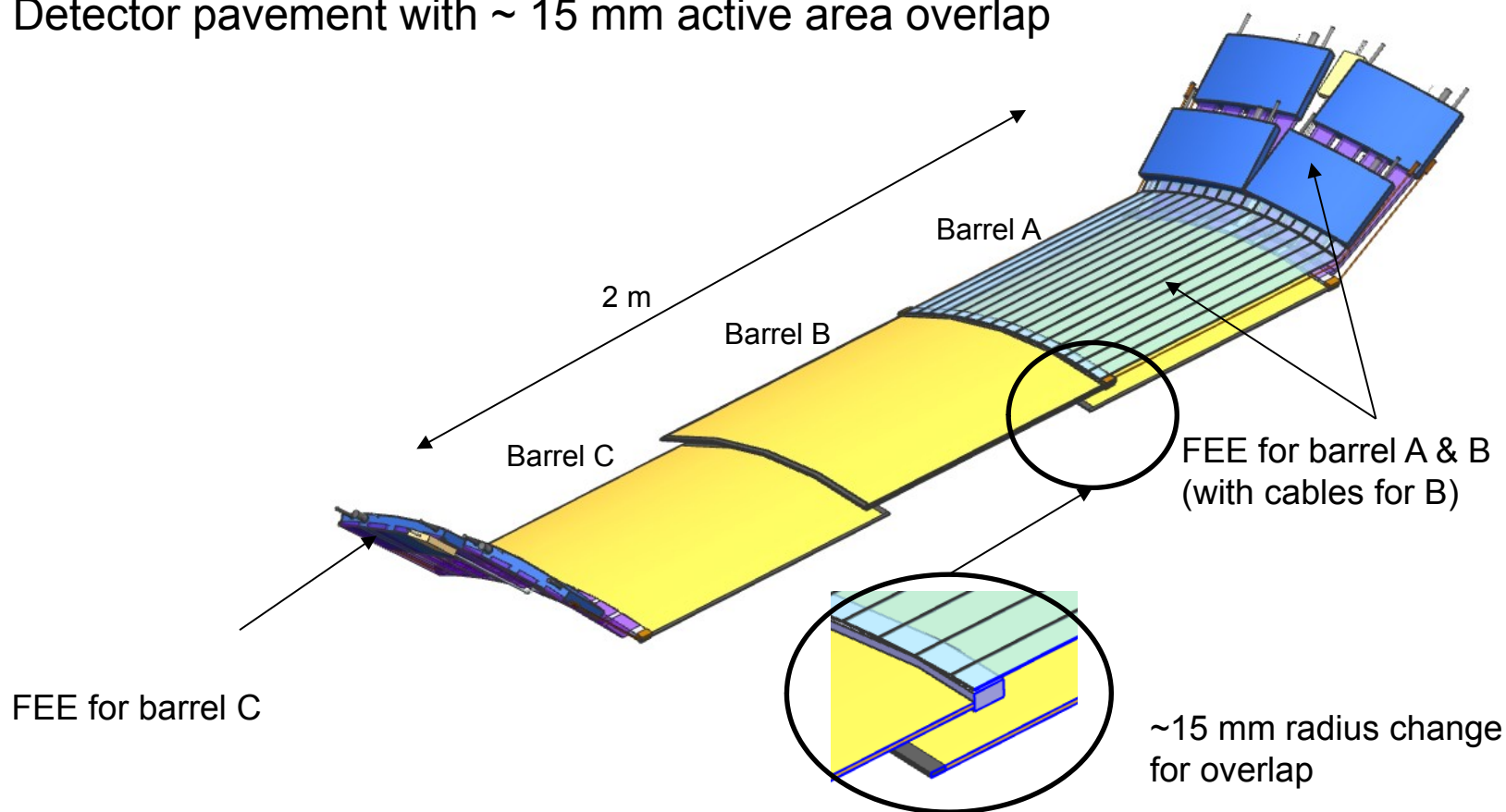
Tile model with cable volume:

