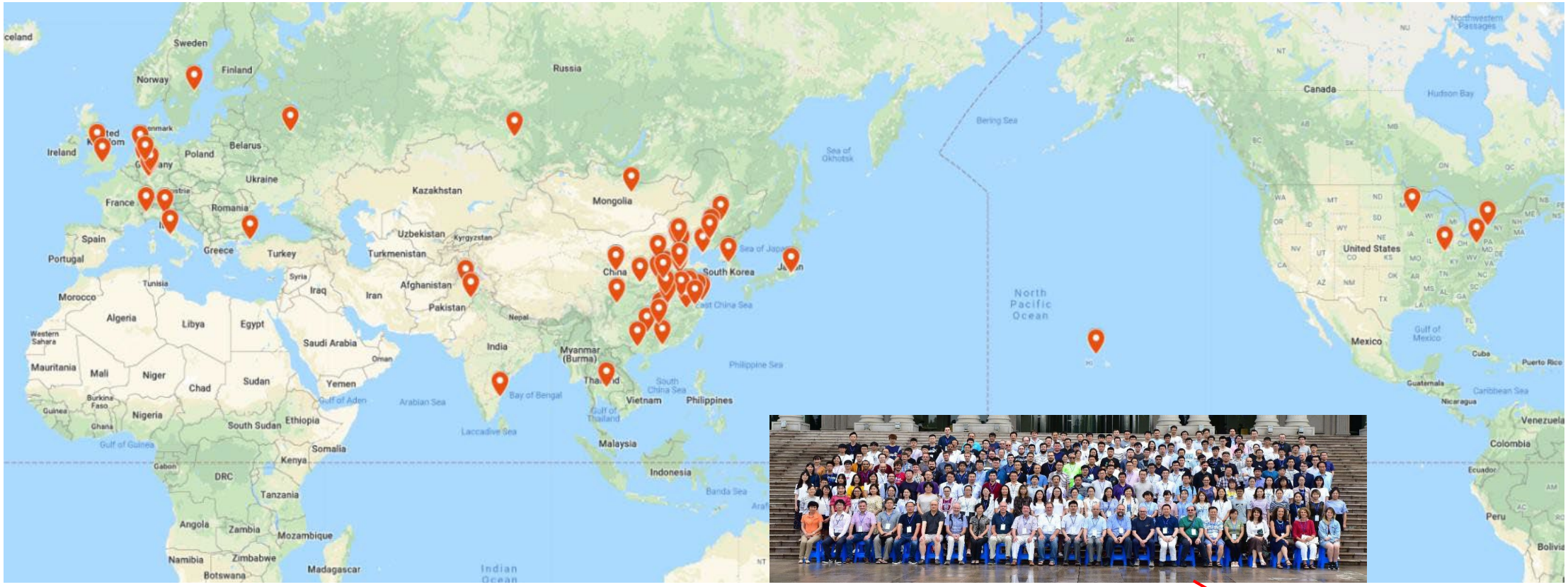
BESIII Collaboration



INFN FERRARA
Istituto Nazionale di Fisica Nucleare
Sezione di Ferrara

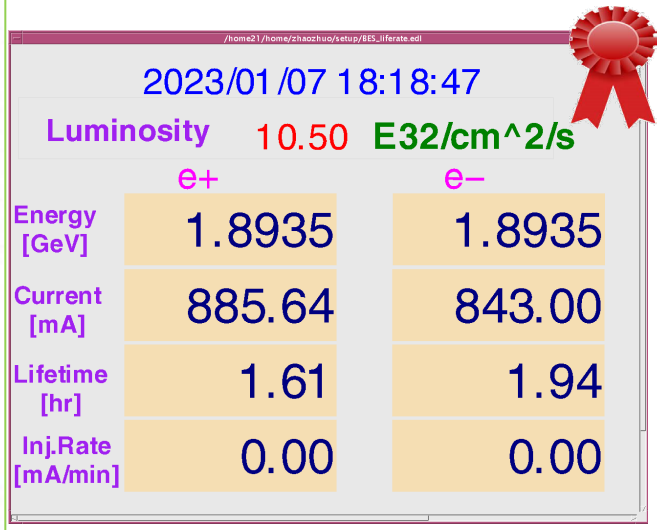
INFN
Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

