BESIII plans for test beam

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on behalf of the working group

RD51 Collaboration Meeting
10/03/2016 - Geneva

INFN Istituto Nazionale di Fisica Nucleare

Università degli Studi di Ferrara

Layout

Cylindrical GEM Inner Tracker project

Status of our previous data

Plan for the next beam test

Experimental setup (Beam, gas, magnet)

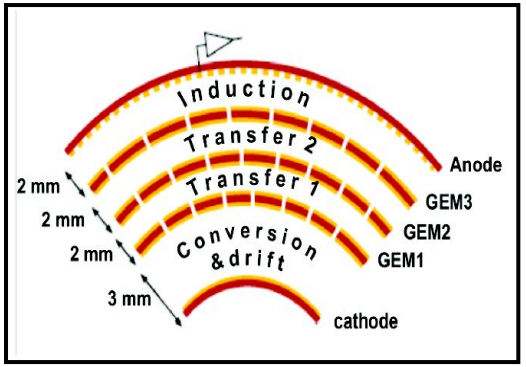
Cylindrical GEM Inner Tracker

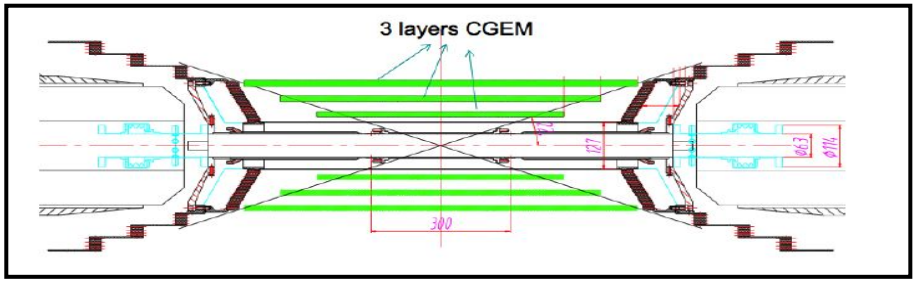
BESIII inner drift chamber is showing aging effect

Proposed an upgrade based on Cylindrical GEM detectors technology

Experimental requirements to be matched:

- inner radius: 78 mm (min)
- outer radius: 179 mm (max)
- 93% of 4π solid angle
- σ_{xy} ~ 130 μm (per layer)
- σ_z < 1 mm (per layer)
- X_0 < 1.5 %
- Trigger rate ~ 10^4 Hz/cm^2





Ministero degli Affari Esteri e della Cooperazione Internazionale

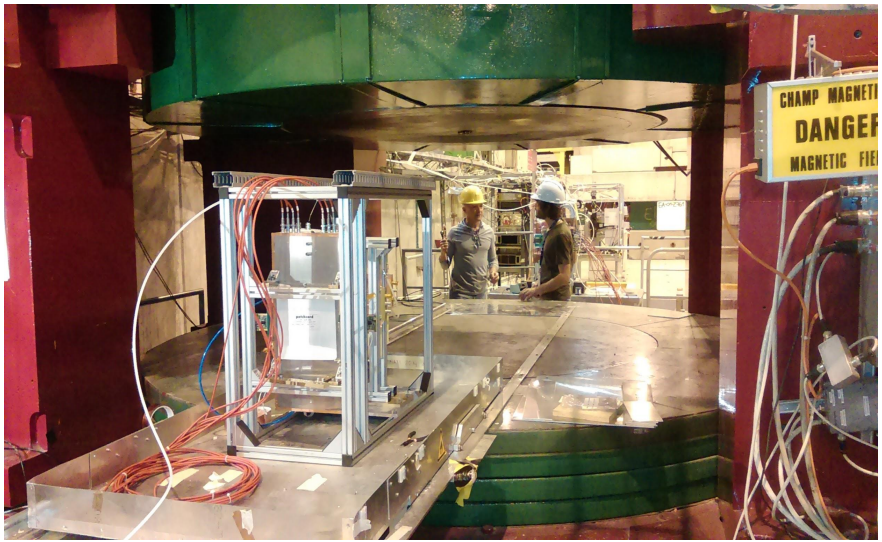
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

"Significant Research Project"
MAECI-MOST 2013-2015

BESIIICGEM funded by the European Commission within the call H2020-MSCA-RISE-2014