- HV box and HV cables
- LV
- Cooling
- FO
- Gas in/out



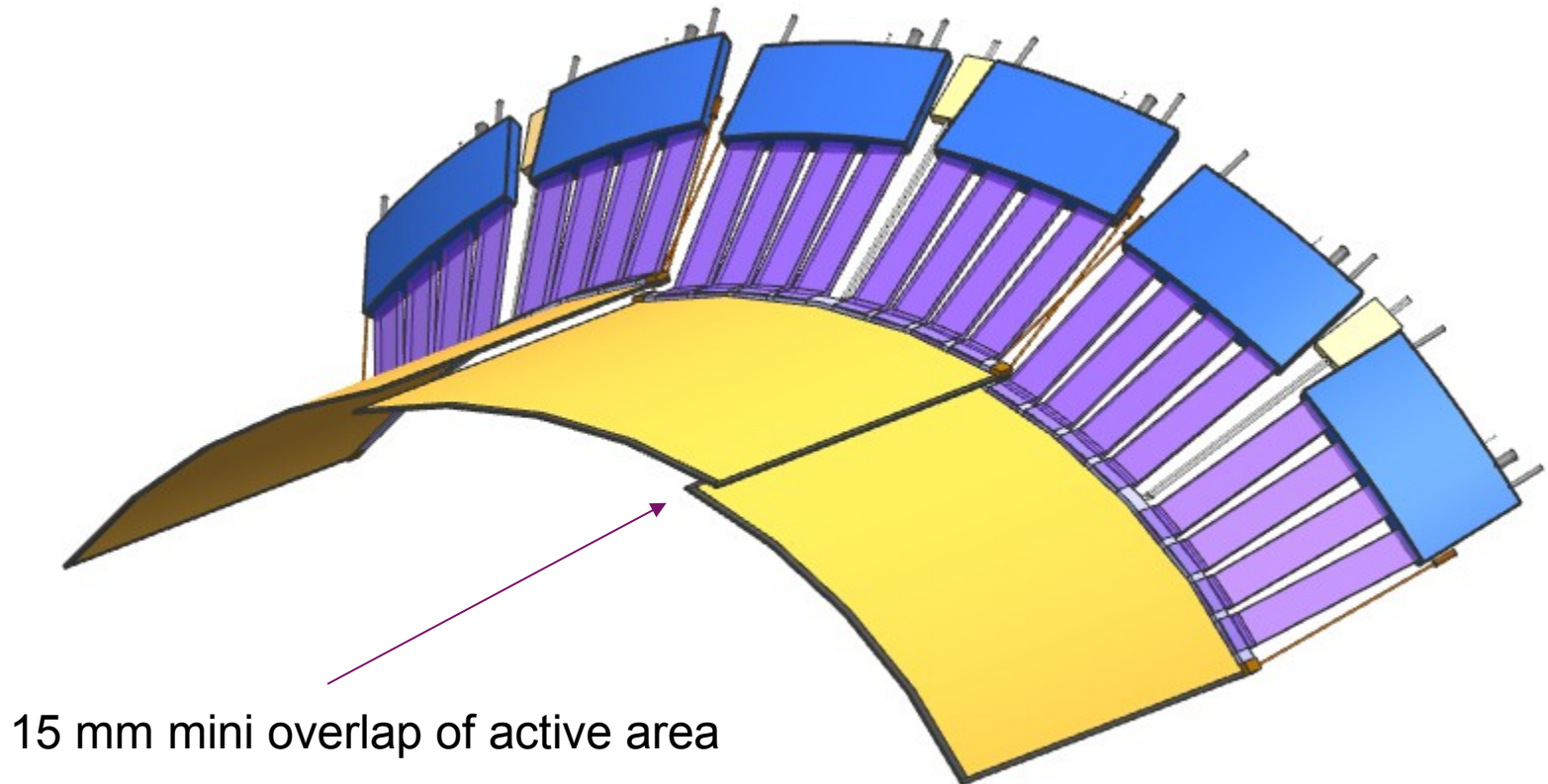
3 barrel detectors (A, B, C) per sector on outer barrel to cover ~2 m

- For barrel B, FEE on hadron going side with thin signal cables
 - Exact choice for cable/connector to be made late 23
- Detector pavement with ~ 15 mm active area overlap



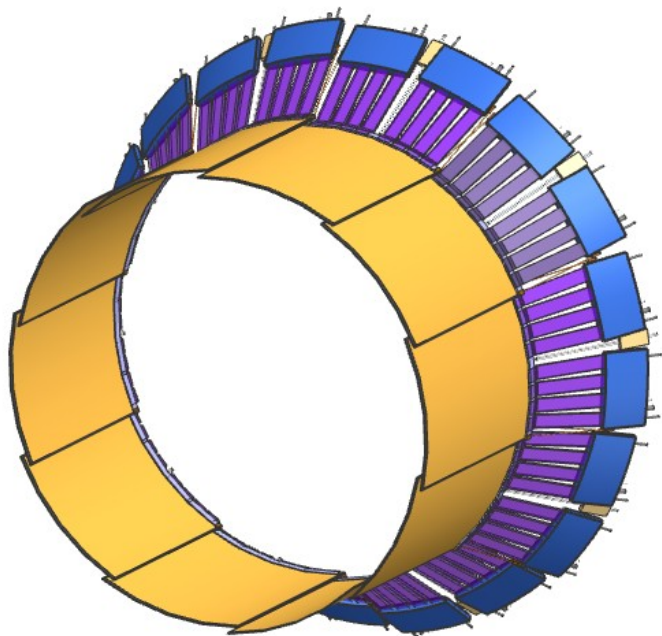
For each layer full cover with mini 15 mm overlap implies diff radius.

