

The BESIII Experiment and the CGEM-IT Project

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**Università
degli Studi
di Ferrara**

Outline

- The BESIII Experiment and the Physics@BESIII
- The CGEM-IT project



The BESIII Experiment

The *BESIII* Experiment

BESIII (Beijing Spectrometer III) is an experiment located at BEPCII (Beijing Electron Positron Collider II) at IHEP (Institute of High Energy Physics)

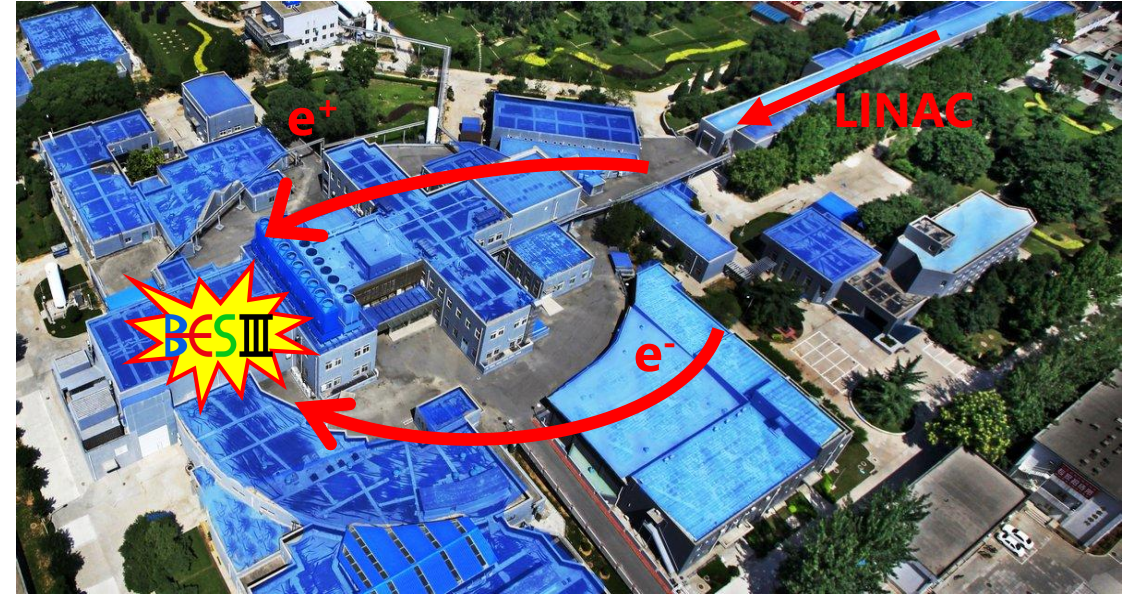
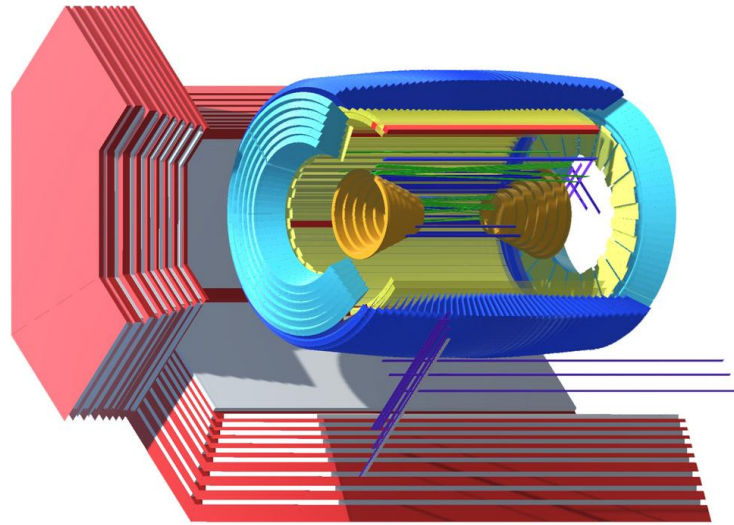
Multi-layer Drift Chamber

