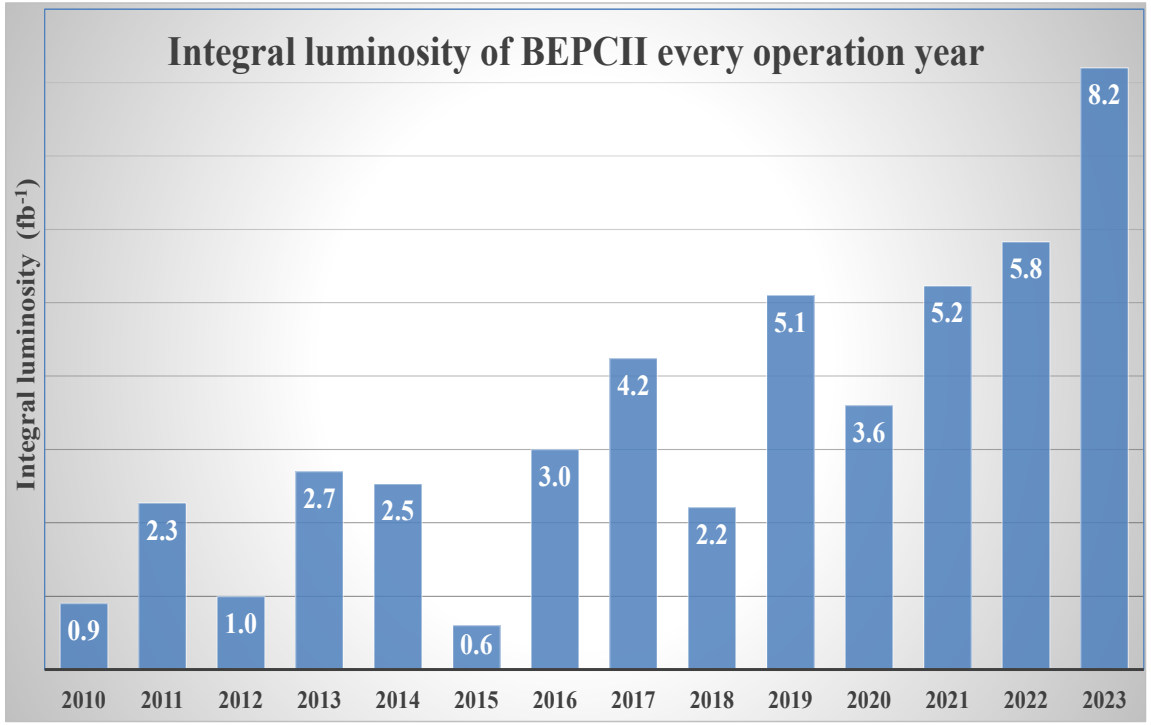
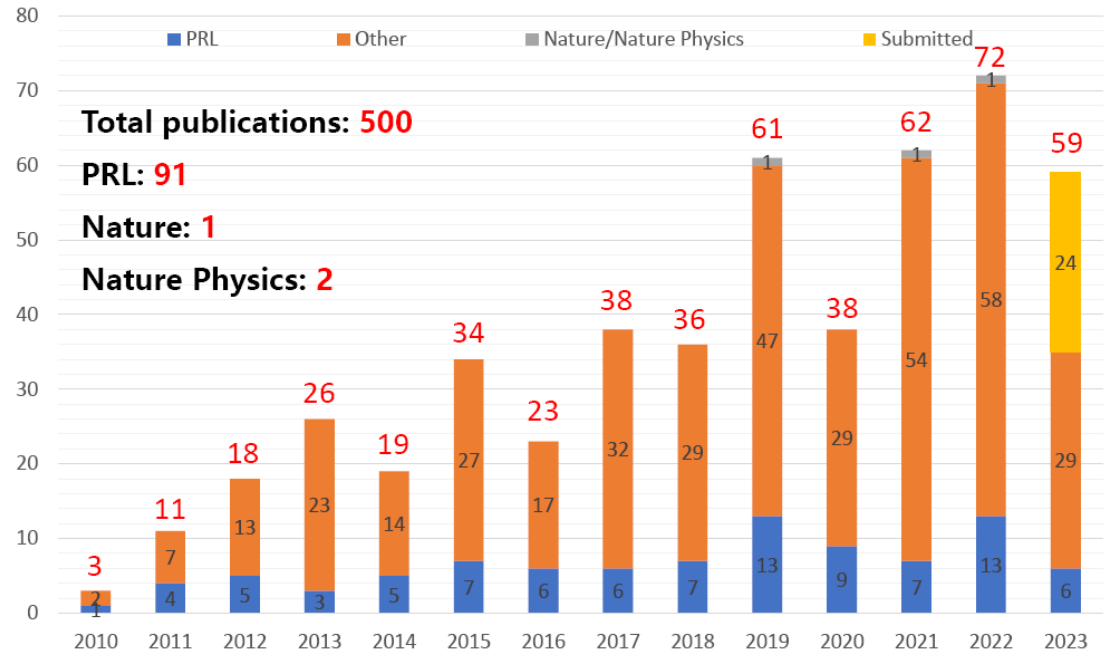
Stato di BESIII