- Allow to have same flat detector at different radius by adjusting the overlap
 - **Number of detector type reduced**

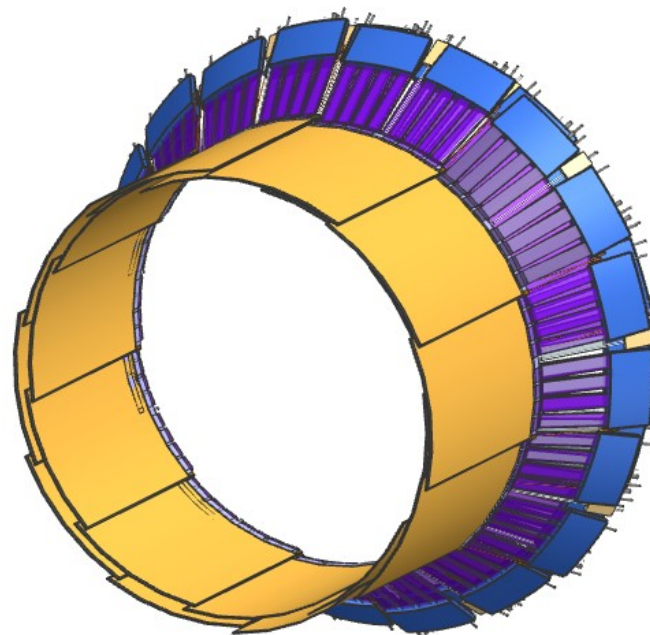


Outer barrel is two layers

- 2 layers of identical detector curved with two tool at adjacent radius (~20mm)
- Use the overlap variable (i.e. less overlap on R3)



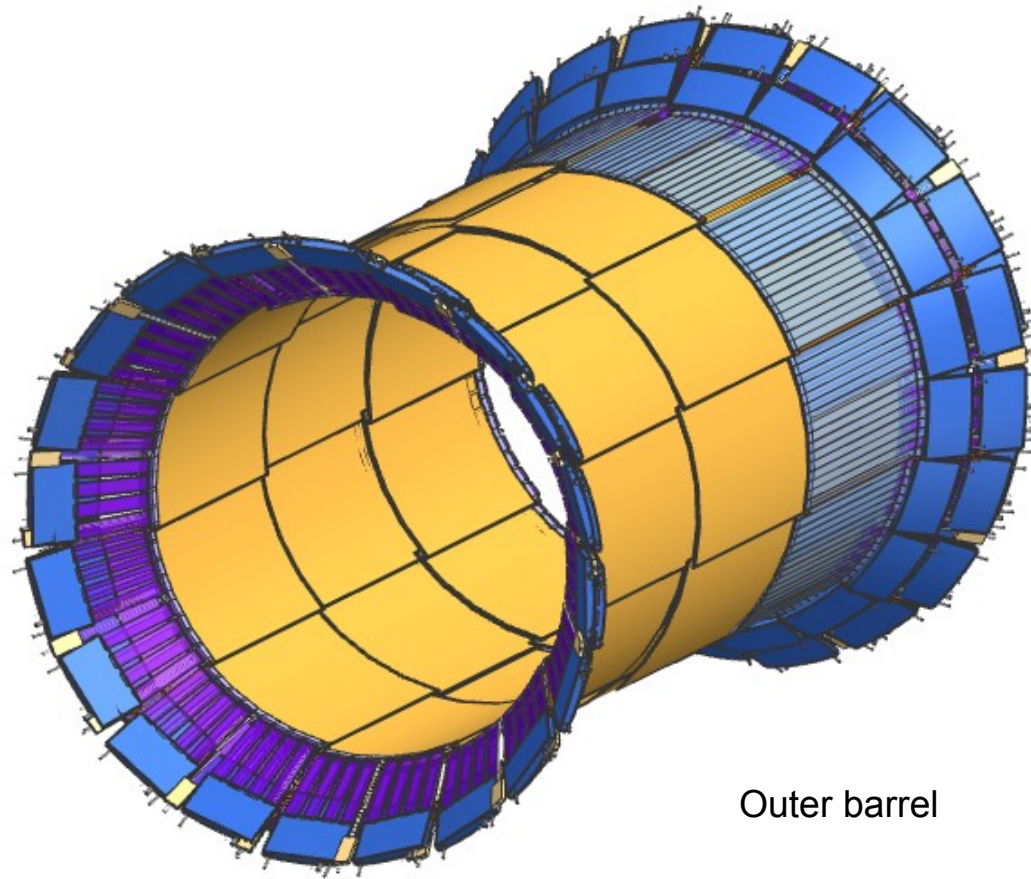
Barrel A with layer R4 (r4 775 mm)



Barrel A with layer R4 and R3 (r3 756mm)