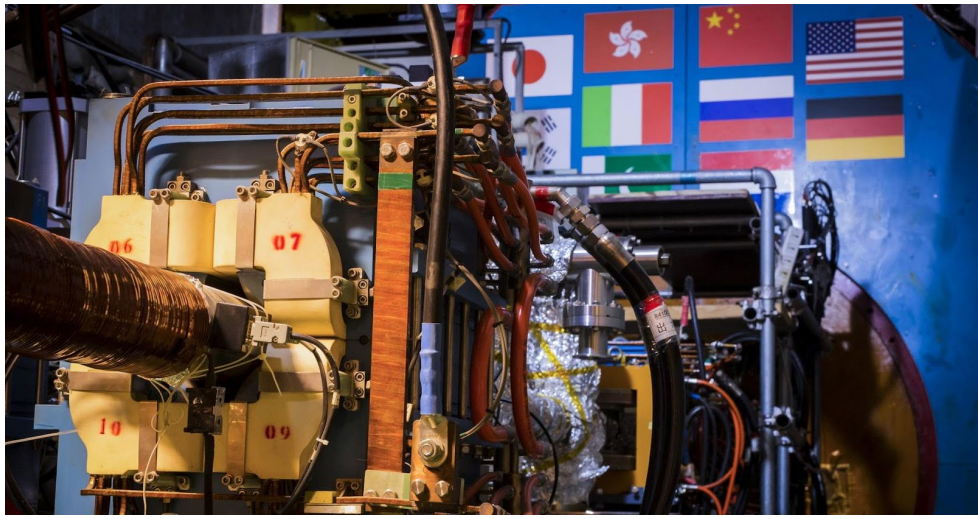
INFN PERUGIA

INFN TORINO
Istituto Nazionale di Fisica Nucleare
Sezione di Torino

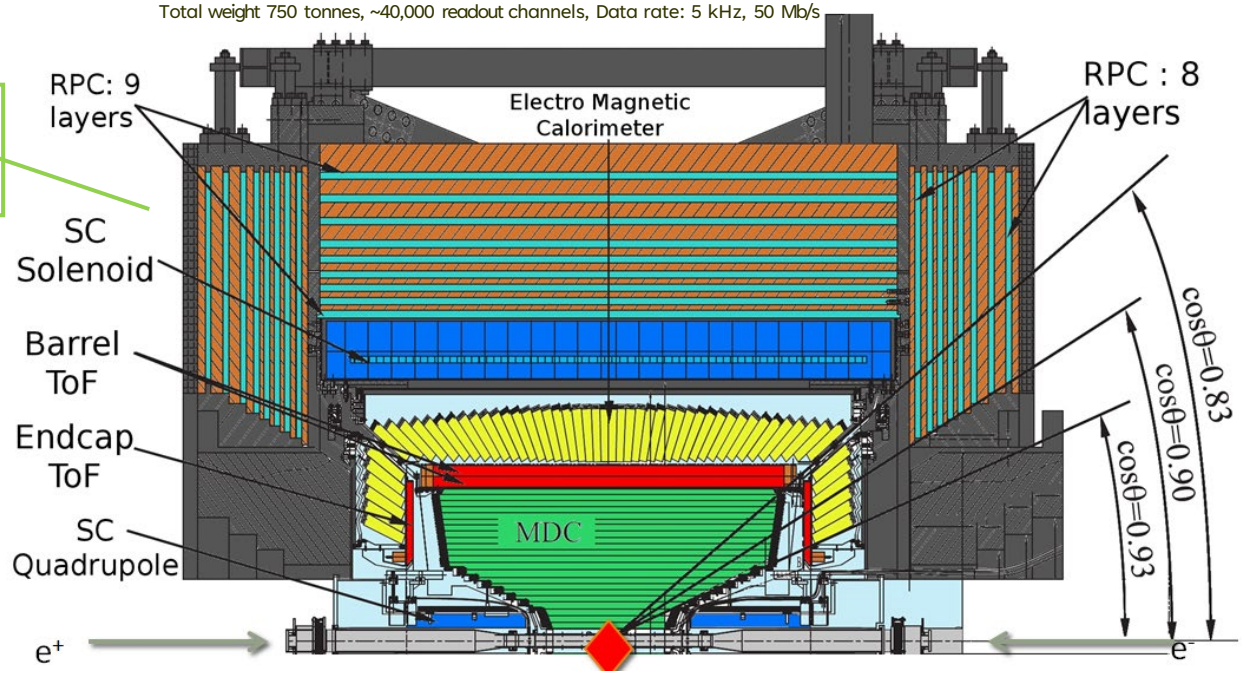
BESIII Italian Collaboration
~45 researchers