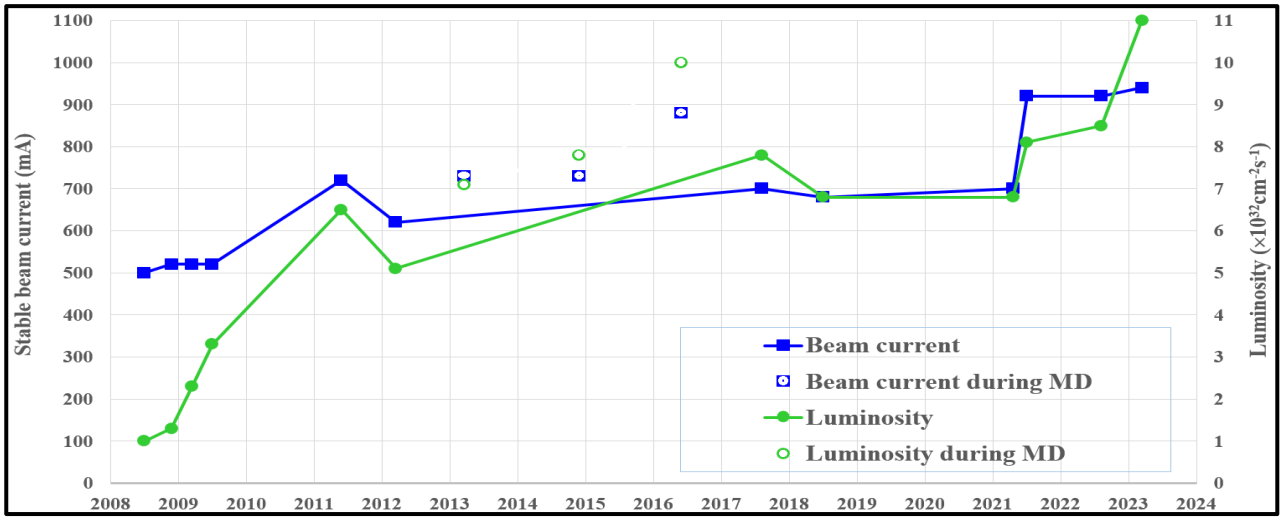
M. Bertani

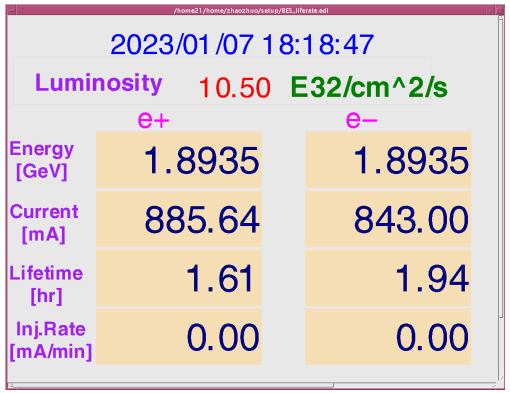
riunione gruppo 1, 20 settembre 2023

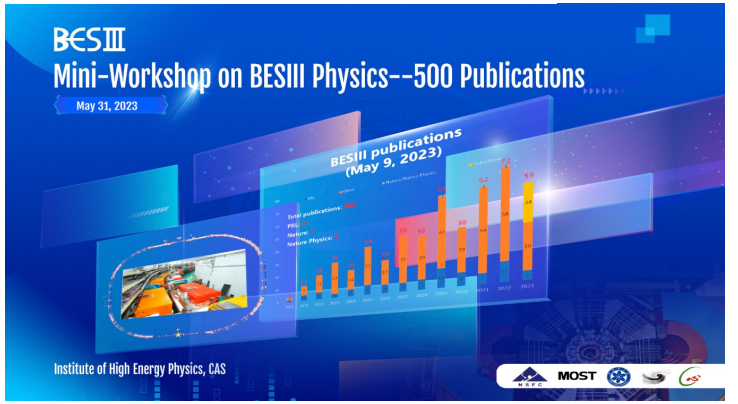
LUMINOSITY (INTEGRAL&PEAK) + PUBLICATION RECORDS : 2010-2023