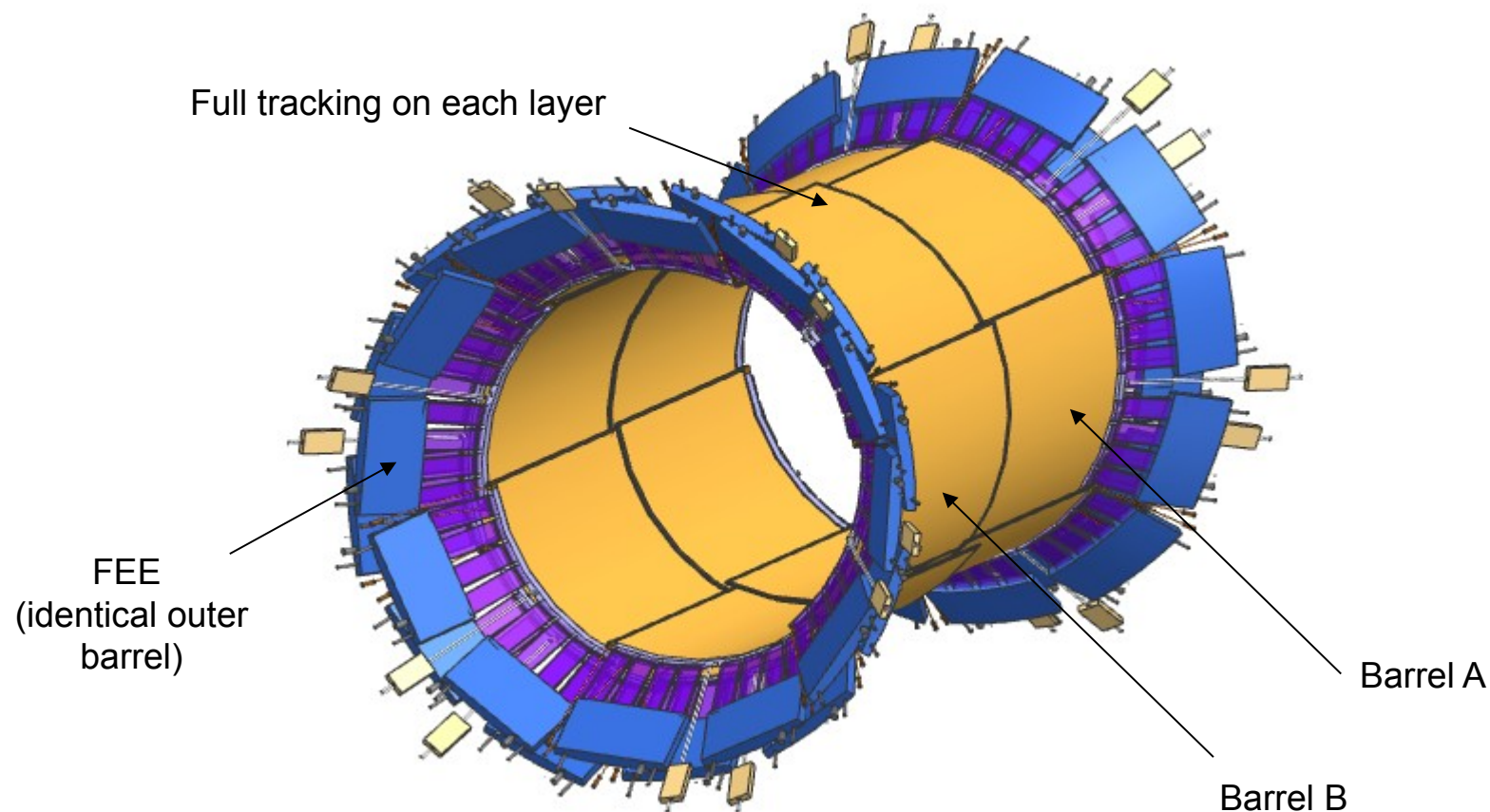
Outer barrel is composed of 10 sectors x 3 barrels x 2 layers:

- 60 detectors ($\sim 21 \text{ m}^2$ active area)
- 120 FEE boards ($\sim 61 \text{ k}$ channels)
- Lots of cables...



