CyMBaL – News

MPGD-DSC CyMBaL meeting, Feb 28th 2024

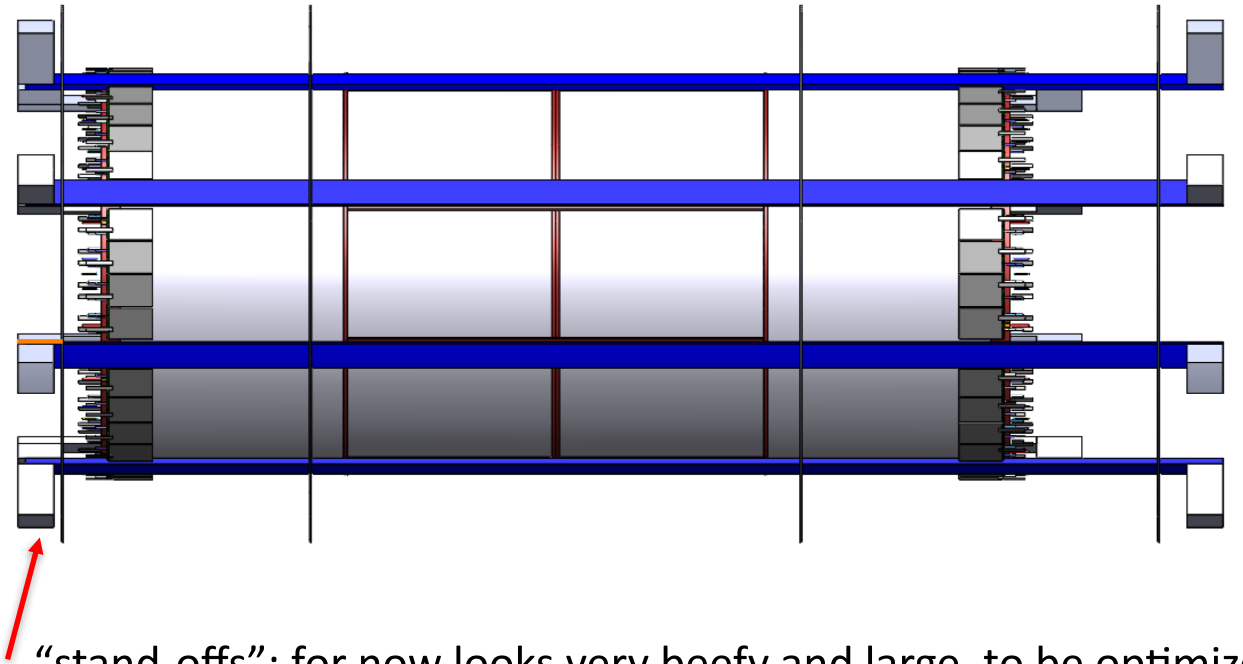
Cylindircal Micromegas Barrel Layer (CyMBaL)

- Inner detector structure workshop: https://indico.bnl.gov/event/22387/ (Feb 20th)
  - Support structure taken care by Purdue U.
  - Our modules should be able to self sustain
  - Question: what is the total weight of the system?
- Report eRD108 due by tomorrow (Feb 29th). A draft is being completed (see later)
- Detector R&D day: March 25th check progress and outlook for FY25
- Preliminary Design Review (PDR): March 20th - 21st

