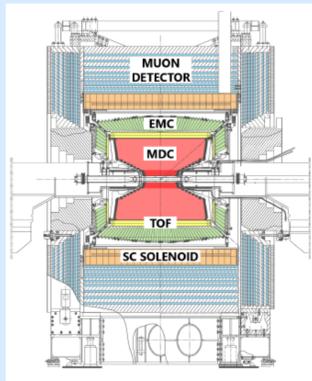


CONTEXT & MOTIVATION

THE BESIII DETECTOR

BesIII (Beijing Spectrometer) is a spectrometer working in the tau-charm region ($2+4.95$ GeV) located at the interaction point of the Beijing Electron-Positron Collider, which has a luminosity peak of $1.0 \times 10^{33}/\text{cm}^2\text{s}$, as measured in April 2016.



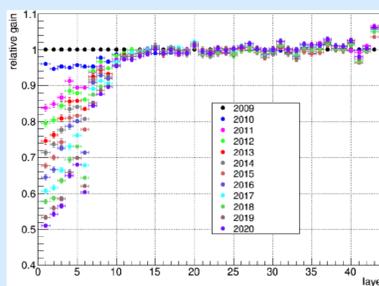
The spectrometer is made up of 5 detectors:

- 1) Multi-drift chamber (MDC)
 - $130 \mu\text{m}$ spatial resolution
 - $dp/p \sim 0.5\%$ @ $1 \text{ GeV}/c$
- 2) Time of flight system (TOF)
 - 70 ps (BTOF), 60 ps (ETOF) time resolution for particle identification
- 3) CsI Electromagnetic calorimeter (EMC)
 - $dE/E \sim 2.5\%$ @ $1 \text{ GeV}/c$
- 4) Muon detector
 - minimum muon momentum $0.4 \text{ GeV}/c$
- 5) Superconducting solenoid of 1T

BESIII program of physics investigates charmonium and charmonium-like states, charmed mesons and baryons, light hadron spectroscopy, τ physics, QCD and CKM parameters, baryon form factors, and new physics by studying rare and forbidden decays.

AGING OF INNER MDC

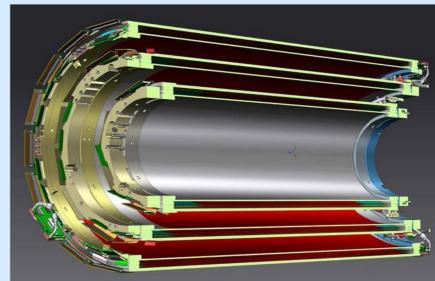
Due to the aging phenomena of the innermost part of the MDC the BESIII collaboration decided the replacement.



DESIGN & ELECTRONICS

THE CGEM-IT DETECTOR

The Italian Collaboration has proposed the Cylindrical GEM Inner Tracker.



It is a Gas Electron Multiplier (GEM) made by three independent, coaxial tracking layers, each with three multiplication stages.

Main detector features:

- Rate capability up to $10^4 \text{ Hz}/\text{cm}^2$
- Resolution along the beam direction $< 1 \text{ mm}$
- Resolution in the transverse plane $\sim 130 \mu\text{m}$
- Material budget $\leq 1.5\% X_0$

TIGER

Torino Integrated GEM Electronics for Readout is the ASIC designed for the readout of GEM detectors. They can read $60 \text{ kHz}/\text{channel}$ data rate with an input charge $2+50 \text{ fC}$. TIGERs are connected to the detector through FEBs (Front End Board). Each FEB manages two TIGERs.



GEMROC

GEMROC (GEM ReadOut Card) are FPGA based modules, developed by the INFN section of Ferrara, each managing 4 FEBs.