Time of Flight Detector

EM Calorimeter

1T Solenoidal Magnet

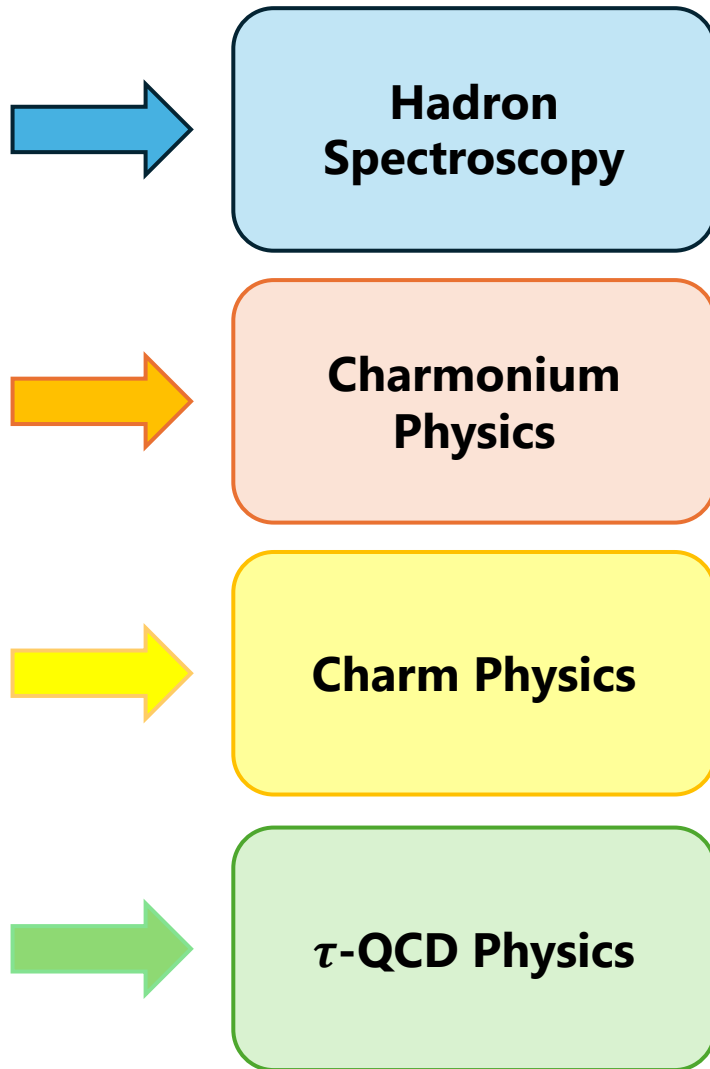
Muon Detector



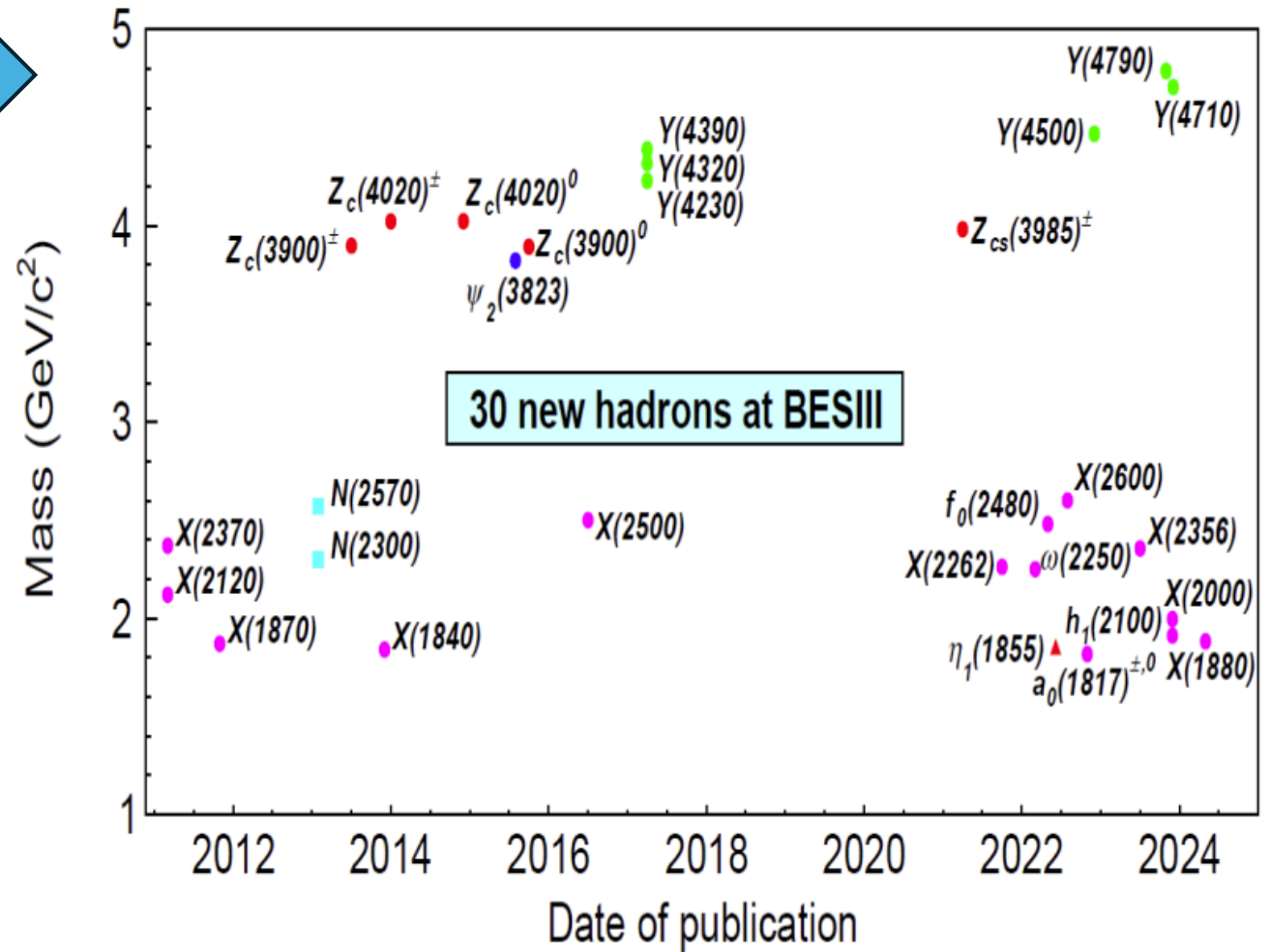
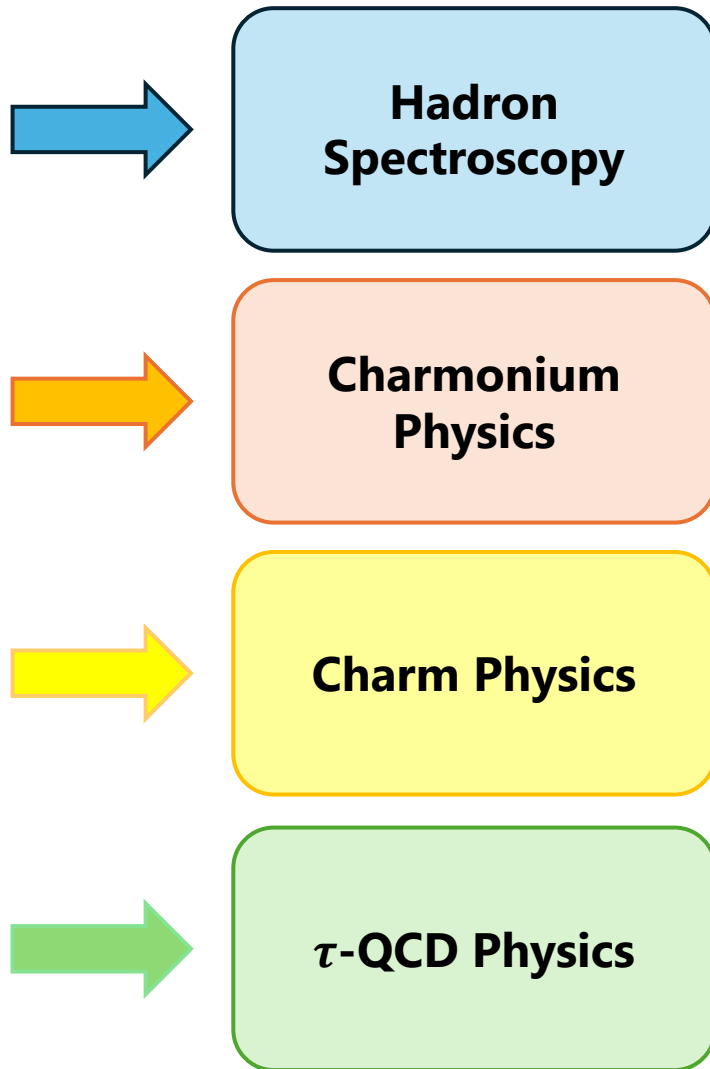
BESIII has collected the world's largest sample of $\psi(2S)$, with $(27.12 \pm 0.14) \times 10^8$ events, and of J/ψ , with 10^{10} events