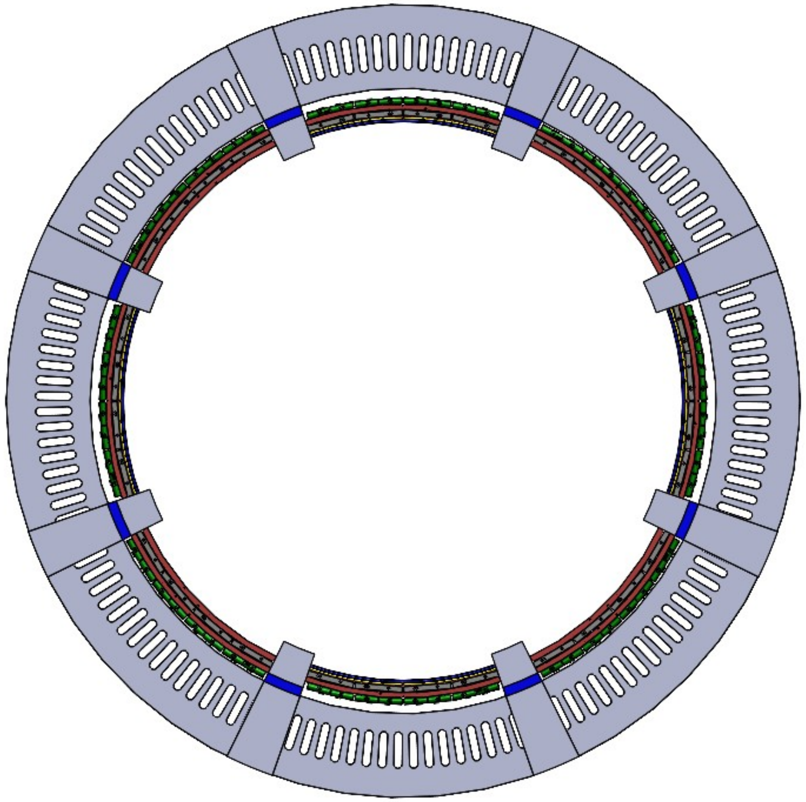
“Global” support structure inner detectors

1. Set of engagement rings mounted on inner rigid supports at off - 12, 3, 6, 9 o’clock positions for MPGD assembly
   - “stand-offs” (L-brackets) attach the structure in the last step to the GIST via inserts & screws

2. Mount inner MPGD on these “support beams/rails”
   – Needs temporary support to feed out mechanics



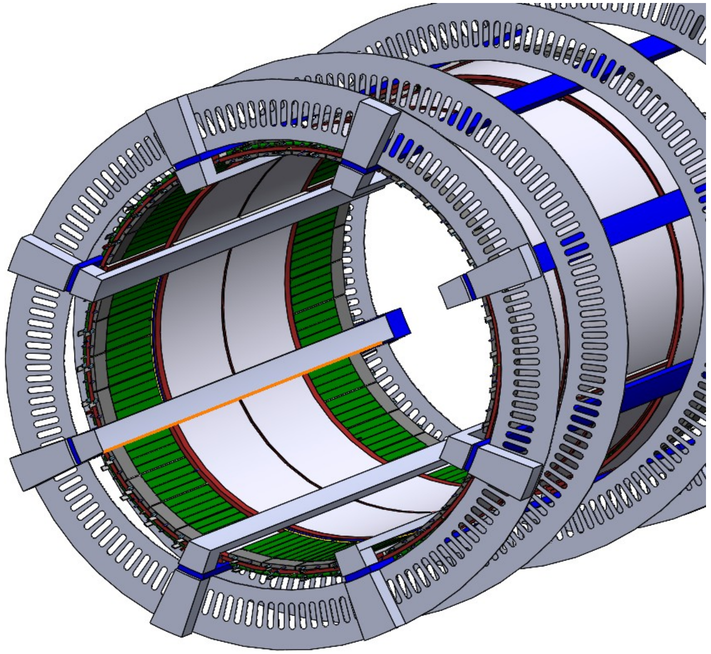
“stand-offs”: for now looks very beefy and large, to be optimized