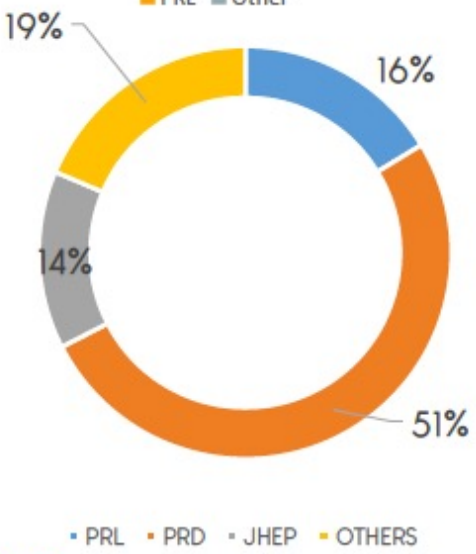






PUBLICATIONS

BESIII Physics Journal Publications



	A100	A75	A50	A25	R1	R2-PC	R2-CWR
PRL (7)						1	
PRD (41)	1				3	10	12
JHEP (6)							
Others (8)						2	

62

29

Study of the $h_c(1^1P_1)$ meson via $\psi(2S) \to \pi^0 h_c$ decays at BESIII

M. Ablikim,[1] M. N. Achasov,[9,b] P. Adlarson,[68] S. Ahmed,[14] M. Albrecht,[4] R. Aliberti,[28] A. Amoroso,[67a,67c] M. R. An,[32] Q. An,[64,50] X. H. Bai,[58] Y. Bai,[49] O. Bakina,[29] R. Baldini Ferroli,[23a] I. Balossino,[24a] Y. Ban,[39,k] V. Batozskaya,[1,37] D. Becker,[28] K. Begzsuren,[26] N. Berger,[28] M. Bertani,[23a] D. Bettoni,[24a] F. Bianchi,[67a,67c] J. Biernat,[68] J. Bloms,[61] A. Bortone,[67a,67c] I. Boyko,[29] R. A. Briere,[5] A. Brueggemann,[61] H. Cai,[69] X. Cai,[1,50] A. Calcaterra,[23a] G. F. Cao,[1,55] N. Cao,[1,55] S. A. Cetin,[54a] J. F. Chang,[1,50] W. L. Chang,[1,55] G. Chelkov,[29,a] C. Chen,[36] G. Chen,[1] H. S. Chen,[1,55] M. L. Chen,[1,50] S. J. Chen,[35] T. Chen,[1] X. R. Chen,[25] X. T. Chen,[1] Y. B. Chen,[1,50] Z. J. Chen,[20,l] W. S. Cheng,[67c] G. Cibinetto,[24a] F. Cossio,[67c] J. J. Cui,[42] H. L. Dai,[1,50] J. P. Dai,[71] A. Dbeyssi,[14] R. E. de Boer,[4] D. Dedovich,[29] Z. Y. Deng,[1] A. Denig,[28] I. Denysenko,[29] M. Destefanis,[67a,67c] F. De Mori,[67a,67c] Y. Ding,[33] J. Dong,[1,50] L. Y. Dong,[1,55] M. Y. Dong,[1,50,55] X. Dong,[69] S. X. Du,[73] P. Egorov,[29,a] Y. L. Fan,[69] J. Fang,[1,50] S. S. Fang,[1,55] Y. Fang,[1] R. Farinelli,[24a] L. Fava,[67b,67c] F. Feldbauer,[4] G. Felici,[23a] C. Q. Feng,[64,50] J. H. Feng,[51] K. Fischer,[62] M. Fritsch,[4] C. D. Fu,[1] Y. N. Gao,[39,k] Yang Gao,[64,50] I. Garzia,[24a,24b] P. T. Ge,[69] C. Geng,[51] E. M. Gersabeck,[59] A. Gilman,[62] K. Goetzen,[11] L. Gong,[33] W. X. Gong,[1,50] W. Gradl,[28] M. Greco,[67a,67c] M. H. Gu,[1,50] C. Y. Guan,[1,55] A. Q. Guo,[25] A. Q. Guo,[22] L. B. Guo,[34] R. P. Guo,[41] Y. P. Guo,[9,g] A. Guskov,[29,a] T. T. Han,[42] W. Y. Han,[32] X. Q. Hao,[15] F. A. Harris,[57] K. K. He,[47] K. L. He,[1,55] F. H. Heinsius,[4] C. H. Heinz,[28] Y. K. Heng,[1,50,55] C. Herold,[52] M. Himmelreich,[11,e] T. Holtmann,[4] G. Y. Hou,[1,55] Y. R. Hou,[55] Z. L. Hou,[1] H. M. Hu,[1,55] J. F. Hu,[48,j] T. Hu,[1,50,55] Y. Hu,[1] G. S. Huang,[64,50] K. X. Huang,[51] L. Q. Huang,[65] X. T. Huang,[42] Y. P. Huang,[1] Z. Huang,[39,k] T. Hussain,[66] N. Hüsken,[22,28] W. Imoehl,[22] M. Irshad,[64,50] S. Jaeger,[4] S. Janchiv,[26,g] Q. Ji,[1] Q. P. Ji,[15] X. B. Ji,[1,55] X. L. Ji,[1,50] Y. Y. Ji,[42] H. B. Jiang,[42] S. S. Jiang,[32] X. S. Jiang,[1,50,55] J. B. Jiao,[42] Z. Jiao,[18] S. Jin,[35] Y. Jin,[58] M. Q. Jing,[1,55] T. Johansson,[68] N. Kalantar-Nayestanaki,[56] X. S. Kang,[33] R. Kappert,[56] M. Kavatsyuk,[56] B. C. Ke,[73] I. K. Keshk,[4] A. Khoukaz,[61] P. Kiese,[28] R. Kiuchi,[1] R. Kliemt,[11] L. Koch,[30] O. B. Kolcu,[54a] B. Kopf,[4] M. Kuemmel,[4] M. Kuessner,[4] A. Kupsc,[37,68] W. Kühn,[30] J. J. Lane,[59] J. S. Lange,[30] P. Larin,[14] A. Lavania,[21] L. Lavezzi,[67a,67c] Z. H. Lei,[64,50] H. Leithoff,[28] M. Lellmann,[28] T. Lenz,[28] C. Li,[40] C. Li,[36] C. H. Li,[32] Cheng Li,[64,50] D. M. Li,[73] F. Li,[1,50] G. Li,[1] H. Li,[64,50] H. Li,[44] H. B. Li,[1,55] H. J. Li,[15] H. N. Li,[48,j] J. L. 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Luo,[9,g] X. L. Luo,[1,50] X. R. Lyu,[55] Y. F. Lyu,[36] F. C. Ma,[33] H. L. Ma,[1] L. L. Ma,[42] M. M. Ma,[1,55] Q. M. Ma,[1] R. Q. Ma,[1,55] R. T. Ma,[55] X. Y. Ma,[1,50] Y. Ma,[39,k] F. E. Maas,[14] M. Maggiora,[67a,67c] S. Maldaner,[4] S. Malde,[62] Q. A. Malik,[66] A. Mangoni,[23b] Y. J. Mao,[39,k] Z. P. Mao,[1] S. Marcello,[67a,67c] Z. X. Meng,[58] J. G. Messchendorp,[56,d] G. Mezzadri,[24a] H. Miao,[1] T. J. Min,[35] R. E. Mitchell,[22] X. H. Mo,[1,50,55] N. Yu. Muchnoi,[10,b] H. Muramatsu,[60] S. Nakhoul,[11,e] Y. Nefedov,[29] F. Nerling,[11,e] I. B. Nikolaev,[10,b] Z. Ning,[1,50] S. Nisar,[8,m] S. L. Olsen,[55] Q. Ouyang,[1,50,55] S. Pacetti,[23b,23c] X. Pan,[9,g] Y. Pan,[58] A. Pathak,[1] A. Pathak,[27] M. Pelizaeus,[4] H. P. Peng,[64,50] K. Peters,[11,e] J. Pettersson,[68] J. L. Ping,[34] R. G. Ping,[1,55] S. Plura,[28] S. Pogodin,[29] R. Poling,[60] V. Prasad,[64,50] H. Qi,[64,50] H. R. Qi,[53] M. Qi,[35] T. Y. Qi,[9,g] S. Qian,[1,50] W. B. Qian,[55] Z. Qian,[51] C. F. 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Improvement of the CGEM detector simulation with cosmic-rays