τ -charm factory $2.0 \text{ GeV} \leq \sqrt{s} \leq 4.95 \text{ GeV}$ with an instantaneous luminosity of $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ @ $\sqrt{s}=3.77 \text{ GeV}$

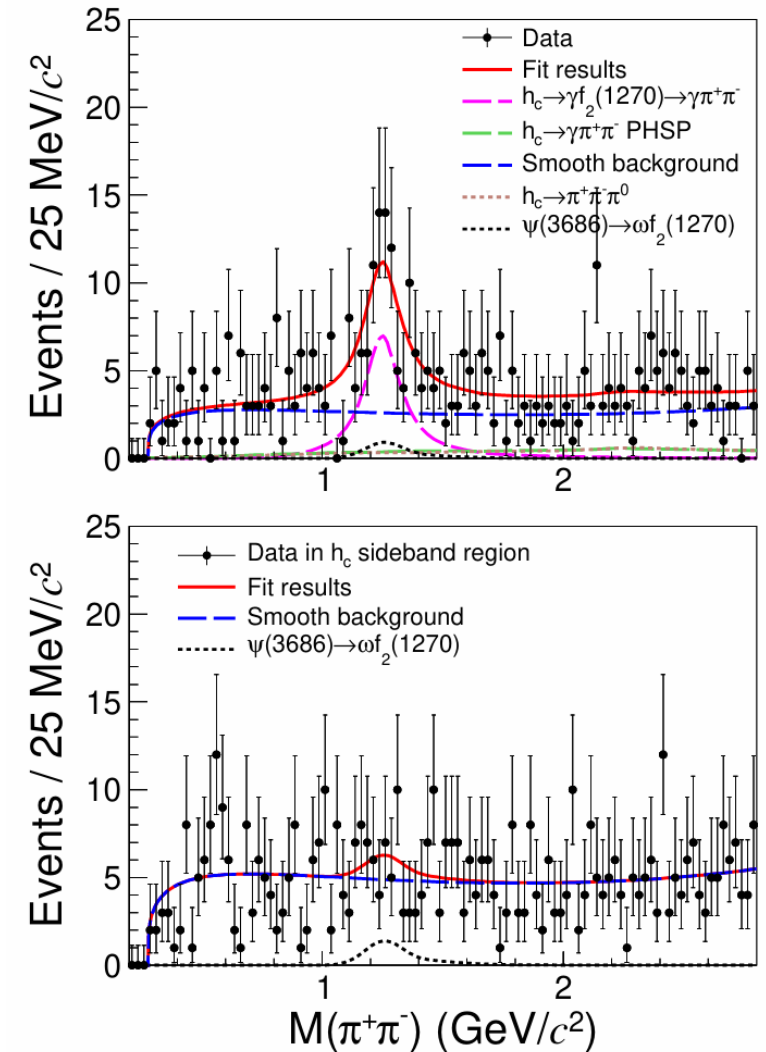
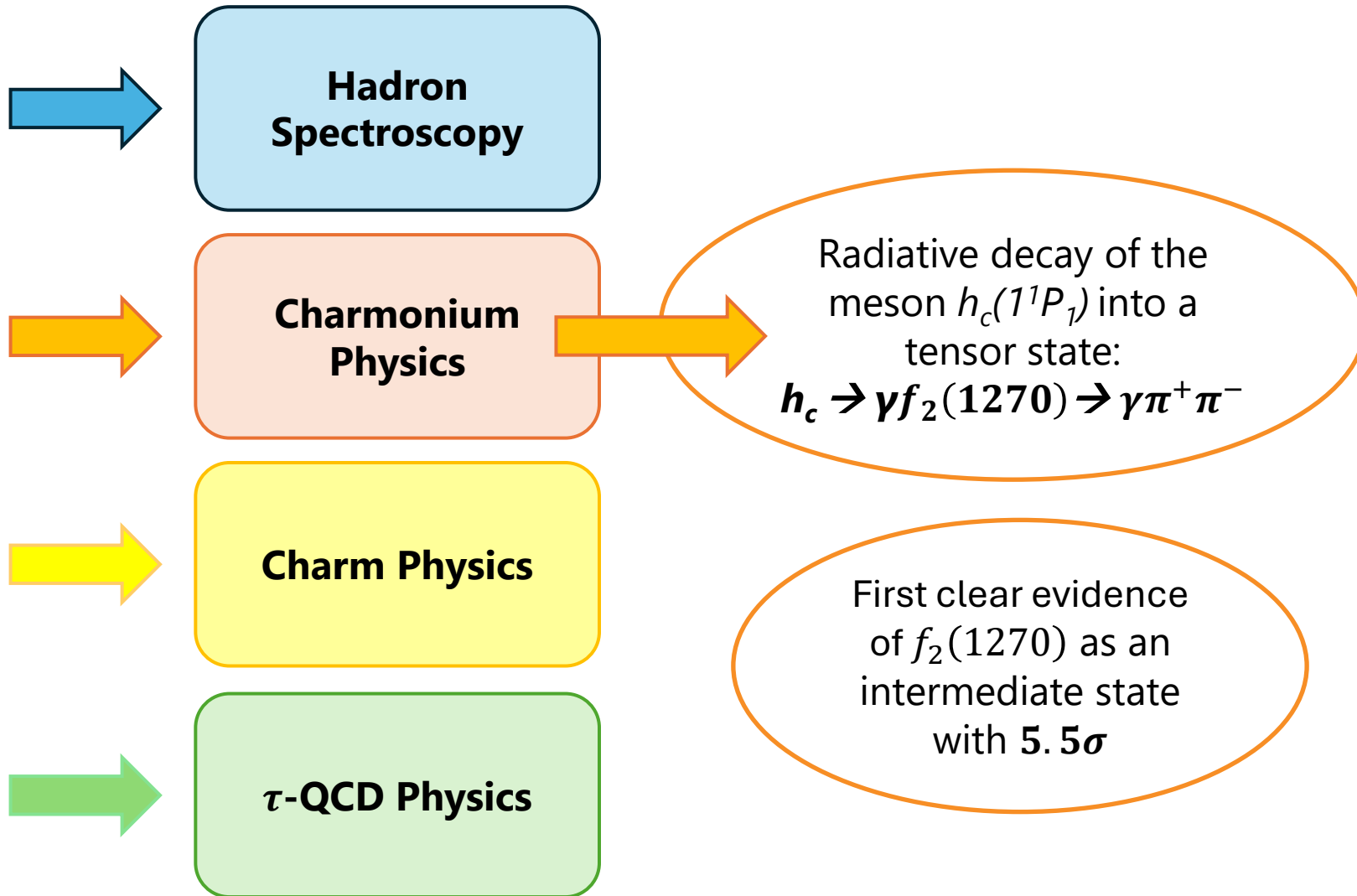
Physics@BESIII