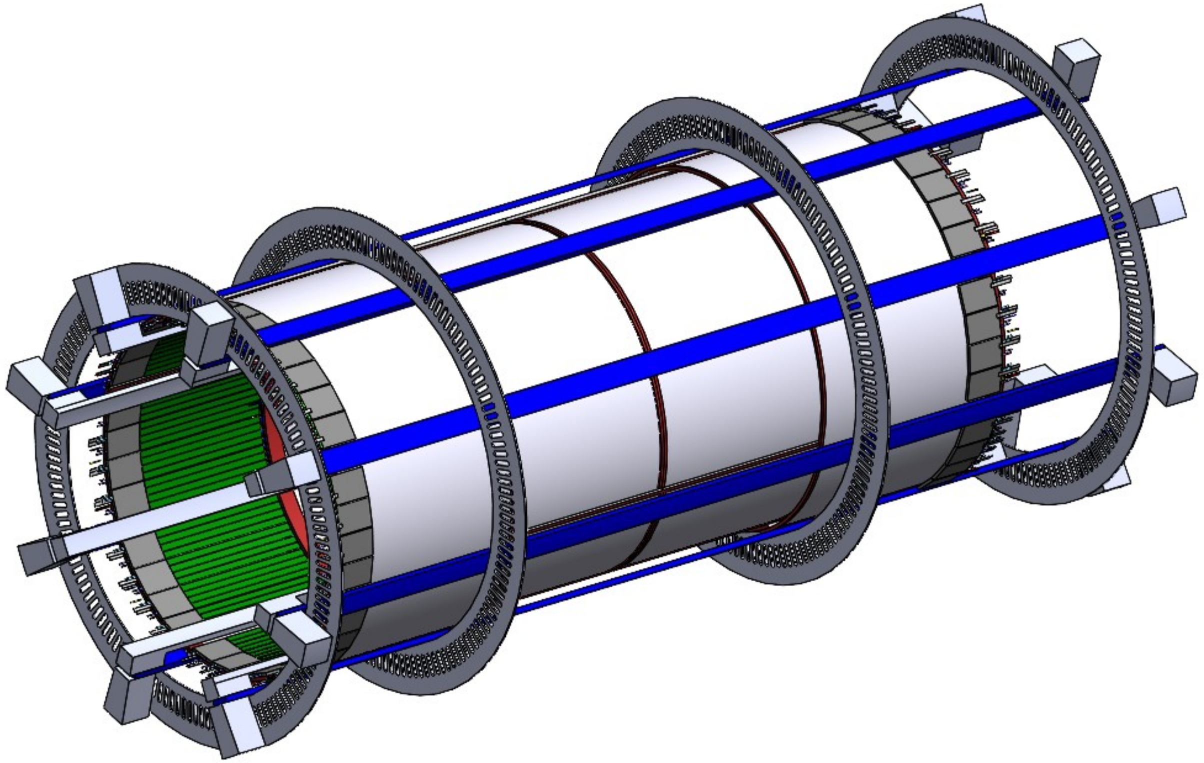


“Global” support structure inner detectors

3. Install inner tracks/beams per half/side to support SVT once MPGD integration is completed
   - Total of 8 beams/rails support SVT
   - Again L-brackets / standoff’s

4. Next step is to slide this “integrated” structure over the inner SVT
5. SVT includes the beam pipe which needs temporary support





eRD108 report

The eRD108 report

Introduction

The goal of the R&D on Micro-Pattern Gaseous Detectors (MPGDs) is to develop the available technologies, such as Micromegas and µRWELL, to meet the requirements of the ePIC detector tracking system. In particular, MPGDs are expected to complement the silicon based inner tracking system on three main aspects:

1. Additional space points with good timing resolution and short integration time for pattern recognitior
2. To improve the measurement of the track incident angles on the DIRC

In ePIC, three MPGD sub-system are being developed. Large rectangular µRWELL modules in front of the DIRC, µRWELL disks in the forward and backward directions, an inner cylindrical Micromegas layer that wraps around the silicon tracker. This report will mainly focus on the ongoing R&D effort on the cylindrical Micromegas layer.