15 countries, 72 institutions
~600 members





BEijing Spectrometer (BESIII)



DATA TAKING TILL 2030 at least

Muon counters:
$\delta_{r\varphi}$ = 1.4 cm – 1.7 cm
Electromagnetic Calorimeter:
dE/√E (1 GeV) = 2.5 %
Time Of Flight:
σt (barrel) = 70 ps
σt (endcap) = 60 ps
Main Drift Chamber:
σx (1 GeV/c) ~ 130 μm
dp/p (1 GeV/c) = 0.5 %
SC solenoid:
1T magnetic field

M. Ablikim et al 2010 NIM A 614-210
M. Ablikim et al 2020 Chinese Phys. C 44 040001

BESIII physics program datasets

Totally about 48 fb^{-1} integrated luminosity from 2.0-4.95 GeV

Data sets collected so far include

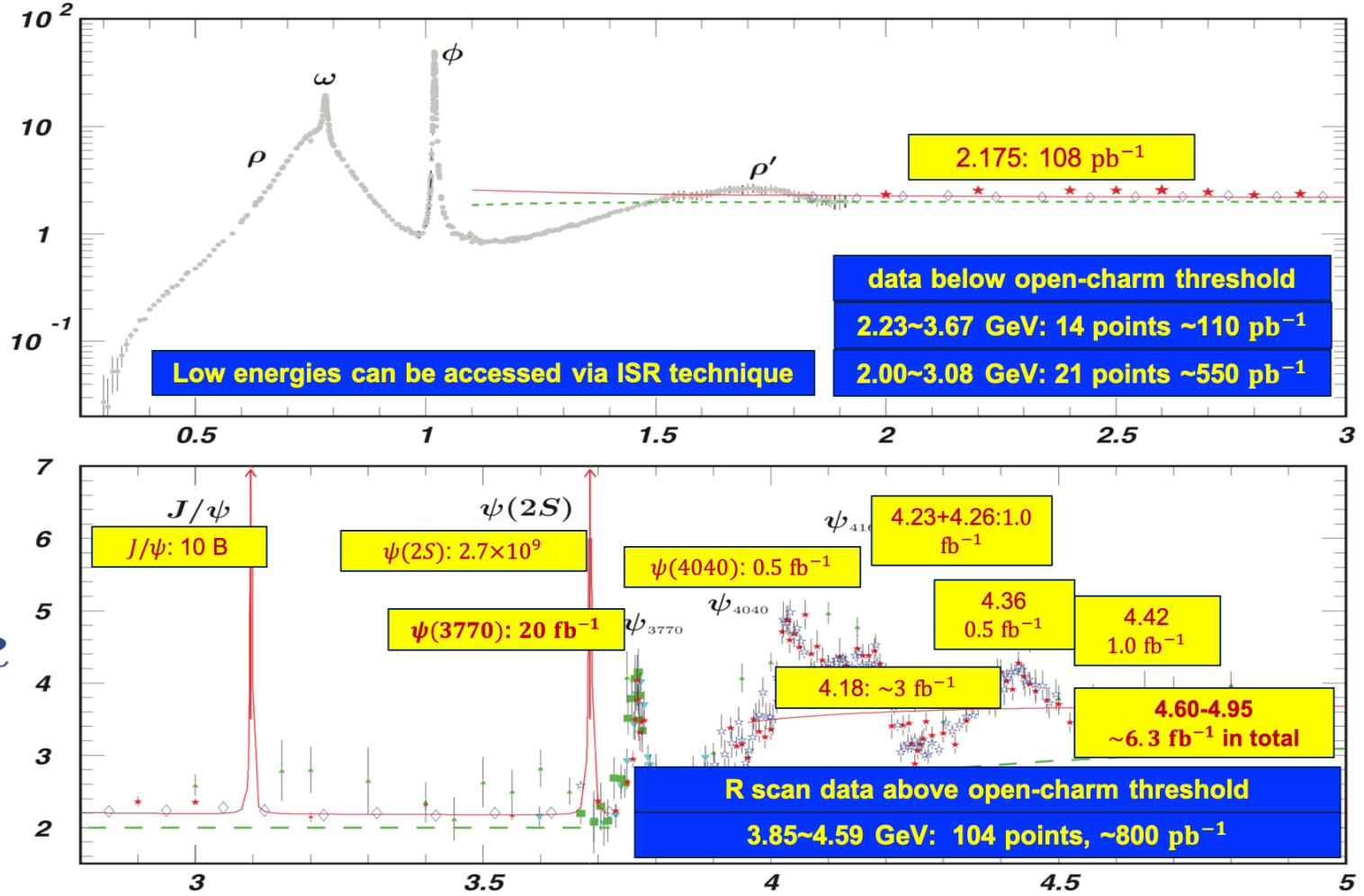
- 10 B J/ψ events
- 2.7 × 10^9 ψ(2S) events
- 16 fb^{-1} ψ(3770)
- Scan data between