Physics@BESIII



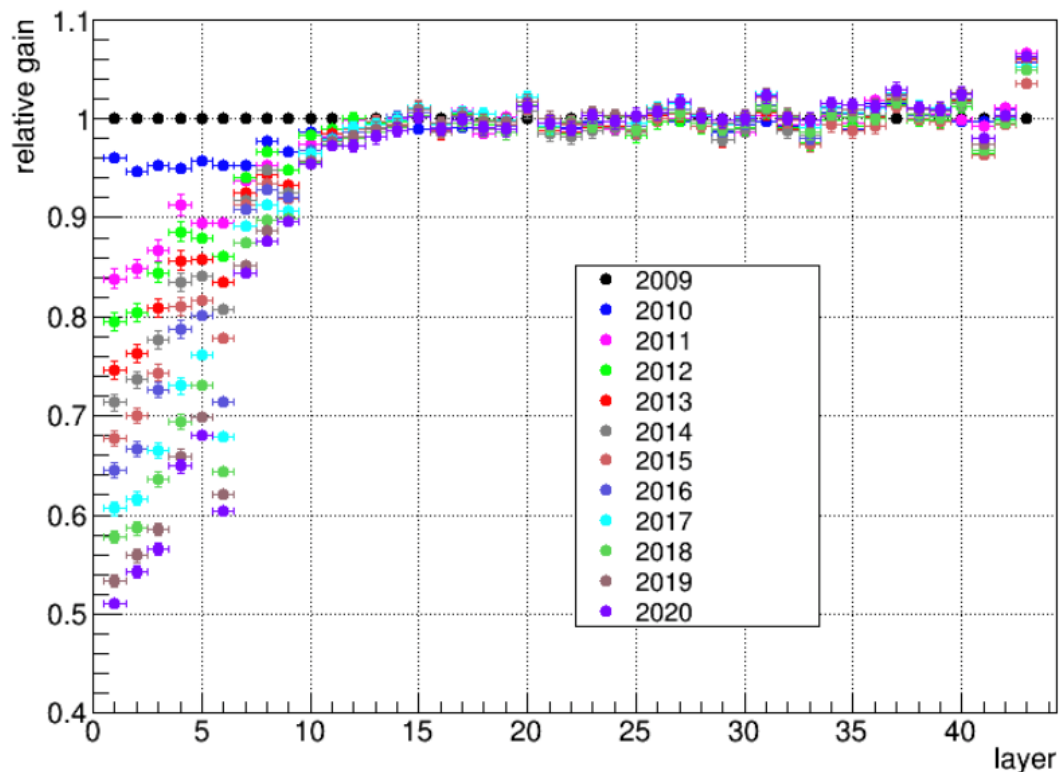
Physics@BESIII



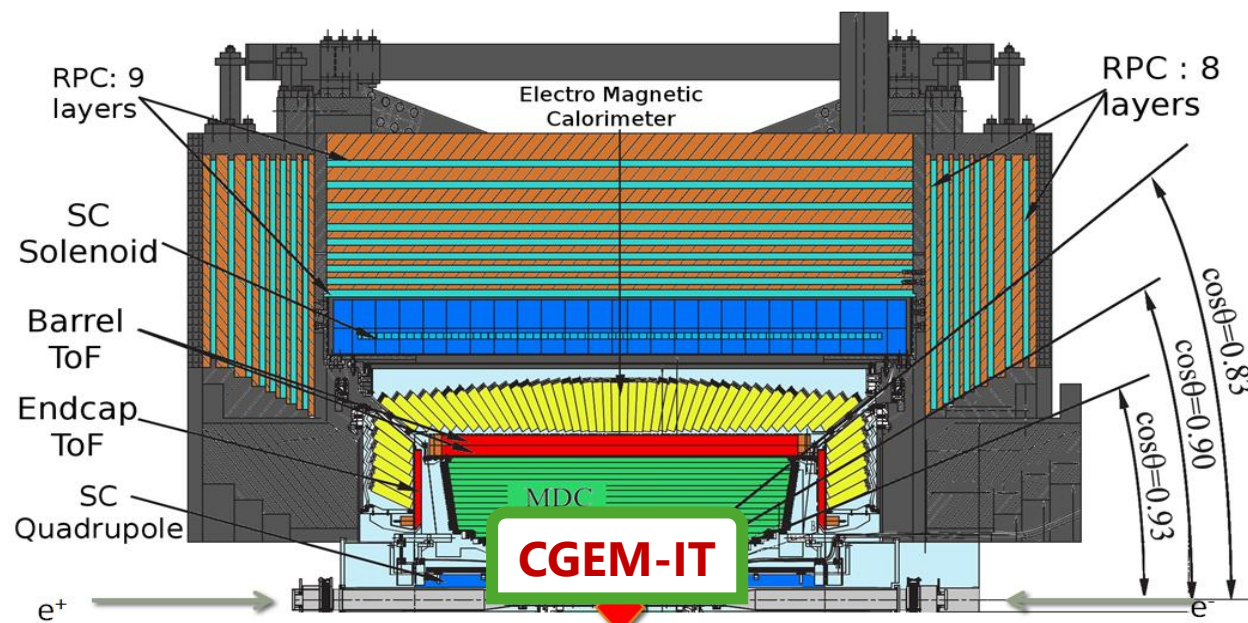


The CGEM-IT Project

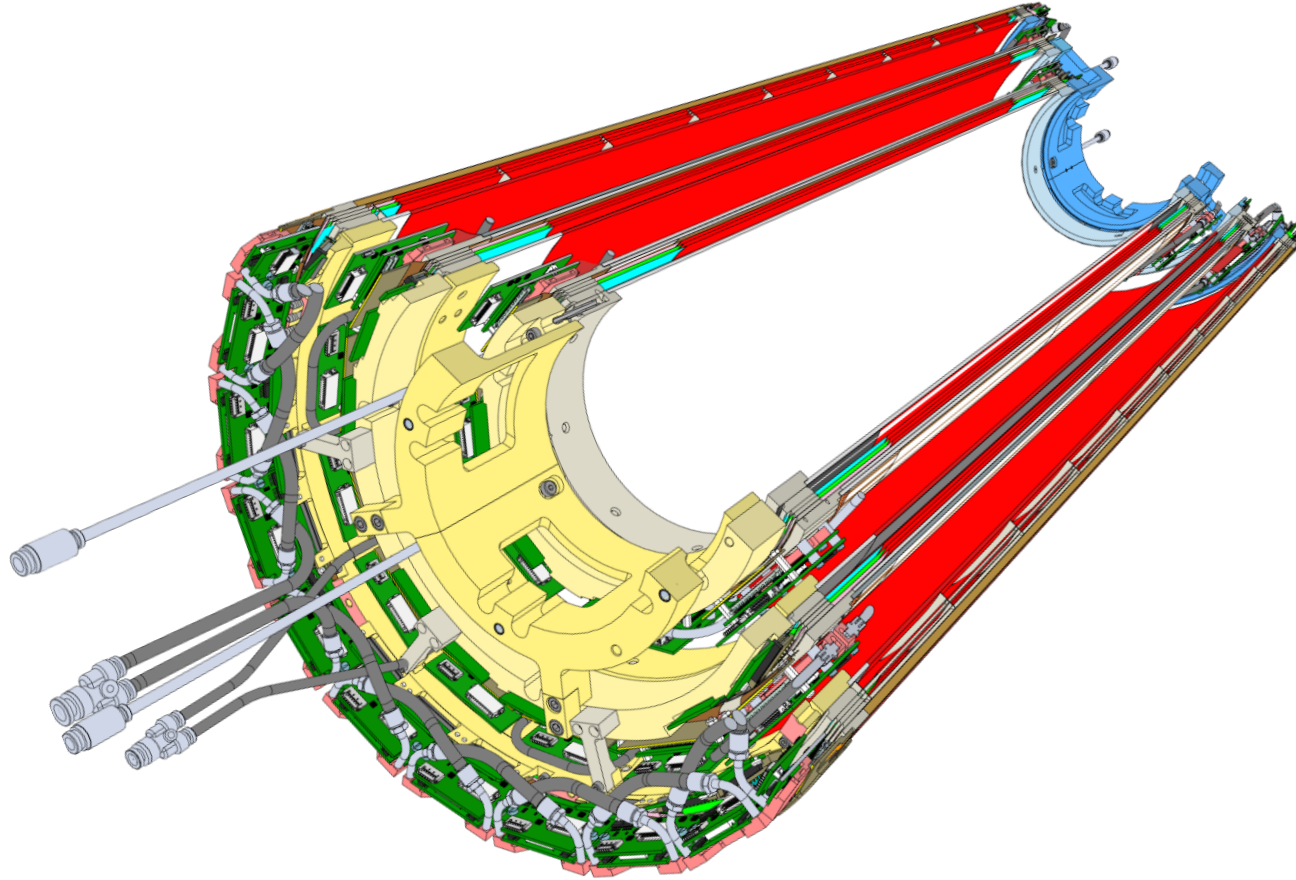
The MDC Ageing



- The inner part of the MDC is suffering from ageing due to beam-induced background, with a gain drop of about 50% for the first layer
- This gain loss led to the decision to replace the inner part