Cylindrical Micromegas Barrel Tracker - CyMBaL

In the current ePIC design of the tracking system, the inner MPGD layer, i.e. CyMBaL, sits at a radius of 50 cm and covers, in the longitudinal direction, from z=-105cm to z=135cm. CyMBaL current design consists of 32 identical 2D Micromegas modules, bent at two different radii of 50cm and 52.5cm, that overlaps in the azimuthal and in the longitudinal directions to provide full acceptance coverage. The current estimated size foi a module is 65x46cm2, with an active area of about 59x44cm2. The technology chosen for the CyMBaL modules is the evolution to 2D readout of the cylindrical Micromegas developed for the CLAS12 Barrel Micromegas Tracker (BMT).

What was planned

The plan for the FY24 cycle is twofold.

The finalisation of the FY23 program:

- Finalisation of the analysis of the 2023 beam test and set up the cosmics test bench with the addition of the silicon telescope with the goal of characterizing different 2D readout patterns.
- Design, production and tests of a large-scale prototype with the chosen 2D readout. In order to save engineering time, it was decided to start from the mechanics of a CLAS12 BMT tile. The active area of a BMT module is about 44x44cm2, comparable with the expected size of CyMBaL modules. The bending radius will be about half of the CyMBaL modules.
- Design and production of a scale 1 mechanical mock up, to test the mechanical properties of a larger detector compared to the BMT modules.

The FY24 proposal included two activities aiming at addressing some needed ameliorations:

- In order to compensate the loss in spatial resolution at large angles, one might reduce the conversion gap from 3 mm to 1 mm. Working with a thin gap, though, reduces the number of primary electrons and therefore the efficiency. One can compensate the loss of primaries by modifying the gas mixtures. A prototype with 1 mm gap will be built to test different gas mixtures.
- Although the Micromegas modules will be quite light (about 0.5% X0), at large angles, particles will cross more material. One of the major contributions to the material budget is the 100 µm of FR4. The use of carbon fibre instead of FR4 will be investigated.

What was achieved

Analysis of the MAMI beam test

In June 2023, several small prototypes (FY22 and FY23 proposals) with different 2D readout patterns have been taken to a beam test in MAMI, with an electron beam of 880 MeV. A reference tracker using ALPIDE Silicon pixel ladders from the ALICE MFT has been build and successfully used. Although the multiple scattering dominates the measurements, the analysis has shown (see Figure) that 1-mm pitch patterns, both with orthogonal strips and ASACUSA-like 2D pads, can provide spatial resolution close to target value of 150µm. More studies will be conducted with the cosmic ray test bench in Saclay.

INSERT SAMY PLOT

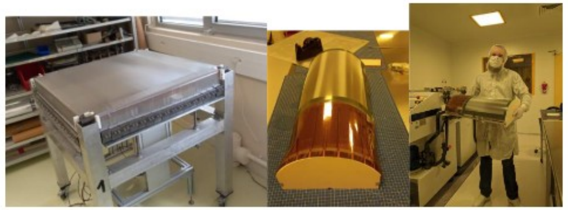
Cosmics test bench in Saclay

The cosmic ray test bench has been refurbished to accommodate a stack of the small prototypes and to be coupled with the silicon tracker for better precision. It consists of four-reference large Micromegas detectors with a coincidence trigger from two plastic scintillators. See Figure ...

ADD A FIGURE of the TEST BENCH, possibly with BANCO

Bulk and bend a CLAS12 PCB

In preparation for the building of the large-scale prototype with the selected 2D readout, the production of curved Micromegas is being re-established. In particular: the mesh tensioning system built for the CLAS12 production has been refurbished; the procedure for the bulk of a resistive Micromegas PCB has been revisited; a first test of the bending of the bulked Micromegas has been successfully achieved.



What is planned (with a rough timeline)

- Building of a scale 1 prototype by end of summer
- Build a 1mm gap prototype and tests with the cosmics test bench ...
-

A draft is being finalized.