X.L. Lu,[a,b] L.L. Wang,[a,b,*] H. Zhou,[c] Z.H. Zhang,[a,b] L.H. Wu,[a,b] H.M. Liu,[a,b] A. Amoroso,[d,e] R. Baldini Ferroli,[f] I. Balossino,[e,*] M. Bertani,[f] D. Bettoni,[g] F. Bianchi,[d,e] A. Bortone,[d,e] G. Cibinetto,[g] A. Cotta Ramusino,[e] F. Cossio,[e] G. Cotto,[d,e] M.Y. Dong,[a,b] M. Da Rocha Rolo,[e] F. De Mori,[d,e] M. Destefanis,[d,e] J. Dong,[a] F. Evangelisti,[h,g] R. Farinelli,[g] L. Fava,[i,e] G. Felici,[f] I. Garzia,[h,g] M. Gatta,[f] G. Girsudo,[e] S. Gramigna,[h,g] S. Garbolino,[e] M. Greco,[d,e] A.Q. Guo,[i,b] Z. Huang,[k] Y.R. Hou,[b] W. Imoehl,[l] L. Lavezzi,[d,e] M. Maggiora,[d,e] F.M. Melendi,[h,g] R. Malaguti,[g] A. Mangoni,[m,f] S. Marcello,[d,e] M. Melchiorri,[g] G. Mezzadri,[g] R.E. Mitchell,[l] Q. Ouyang,[a,b] S. Pacetti,[m,f] P. Patteri,[f] A. Rivetti,[e] R.S. Shi,[a,b] M. Scodeggio,[h,g] S. Sosio,[d,e] S. Spataro,[d,e] B.L. Wang,[b] H.P. Wang,[a,b] Y. Zhang[a,b] and J.Y. Zhao[a,b]

ITALIAN ANALYSES

1. Phase measurements task force
   - Measurement of the phase between Strong and Electromagnetic $J/\psi \rightarrow p\bar{p}$ Decay Amplitudes– under review
   - $J/\psi \rightarrow K^+K^-$ via $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$– CWR stated on August 23
   - Study of $\pi^+\pi^- J/\psi$ around psi(2S) mass using 2018 scan data– MC studies and fits optimization ongoing
2. Analysis of $J/\psi \rightarrow p\bar{p}$ via $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$
   - Collaboration with Meichen Yu started. Analysis in a good shape
3. Study of the $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ reaction at $s > 4.600$ GeV and search for the charged Zc(4430) exotic state– analysis very close to the review
4. Psi(2S)–>tau tau: a way to test LFUV @ BESIII– in review; first draft ready and submitted to the analysis reviewers
5. Involved in about 15 review committees of physics analysis