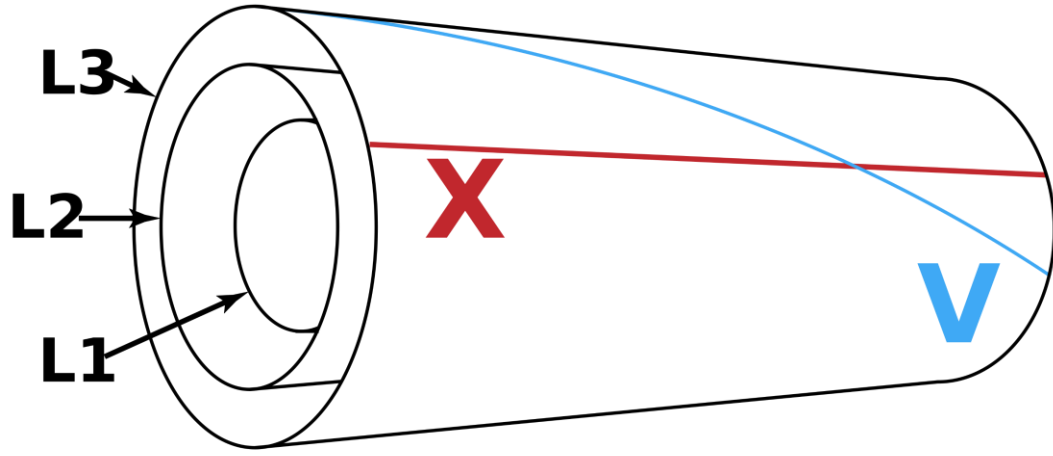


The CGEM-IT Project



- The **Cylindrical Gas Electron Multiplier** (CGEM), developed by the Italian BESIII group, has been proposed to replace the first eight layers of the MDC
- The CGEM-IT consists of 3 independent **cylindrical triple-GEM layers**, referred to as Layer 1 (L1), Layer 2 (L2), Layer 3 (L3)
- The CGEM-IT allows an improvement of the **radiation hardness**, **rate capability**, and **spatial resolution** along the beam axis, while keeping the same momentum resolution

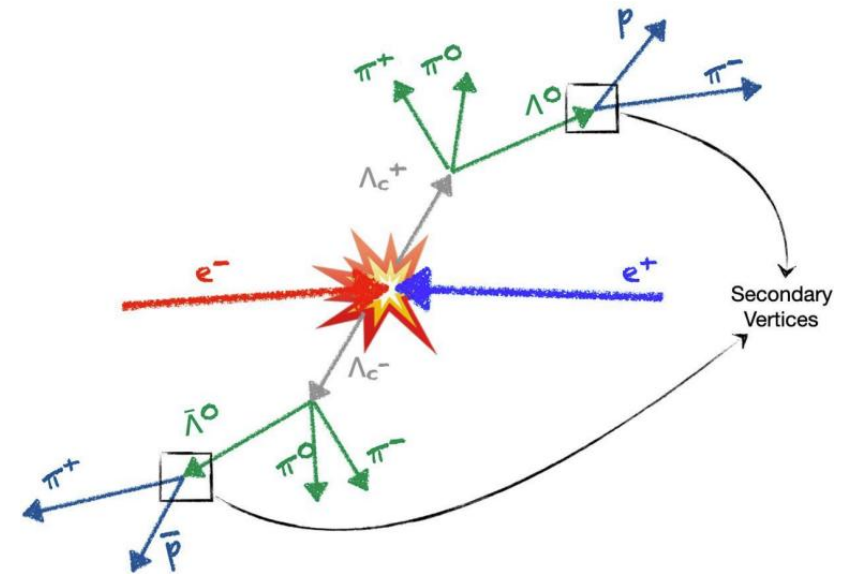
The CGEM-IT Project



	ACTIVE AREA LENGTH	STRIP STEREO ANGLE
L1	532 mm	46.7°
L2	690 mm	-31.0°
L3	847 mm	32.0°

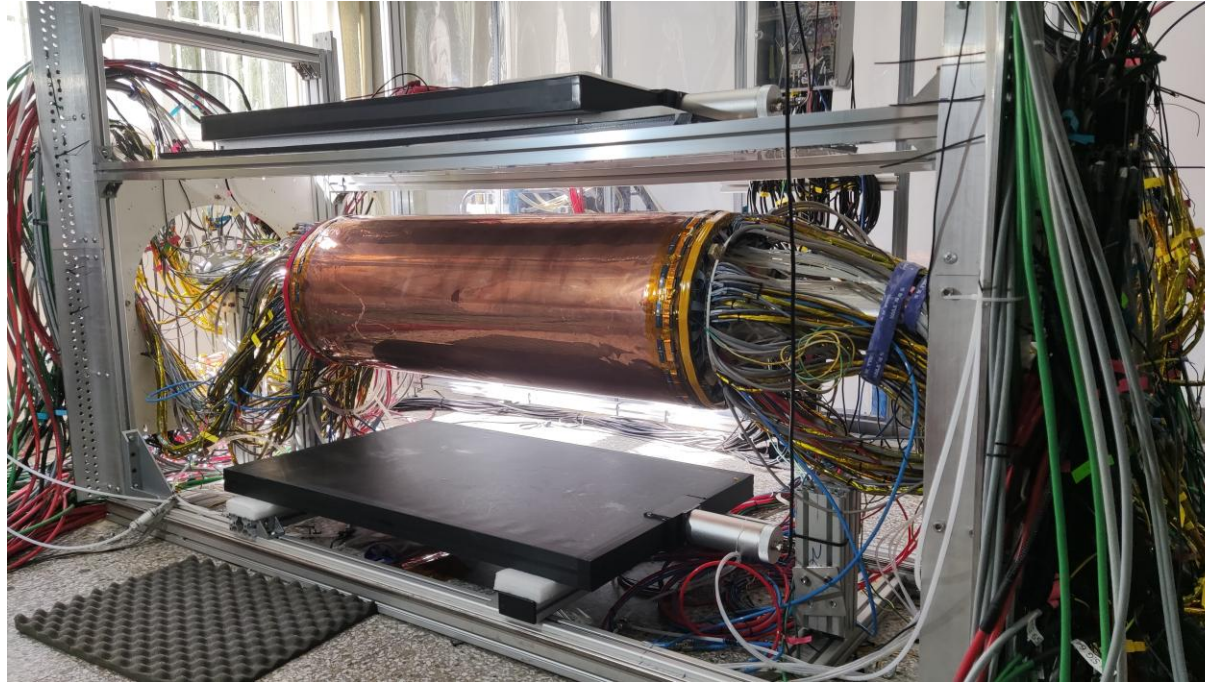
Improvements:

- Resolution in the z direction ($\sim 300\mu m$)
- Reconstruction of secondary vertices (by a factor of ~ 3)



The CGEM-IT Project

**Standalone
Commissioning**



A dedicated cosmic-ray campaign was carried out to evaluate the performance and study the characteristics of the detector

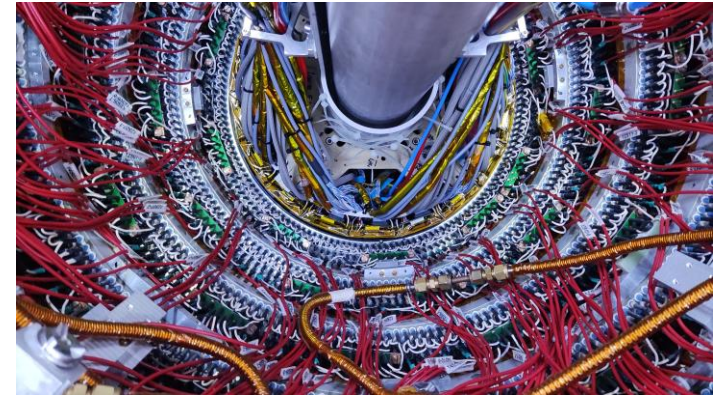
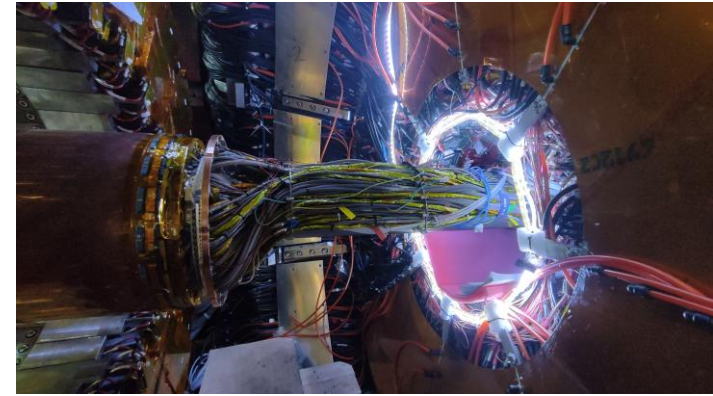
Efficiency $\sim 95\%$ for the three layers

September 2023 – May 2024

The CGEM-IT Project



Installation

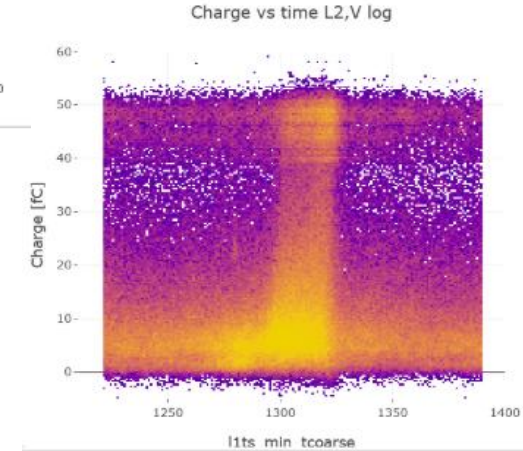
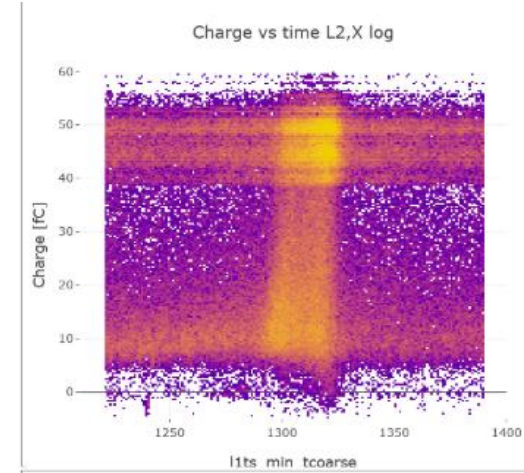


2 October 2024 – 5 October 2024

The CGEM-IT Project

Commissioning of CGEM-IT in BESIII:
noise studies, miscabling corrections,
HV test...

First Collision:
Data Collected by
L1, L2, L3 with
nominal values of
the current beams



Late October 2024 – February 2025

Late April – July 2025

Conclusions

- Since 2009, BESIII has collected large data samples of J/ψ , $\psi(2S)$, $\psi(3770)$ states along with data sets to fully cover its rich physics programme
- The CGEM-IT detector allows an improvement of radiation hardness, rate capability and spatial resolution
- During the summer break several interventions were carried out to improve and complete the systems
- The data taking of BESIII is planned to resume in mid-October



Thank you!