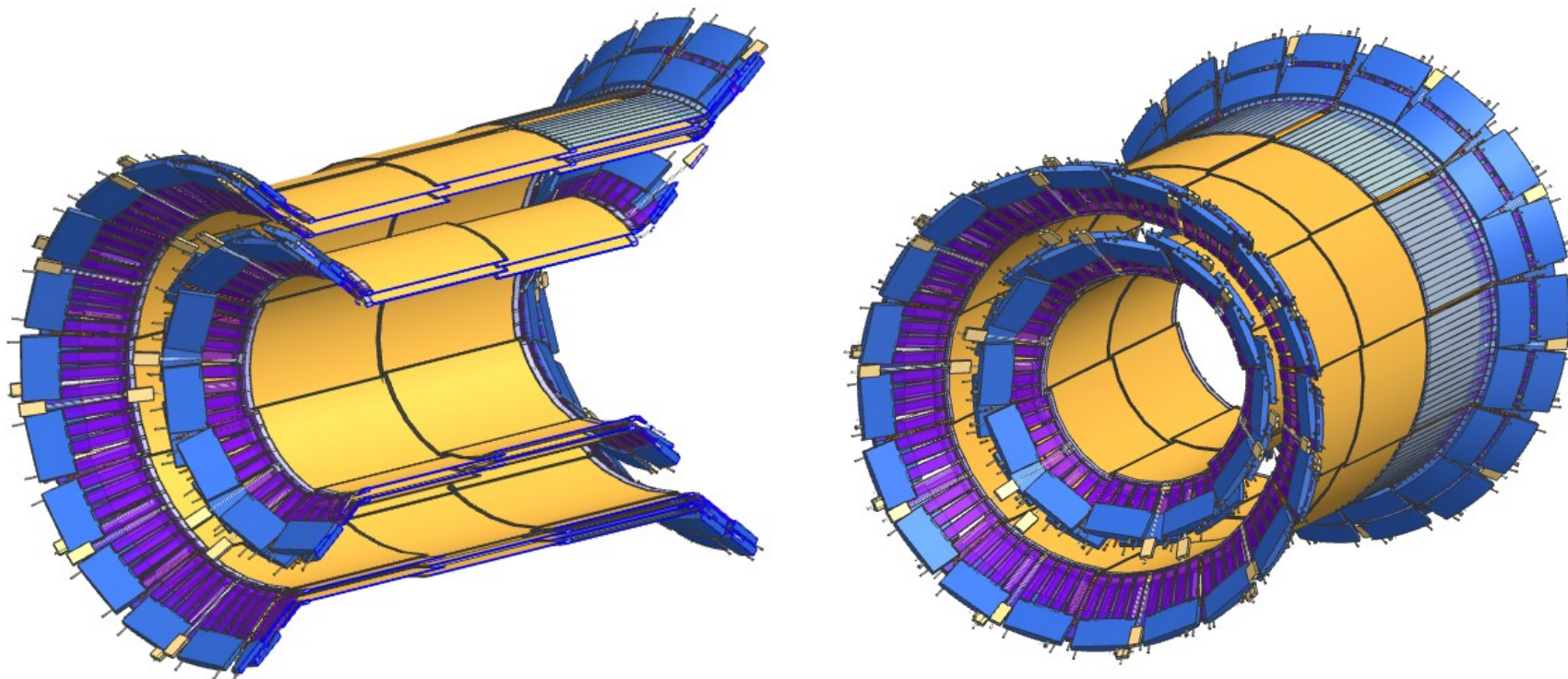
Outer barrel

Same concept with identical surface detector curved at $R2 \sim 470$ and $R1 \sim 490$ mm
6 sectors x 2 barrels x 2 layers = 24 detectors and 48 FEE



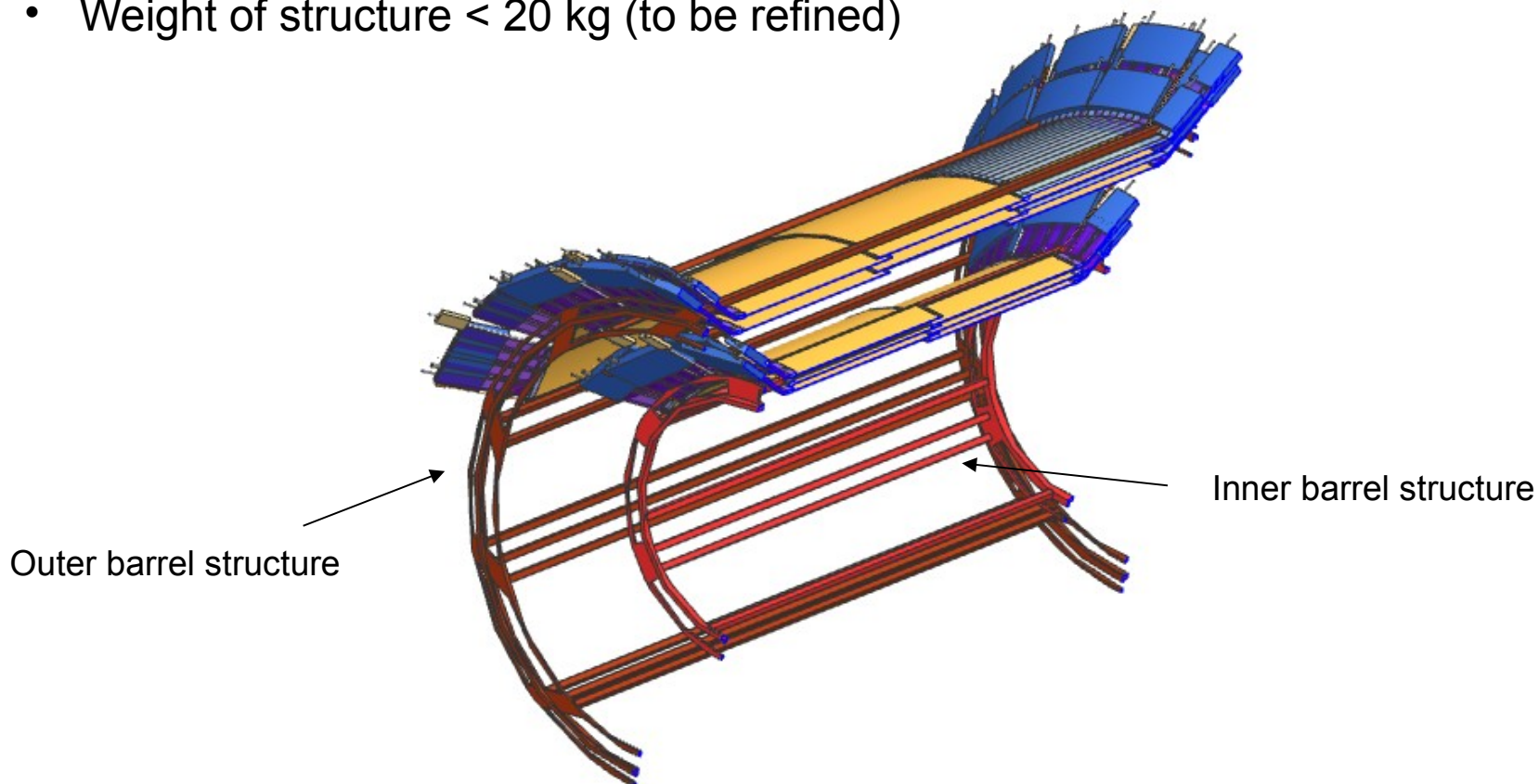
Cymbal:

- 4 full 2D layers tracker
- ~ 84 detectors (~30 m² active area)
- ~ 168 FFE (~90 K channels)



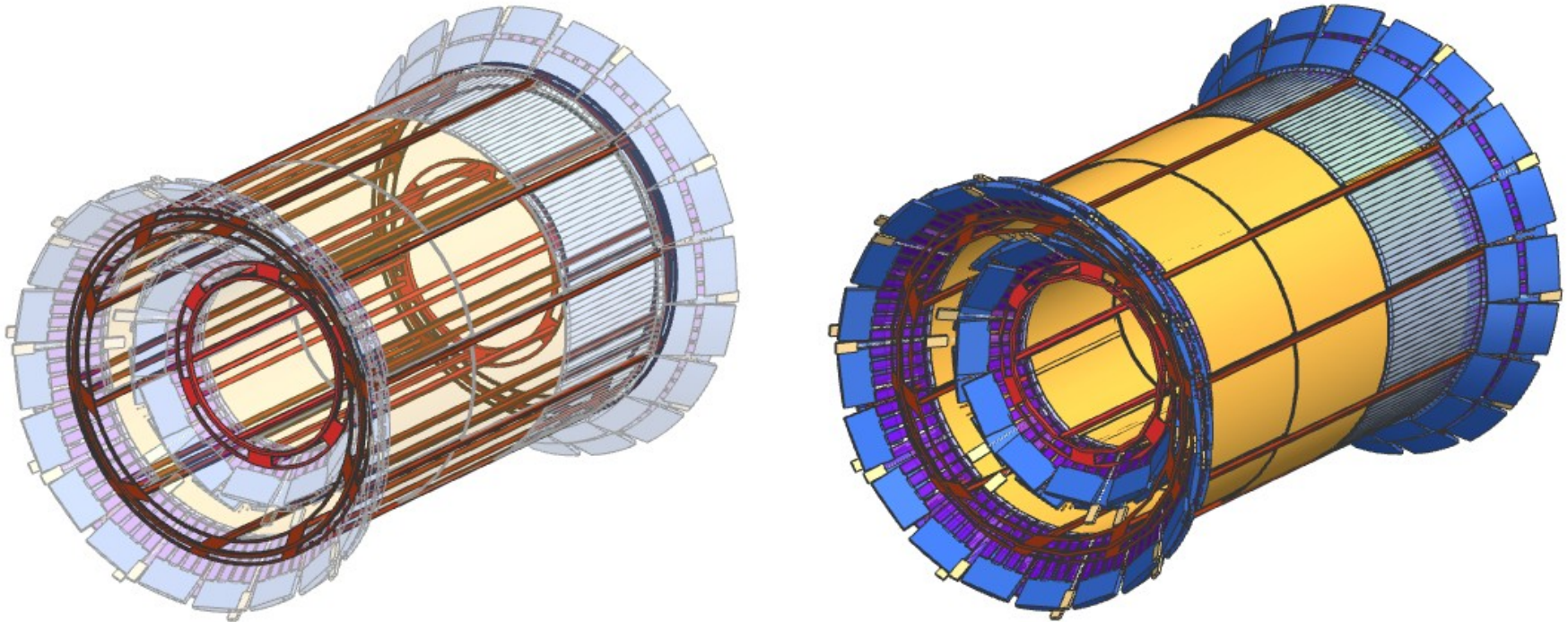
Two barrels concept structure with low mass budget.

- Use of carbon IPN beam with carbon wheels.
- Insertion mode tbd
- CAD 3D only for concept, FEM to be made
- Weight of structure < 20 kg (to be refined)



Two barrel structure with low mass budget.