Previous test beam

December 2014



June 2015

Status

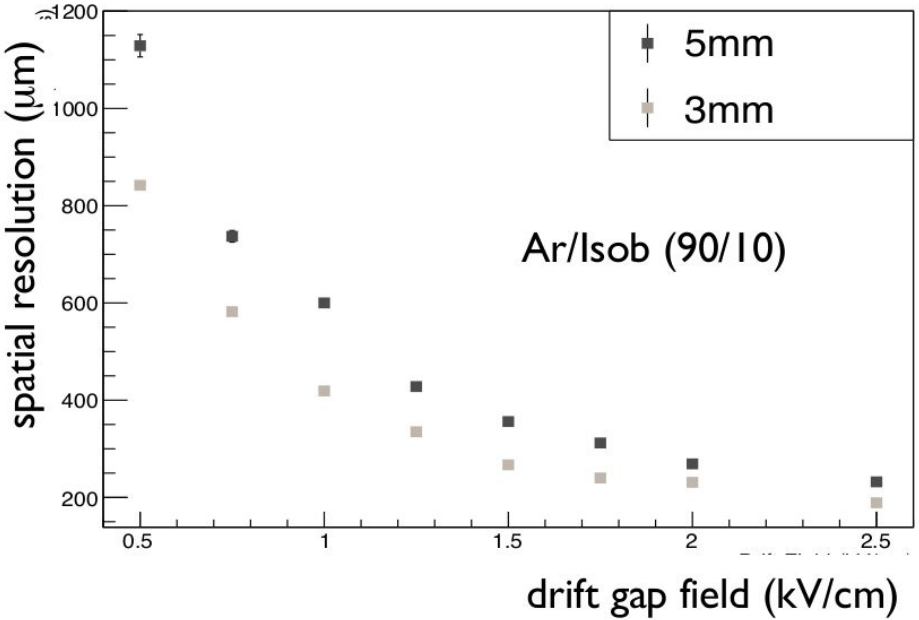
- Two previous test beam within RD51 collaboration (December 2014 and June 2015)

- We have collected several data from different configurations
  - different gas mixtures (ArCO2 (70/30) - ArISO (90/10))
  - drift field scan
  - magnetic field scan

- Aim of testing the largest number of configuration accessible achieved
  - better knowledge of the planar GEM's behaviour and features in magnetic field with charge centroid readout

Status

Charge centroid best results in magnetic field



Resolution will be obtained as difference between position of two close planar prototypes
In this way, several tracking effect are canceled out.
Good result, still not sufficient to match our experimental requirements

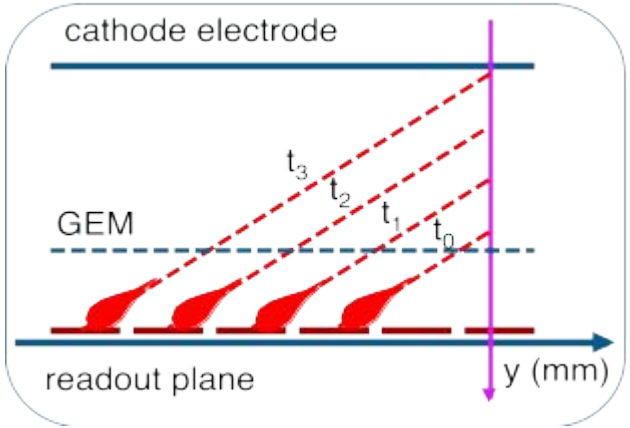
Start testing the μTPC readout

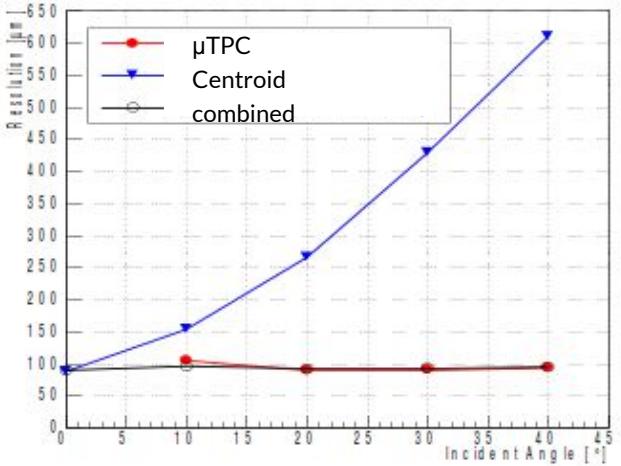
μTPC readout

Time information of the hit can be used to identify the track path inside the gap

Operate the GEM as a small TPC (i.e. μTPC)

Due to the charge spread, at large angles or with high magnetic field, time measurement is more precise than charge centroid





T. Alexopoulos - 4th LNF workshop on Cylindrical GEM detector

Up to now tested at large incident angles
Also gave a glance in magnetic field

Extremely encouraging results up to now!