Backup

Physics@BESIII

Hadron Spectroscopy:

The light hadron group studies meson and baryon spectroscopy with light quarks, as well as exotic states. Using 10 billion J/ψ decays, BESIII investigates gluon-rich processes to explore glueballs and hybrids

Charmonium Physics:

The subgroup focuses on the studies of conventional charmonia and the searches for the XYZ states. It measures cross sections, transitions, and decay between the different charmonia, allowing us to probe the charmonium potential model and shedding

Charm Physics:

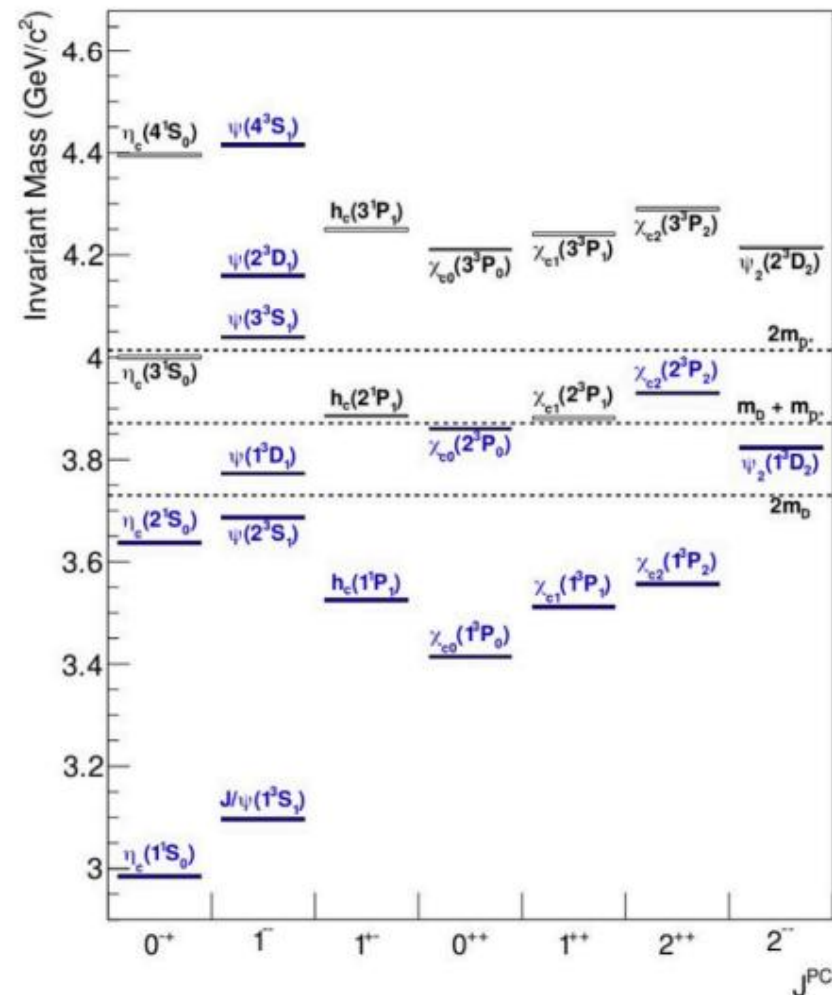
The charm subgroup studies the charmed mesons and baryons. The group contributes to the light quark exotic states search by probing their connections to the $D_{(s)}$ mesons. The charm division also takes care of the electroweak part of the Standard Model measuring the CKM matrix

τ -QCD Physics:

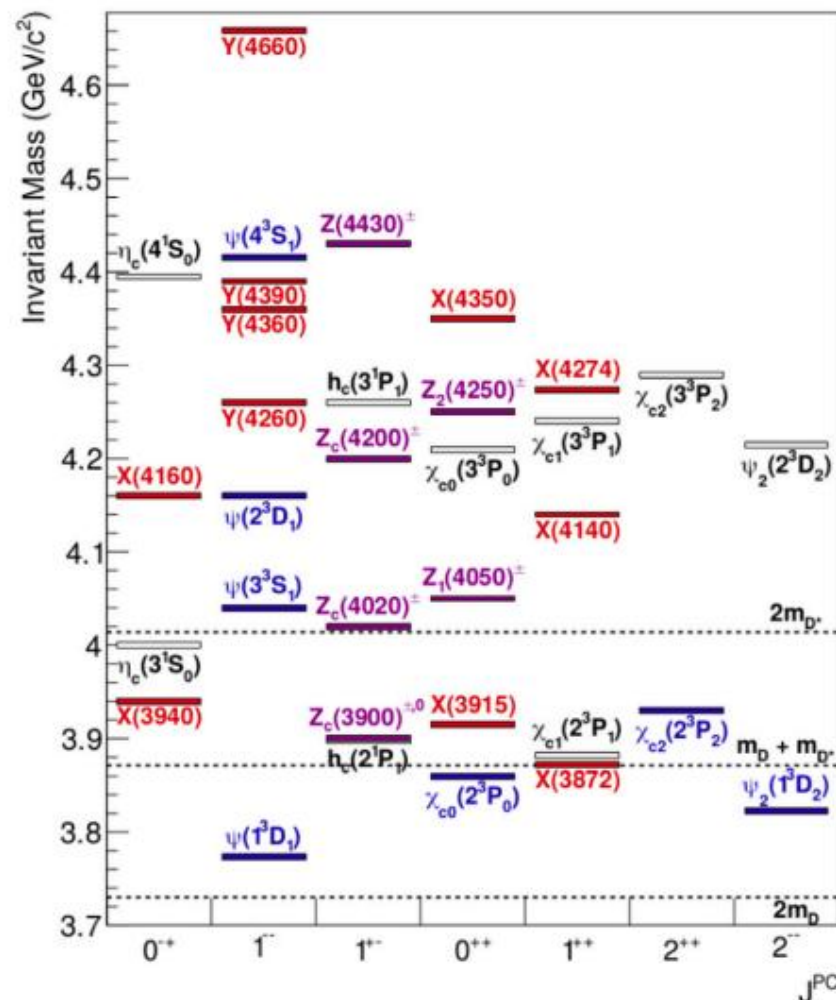
The τ -QCD group is dedicated to precise measurement of key parameters of the SM and the perturbative regime of QCD (e.g. R-value estimation and form factors)

Why Charmonia

Charmonium spectrum before 2003



Charmonium spectrum nowadays



- **Blue:** predicted and discovered
- **Gray:** predicted conventional but not yet discovered
- **Red:** neutral non conventional XYZ mesons
- **Magenta:** charged non conventional states