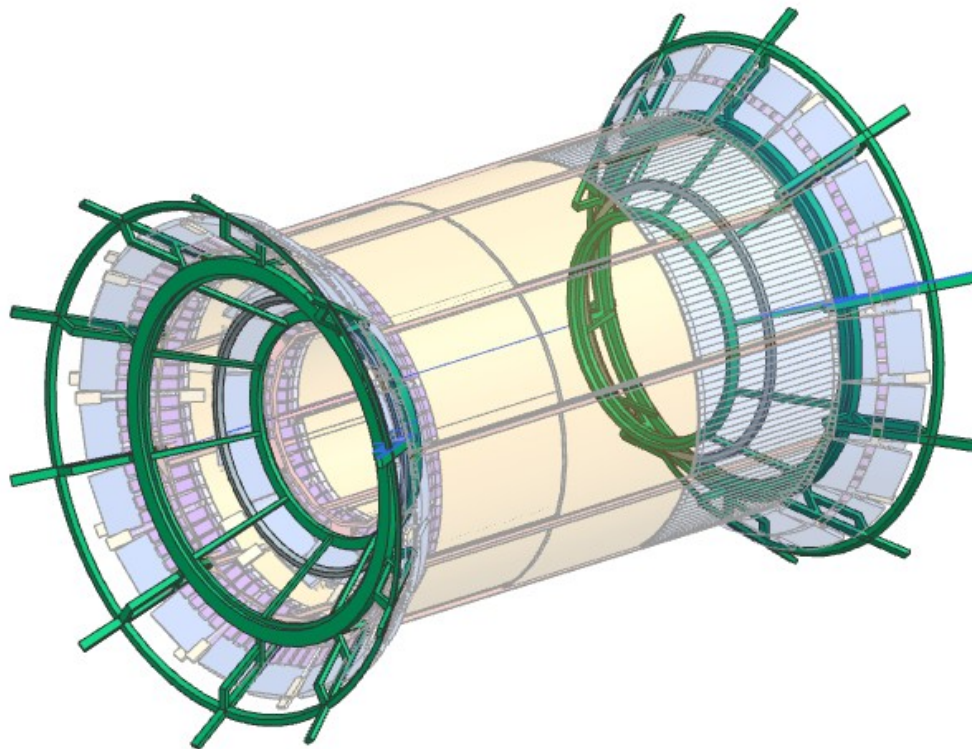
- Carbone structure made of IPN carbon beam with carbons wheel
- Weight of one tile < 0,5 kg, 50 kg max load
 - detail concept V1 and FEM structure in 2023
- Insertion mode will impact structure (e⁻ or ion side, both ?)



Carbon structure concept V1.0

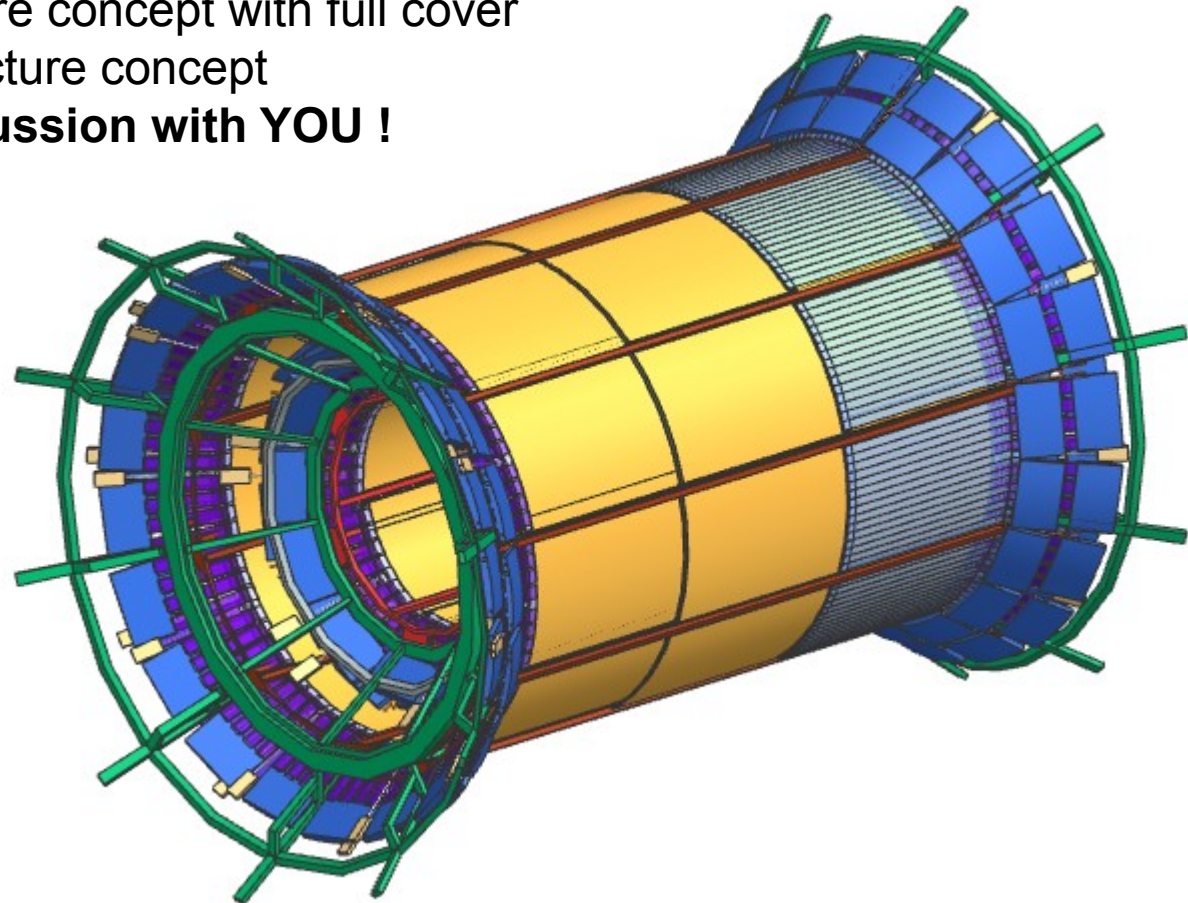
Aluminum (?) structure to hold barrel and electronics