Soon be ready to be shown

Measurement plan

Two main goal in the 2016 data taking (May 24 - June 9):

1. Exploit the full potential of the μTPC readout (magnetic field scan, fine angle scan)
    a. Frequent access to the experimental area

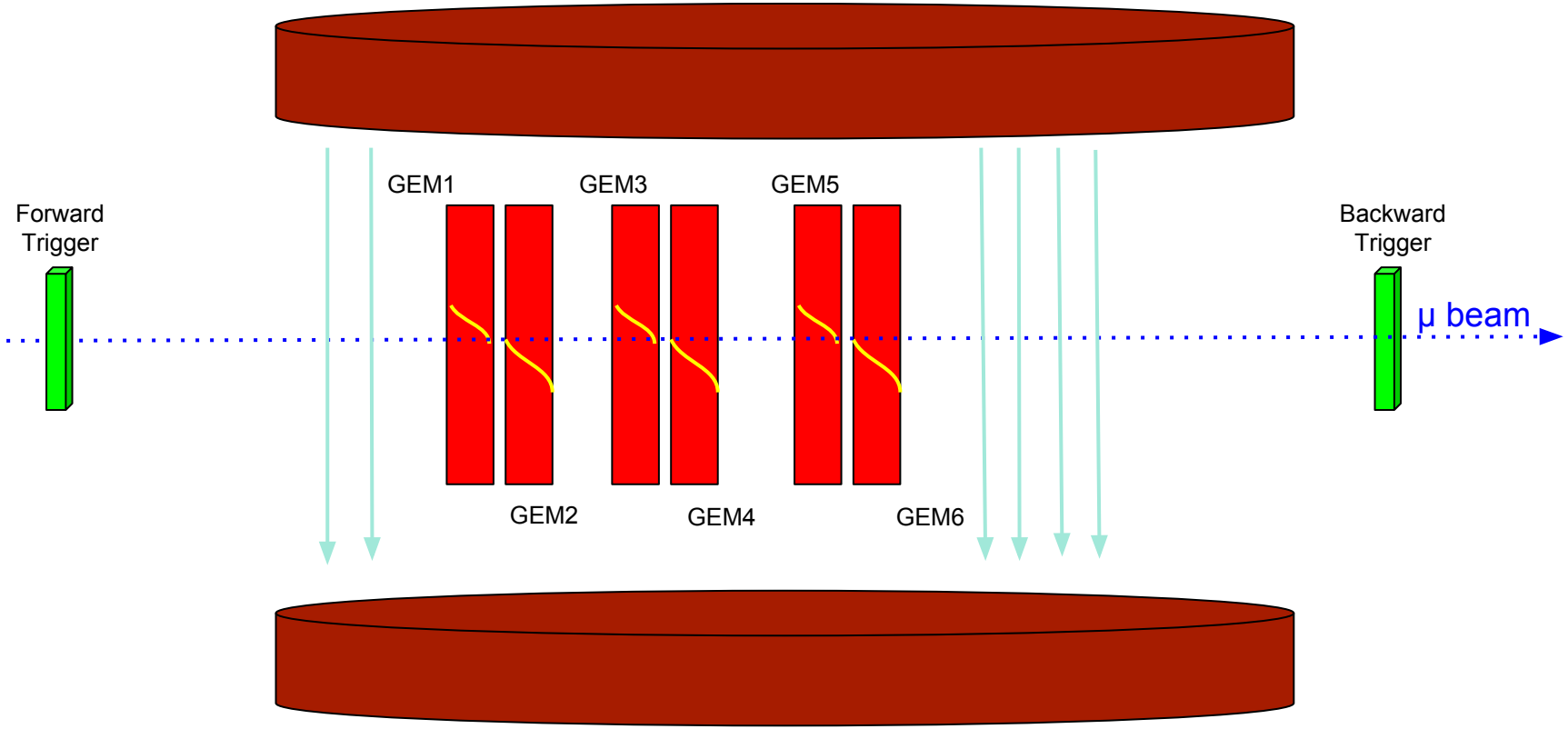
2. Re-test the most interesting configurations (finer drift field scan, test of Lorentz angle)
    a. No particular need to access the area

Experimental setup

Deploy 5 (maybe 6) planar 10x10 cm^2 GEM prototypes in a fixed structures + 2 μ-RWELL

- 3 GEMs + 2 GEMs in independently rotatable systems
- 2 μ-RWELL in rotatable system
- No external tracking
- External trigger system based on scintillators and SiPMs

Experimental Setup



Experimental setup

Need space in area for:

1 mechanical structures holding the GEMs and the μ-RWELLs (½ Goliath)

1 HV CAEN crate, 1 OPERA μ-amperometer, 1 SRS crate in 1 rack

1 PC to control data acquisition and HV

Trigger system (uphill and downhill GOLIATH)

Experimental setup - Service

Beam condition:

Monochromatic 150 GeV/c high intensity muon beam (2 k events/spill)