  2.0 and 3.08 GeV,

  and above 3.74 GeV
- Large datasets for XYZ studies:

  scan with >500 pb^{-1} per energy point

  10 – 20 MeV apart



- Entangled hadron pair-productions near thresholds:

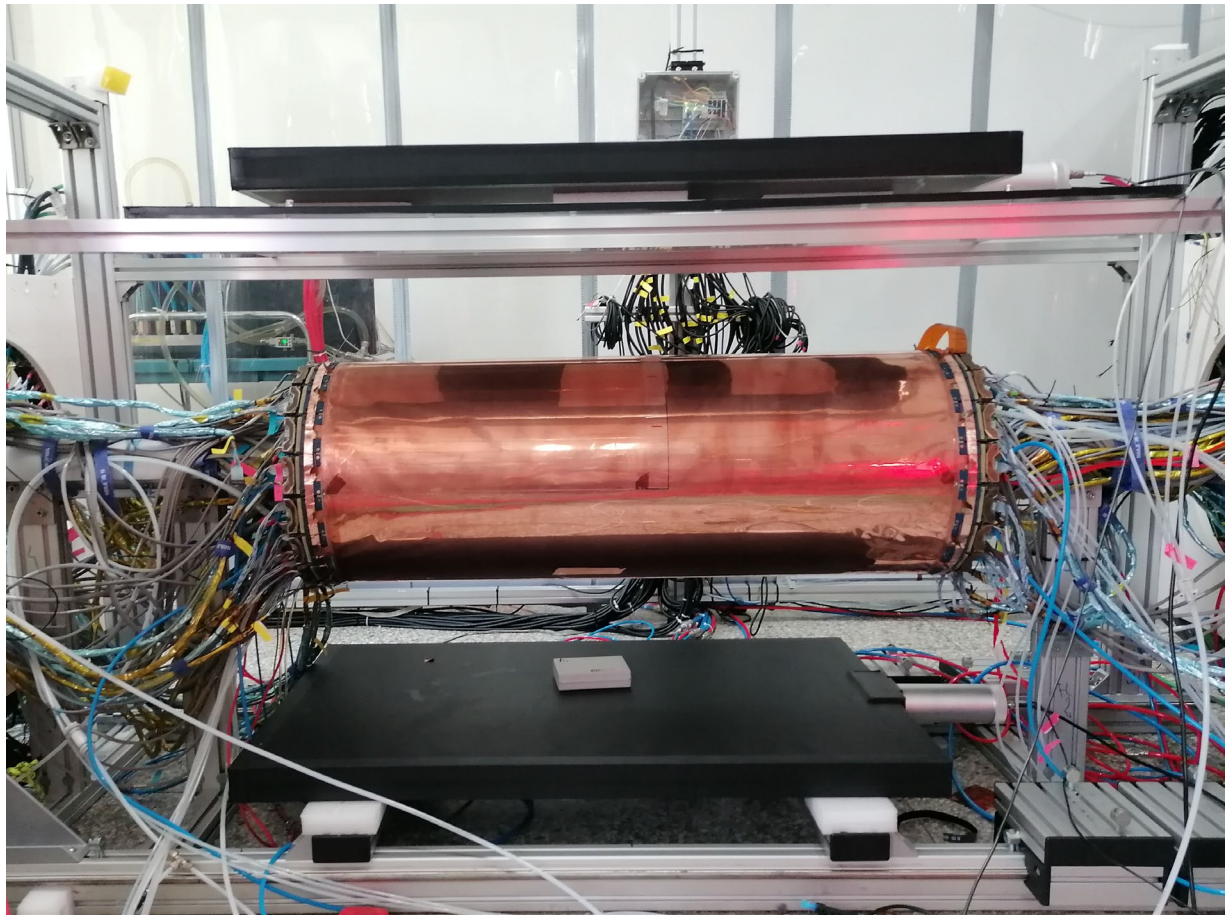
form-factors, relative phase, polarization and CP violation.