- No detail concept
- Strong interface with BNL and neighbors
 - Attachment to rest of the world ?
 - Weight < 180 kg (to be refined)

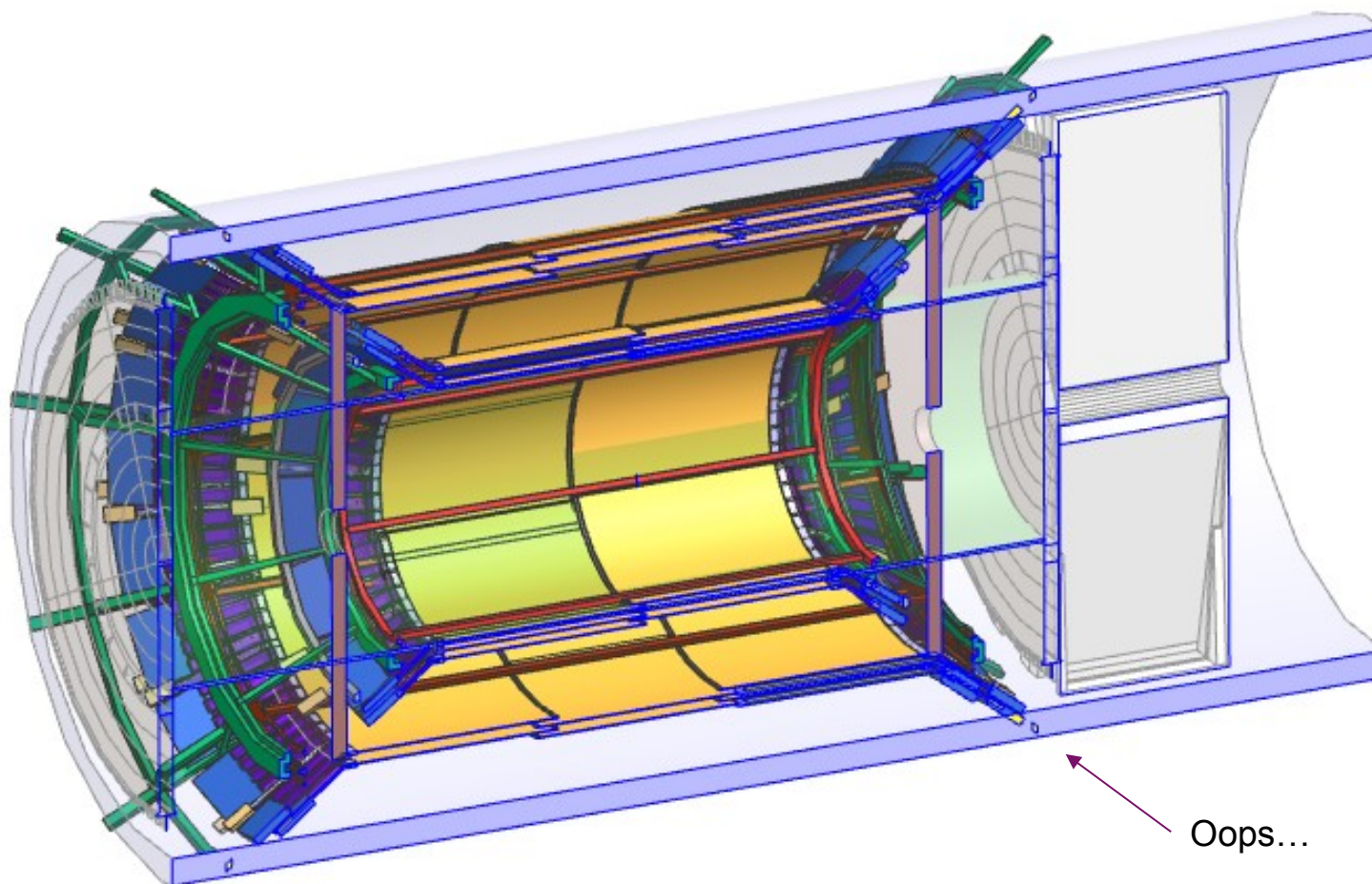


First 3D model with

- Detectors 2D “à la CLAS12”
 - 84 identical detectors for easy production
- Detector structure concept with full cover
- Electronics structure concept
- **Ready for discussion with YOU !**



In Athena environment !



- Micromegas is a mature technology that fits the EIC detector requirements
- A focused R&D on 2D readout optimization is ongoing

- Cymbal 3D CAD model V0.1 for the ATHENA's proposal
- First meeting with BNL/Jlab on Feb 3rd
- Future iterations:
 - Exchange of 3D
 - integration, attachment, keep in zone, cables,...
 - Conscious that many iterations and modifications are needed to get to a “final” design
- Coordination with other projects is needed: Elec Asic, DAQ, services (cooling/gas/HV), ...

Commissariat à l'énergie atomique et aux énergies alternatives
Centre de Saclay | 91191 Gif-sur-Yvette Cedex

Etablissement public à caractère industriel et commercial | R.C.S Paris B 775 685 019



Direction de la Recherche Fondamentale
Institut de recherche
sur les lois fondamentales de l'Univers
Service