CIF Conveners> M. Bertani I.Garzia

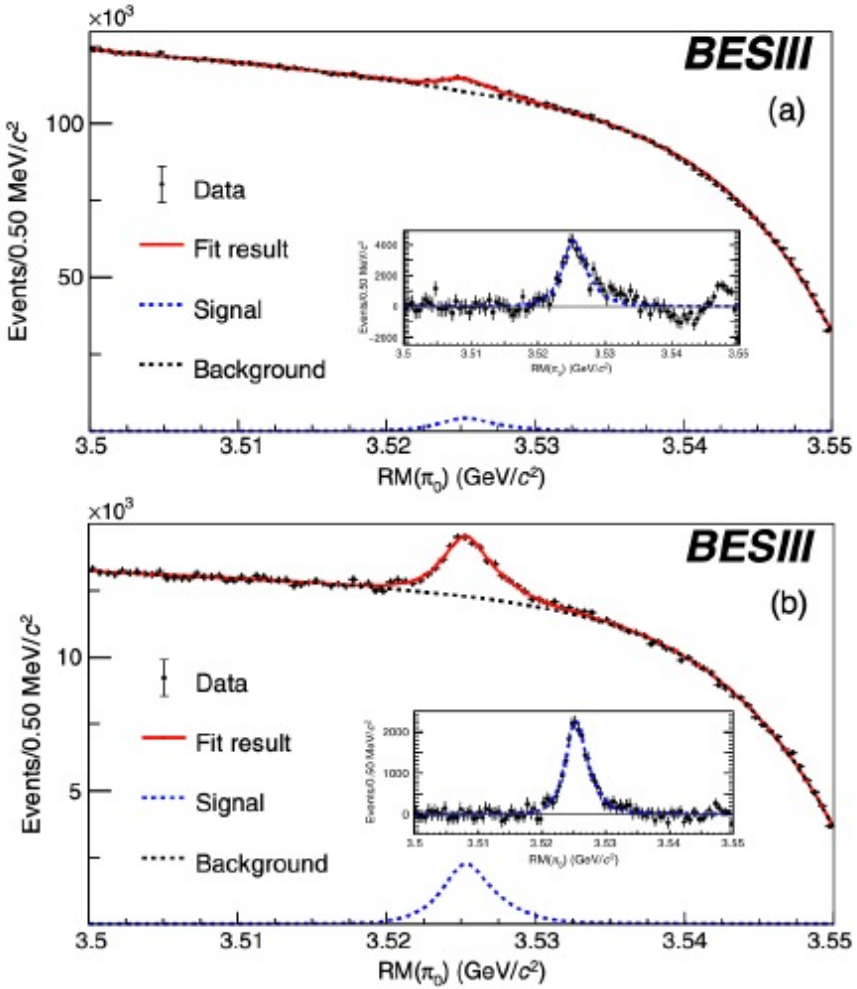
Convener light hadron physics> I.Garzia
Italian coordination of a working group on phase, inside BESIII R/τ/QCD working group >F. De Mori

Study of the $h_c(1^1P_1)$ meson via $\psi(2S) \to \pi^0 h_c$ decays at BESIII

PRD106,072007

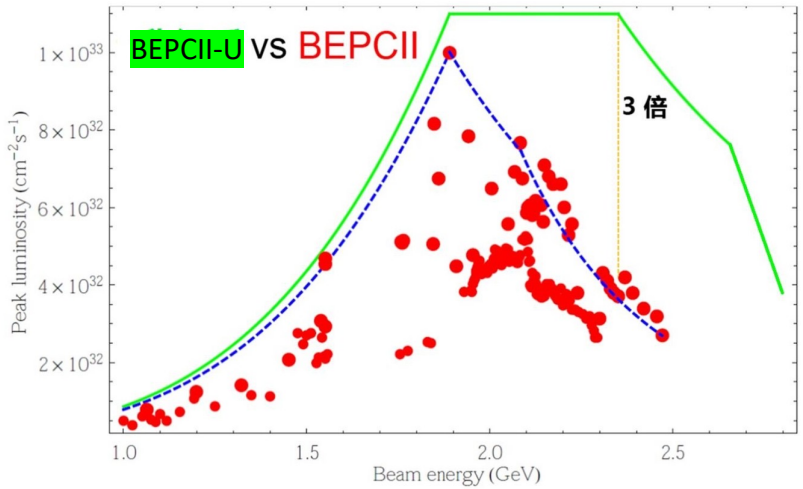
- Master thesis analysis (M. Scodeggio)
- Two decay channels involving the h_c charmonium state
  - inclusive: $\psi(2S) \to \pi^0 h_c$; $h_c \to$ anything
  - tagged: $\psi(2S) \to \pi^0 h_c$; $h_c \to \gamma \eta_c$