Hadron structure & dynamics in the non-perturbative QCD regime

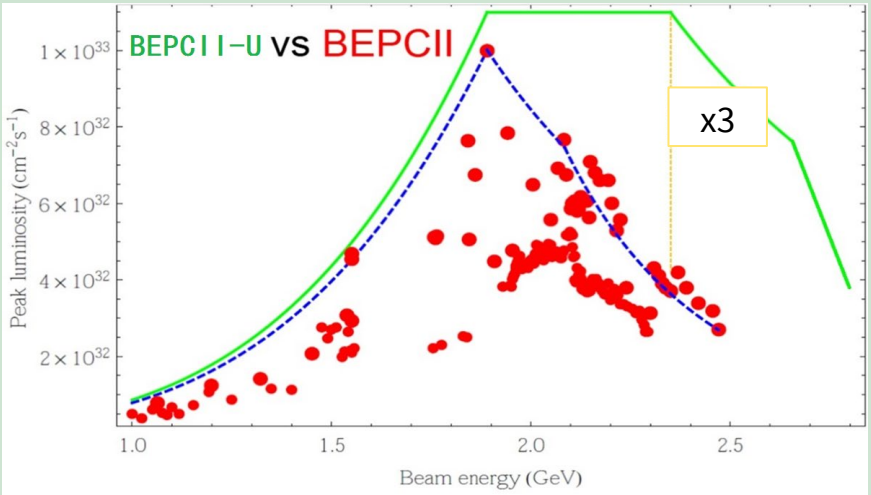
BESIII is playing an important role in charmed flavor and hadron physics

>2024 UPGRADE

CGEM-IT



中國科學院高能物理研究所
Institute of High Energy Physics Chinese Academy of Sciences



- ✓ **Phase I: @ 2.35GeV, Luminosity tripled to 11x10^{32}cm^{-2}s^{-1}**
- ✓ **Phase II: Push higher energy, 2.47GeV>>2.80GeV**

BESIII white paper: Future Physics Program

Table 7.1. List of data samples collected by BESIII/BEPCII up to 2019, and the proposed samples for the remainder of the physics program. The rightmost column shows the number of required data taking days with the current (T_C) and upgraded (T_U) machine. The machine upgrades include top-up implementation and beam current increase.