Content:

- (preliminary) Outcome from the analysis of the beam test
- Set up of the test bench in Saclay for the continuation of the characterization of the prototypes
- Updates on the full size prototype
  - Refurbishing of the tensioning system
  - Restart the bulk and bending of Micromegas in the MPGD lab

Plans:

- Completing the size 1 prototype
- Building the 1mm gap prototype
- Beam test
- Carbon fiber for the structure

PDR

Charges

You are asked to address the following questions:

1. Are the technical performance requirements appropriately defined and complete for this stage of the project?
2. Are the plans for achieving detector performance and construction sufficiently developed and documented for the present phase of the project?
3. Are the current designs and plans for detector, electronics readout, and services sufficiently developed to achieve the performance requirements?
4. Are plans in place to mitigate risk of cost increases, schedule delays, and technical problems?
5. Are the fabrication and assembly plans for the various tracking detector systems consistent with the overall project and detector schedule?
6. Are the plans for detector integration in the EIC detector appropriately developed for the present phase of the project?
7. Have ES&H and QA considerations been adequately incorporated into the designs at their present stage?

Please address these questions point-by-point.

- We need to prepare the first draft for March 5th

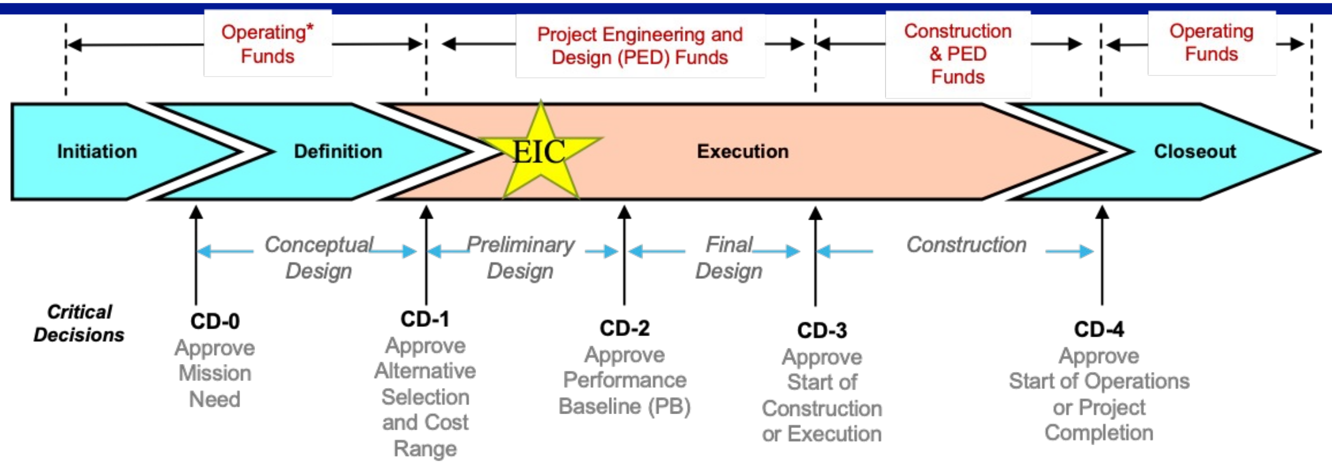
- Rehearsals March 11th - 12th

- PDR: March 20th

We need to coordinate also at the level of MPGD DSC to see how to answer these questions

Design Maturity

[From Elke's slides at the general meeting]



What does 60% design maturity roughly mean:

1) One matured from a conceptual design (CD-1) to a preliminary design (CD-2)
2) There can still be open E&D questions but no showstoppers
3) One needs to have detailed knowledge that one can define the cost and schedule
4) The review committee can judge that one will be able to address those open questions by the projected time of CD-3.

What does 90% design maturity roughly mean:

5) The design matured to final (CD-3), i.e., there are no open E&D questions
6) One can still do design detailing and producing drawings to accompany procurements
7) One can still do design validations as found needed during the vendor construction process; for vendor design-build contracts such as the detector solenoid one can still do design updates as needed.

Merci