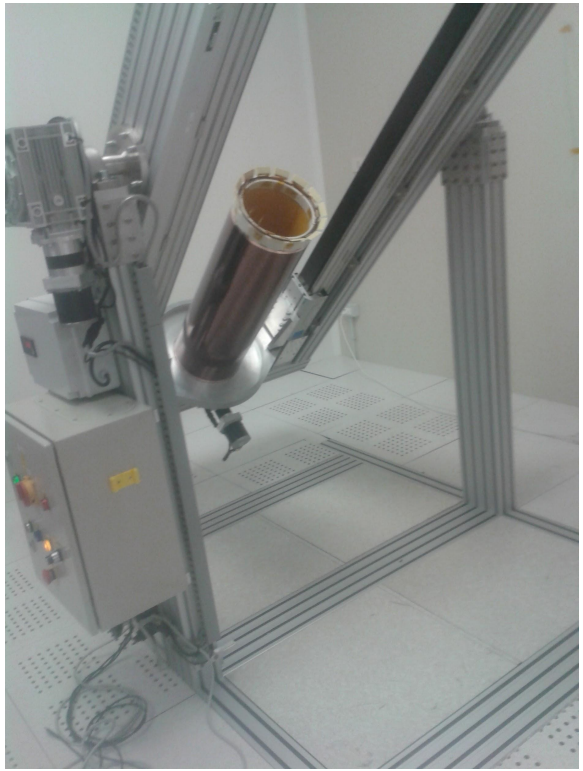
Magnet GOLIATH accessible in the range between [-1, 1] Tesla

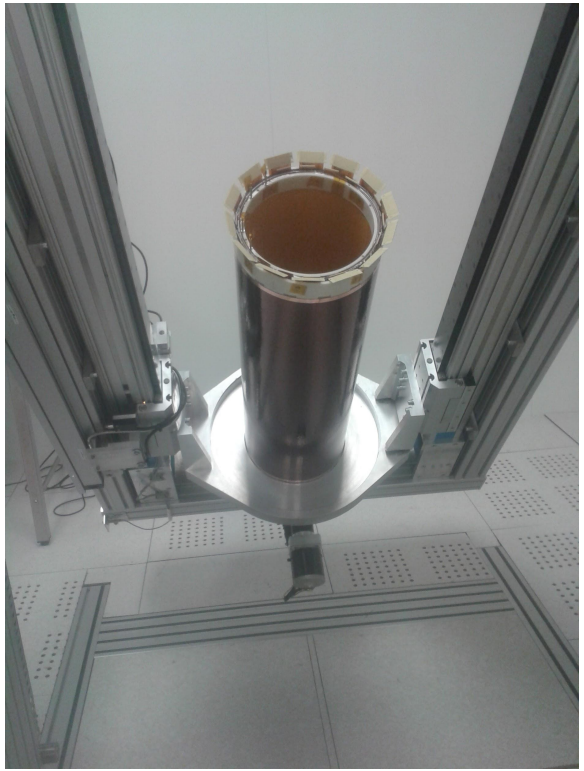
Gas mixtures:

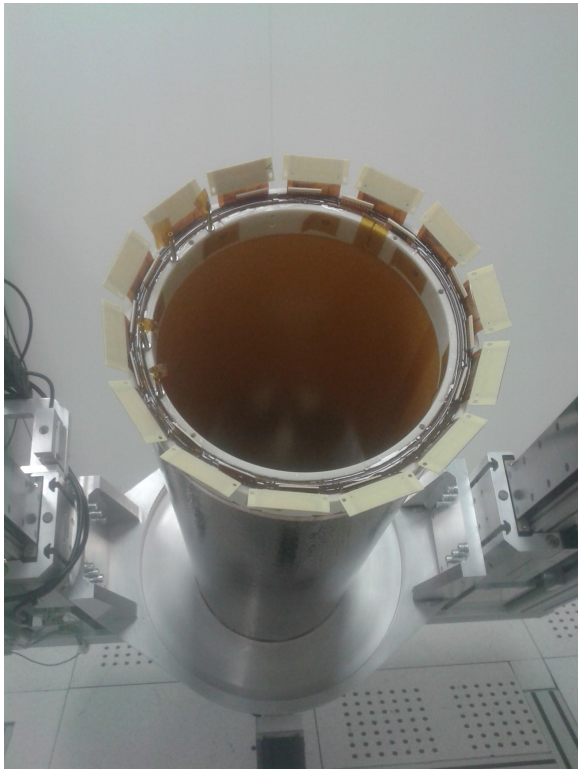
Both Argon-CO_2 (70/30) and Argon-Isobutane (90/10)

And then...

Cylindrical GEM prototype







Test of the Cylindrical Prototype

Last test beam of the year we would like to test the cylindrical prototype

Possible ideas:

Vertical in magnetic field - need to check mechanics and electronics

Condition close as possible to BESIII environment

Horizontal (also without magnetic field)

Test of the mechanical structure against gravity deformation in high intensity beam

Still under discussion within the collaboration

Thanks for your attention!

Experimental setup