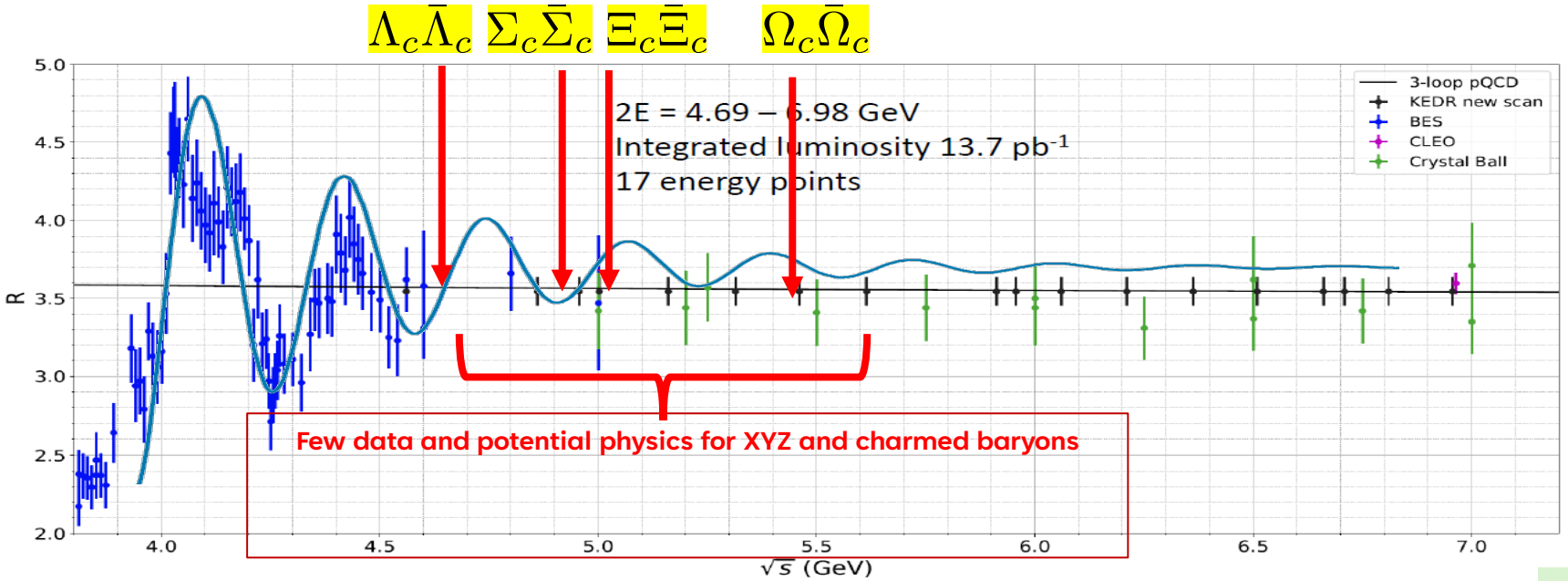
Energy	Physics motivations	Current data	Expected final data	T_C / T_U
1.8 - 2.0 GeV	R values Nucleon cross-sections	N/A	0.1 fb^{-1} (fine scan)	60/50 days
2.0 - 3.1 GeV	R values Cross-sections	Fine scan (20 energy points)	Complete scan (additional points)	250/180 days
J/ψ peak	Light hadron & Glueball J/ψ decays	3.2 fb^{-1} (10 billion)	3.2 fb^{-1} (10 billion)	N/A
$\psi(3686)$ peak	Light hadron & Glueball Charmonium decays	0.67 fb^{-1} (0.45 billion)	4.5 fb^{-1} (3.0 billion)	150/90 days
$\psi(3770)$ peak	$D^0/D^{\pm}$ decays	2.9 fb^{-1}	20.0 fb^{-1}	610/360 days
3.8 - 4.6 GeV	R values XYZ/Open charm	Fine scan (105 energy points)	No requirement	N/A
4.180 GeV	D_s decay XYZ/Open charm	3.2 fb^{-1}	6 fb^{-1}	140/50 days
4.0 - 4.6 GeV	XYZ/Open charm Higher charmonia cross-sections	16.0 fb^{-1} at different $\sqrt{s}$	30 fb^{-1} at different $\sqrt{s}$	770/310 days
4.6 - 4.9 GeV	Charmed baryon/XYZ cross-sections	0.56 fb^{-1} at 4.6 GeV	15 fb^{-1} at different $\sqrt{s}$	1490/600 days
4.74 GeV	$\Sigma_c^+\bar{\Lambda}_c^-$ cross-section	N/A	1.0 fb^{-1}	100/40 days
4.91 GeV	$\Sigma_c\bar{\Sigma}_c$ cross-section	N/A	1.0 fb^{-1}	120/50 days
4.95 GeV	Ξ_c decays	N/A	1.0 fb^{-1}	130/50 days

Potential physics:

- ✓ Cover energy up to 5.6 GeV
- ✓ Deeper studies of the XYZ states
- ✓ Study the ground-state charmed baryons
- ✓ Provide information on charm-quark fragmentation function

arXiv:1912.05983 : Chin.Phys. C44 (2020) no.4, 040001

BESIII white paper: Future Physics Program



* KEDR new scan points positions are fixed at pQCD predictions
Expected total uncertainty is about 3 % (systematic uncertainty about 2.5%)

Potential physics:

- ✓ Cover energy up to 5.6 GeV
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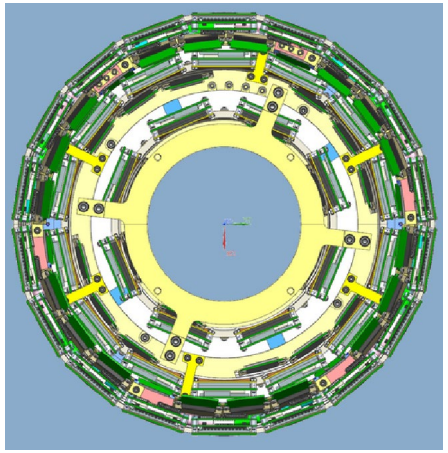
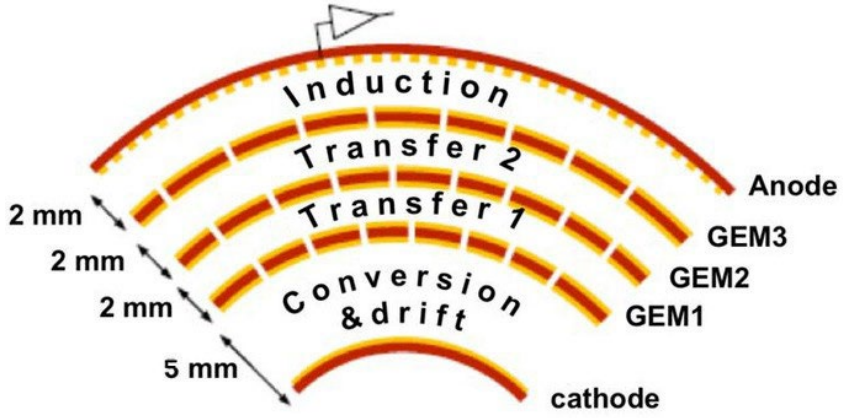
arXiv:1912.05983 : Chin.Phys. C44 (2020) no.4, 040001

CYLINDRICAL GEM-INNER TRACKER





Ar – iC4H10 (90% –10%)
HV 280/280/275 V
E field 1.5/3/3/5 kV/cm

Match
Inner MDC tracking performance

Improve
Low spatial charge
high rate capability (at least 10^6 Hz/cm^2)
fast response
light support frame
low aging
better z resolution (~ 350 μm)
better secondary vertex reconstruction

Operation in 1T magnetic field

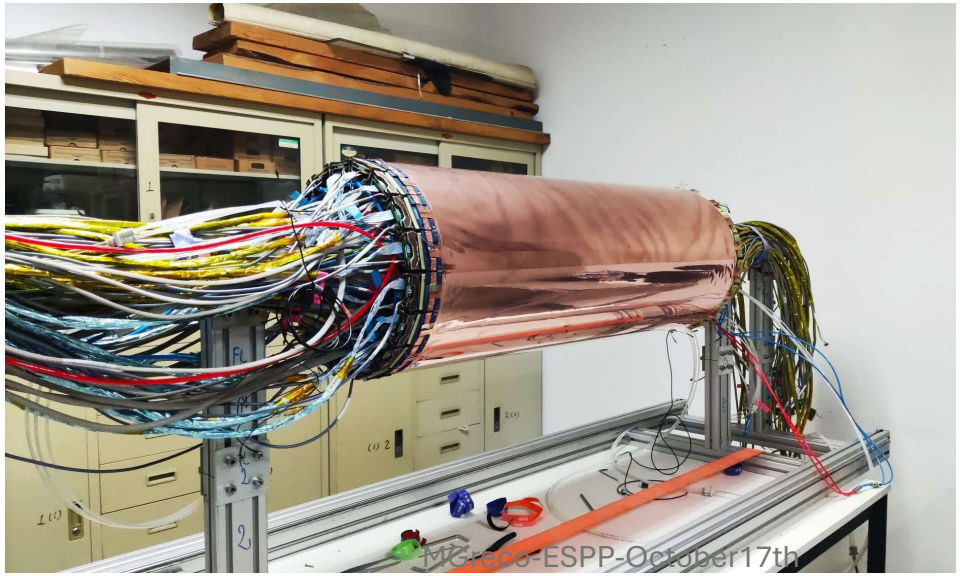
σ_{xy} ~ 130 μm

σ_z < 1 mm

σ_{pt}/p_t ~ 0.5% @ 1 GeV/c

Material budget ~1.5% X_0

High rate capability: 10^4 Hz/cm^2



I. Balossino et al. Symmetry 2022, 14(5), 905

CGEM-IT installation is ongoing NOW!