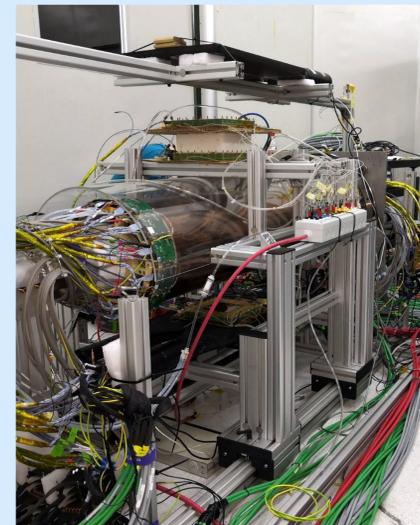
The GEMROC purposes are:

- power distribution
- configuration of TIGER
- data flow control

DETECTOR DATA TAKING

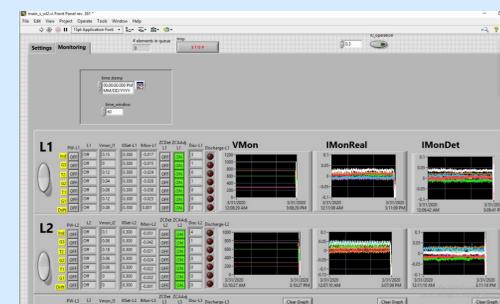
CGEM COSMIC RAY TELESCOPE

The first two layers are already in Beijing, at the Institute of High Energy Physics (IHEP), and are taking cosmic ray data.

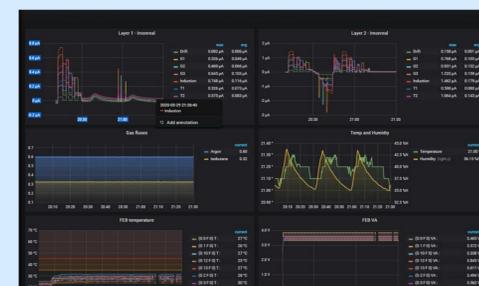


REMOTE CONTROL

Due to the pandemic, the setup is managed remotely, by a web dashboard developed in Torino. The setup allows to control separately the two layers and to change the working voltages.

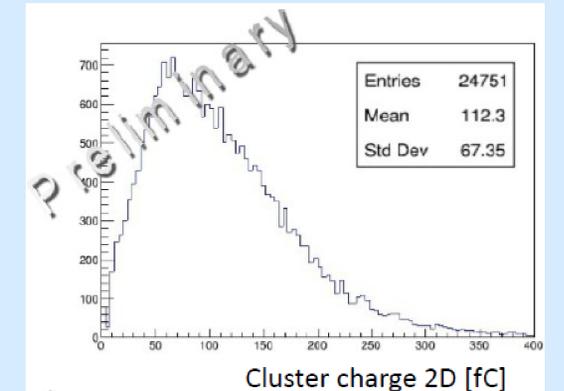


The sensors installed in the laboratory also make it possible to monitor the temperature and humidity in the clean room.

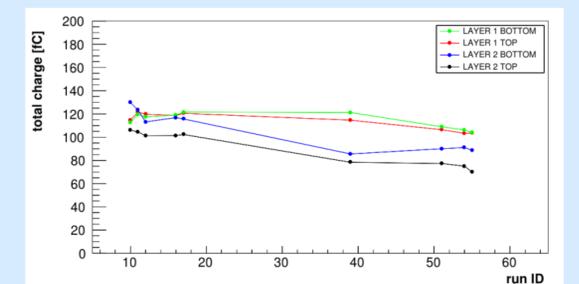


PRELIMINARY RESULTS

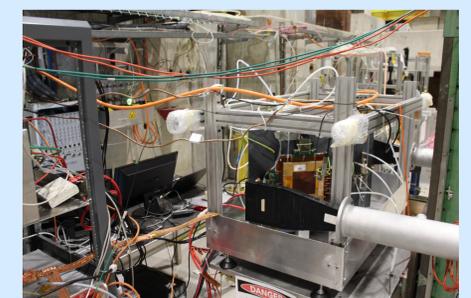
Thanks to the continuous data taking and the development of analysis software it was possible to obtain the first performances figures for the CGEM-IT detector.



It was also possible to test the stability of the spectrometer through the time (January 2020 ÷ March 2021).



Due to the pandemic, the integration activity has been continued by the Italian groups on a small-scale prototype. Recently, a test beam has been performed at CERN with the final electronics configuration.



TO KNOW MORE

Preliminary results from the cosmic data taking of the BESIII cylindrical GEM Detectors
R. Farinelli et al., JINST 15 (2020) 08, C08004, e-Print: 2004.12618
<https://arxiv.org/pdf/2004.12618.pdf>

The CGEM-IT readout chain
A. Bortone et al., 2021, e-Print: 2105.08979
<https://iopscience.iop.org/article/10.1088/1748-0221/16/08/P08065>