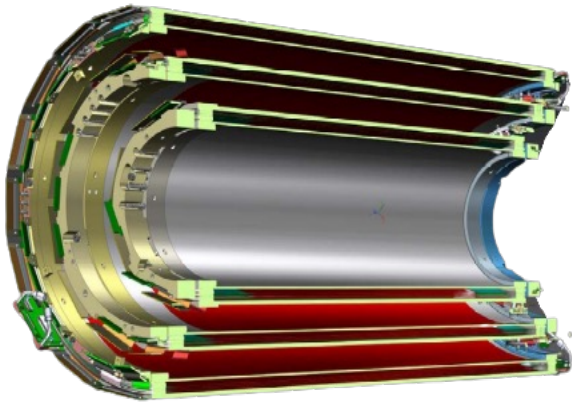
Variable	Value	PDG value [5]
$M(h_c)$ (MeV/c^2)	$3525.32 \pm 0.06 \pm 0.15$	3525.38 ± 0.11
$\Gamma(h_c)$ (MeV)	$0.78^{+0.27}_{-0.24} \pm 0.12$	$0.70 \pm 0.28 \pm 0.22$ (BESIII [7])
$N_{\rm Tag}(h_c)$	23118^{+1500}_{-1398}	...
$\mathcal{B}_{\rm Inc} \times \mathcal{B}_{\rm Tag}$ (10^{-4})	$4.22^{+0.27}_{-0.26} \pm 0.19$	4.58 ± 0.64 (BESIII [6]) 4.16 ± 0.48 (CLEO [8])
$N_{\rm Inc}(h_c)$	46187 ± 2123	...
$\mathcal{B}_{\rm Inc}$ (10^{-4})	$7.32 \pm 0.34 \pm 0.41$	$8.40 \pm 1.30 \pm 1.00$ (BESIII [6]) $9.00 \pm 1.5 \pm 1.3$ (CLEO [25])
$\mathcal{B}_{\rm Tag}$ (%)	$57.66^{+3.62}_{-3.50} \pm 0.58$	$53 \pm 7 \pm 8$ (BESIII [6]) $48 \pm 6 \pm 7$ (CLEO [8])



>2024

Machine and Detector upgrade foreseen July-December 2024





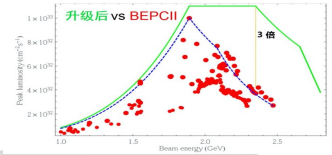
CGEM-IT

2020
White Paper of BESIII

Jun. 2021
Feasibility Study Report

Apr. 2022
Design Finished

Jul. 2024
Shutdown for Installation



BEPCII keep running

Internal Review of Accelerator
May. 2020

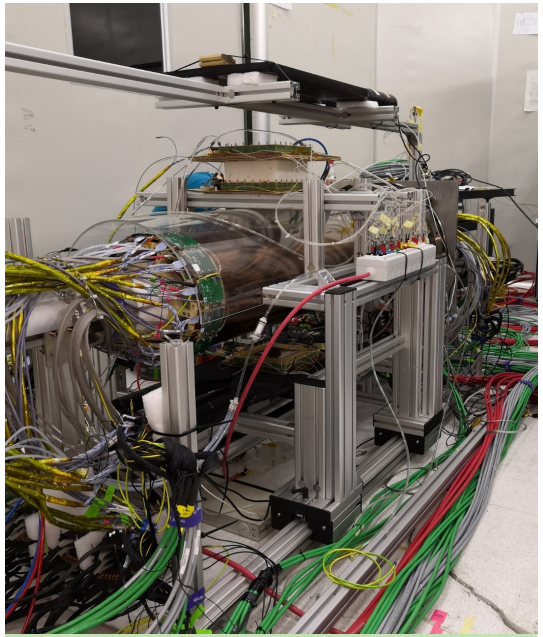
Project Approved
Jul. 2021

Fabrication Finished
Jun. 2024

Commissioning
Jan. 2025

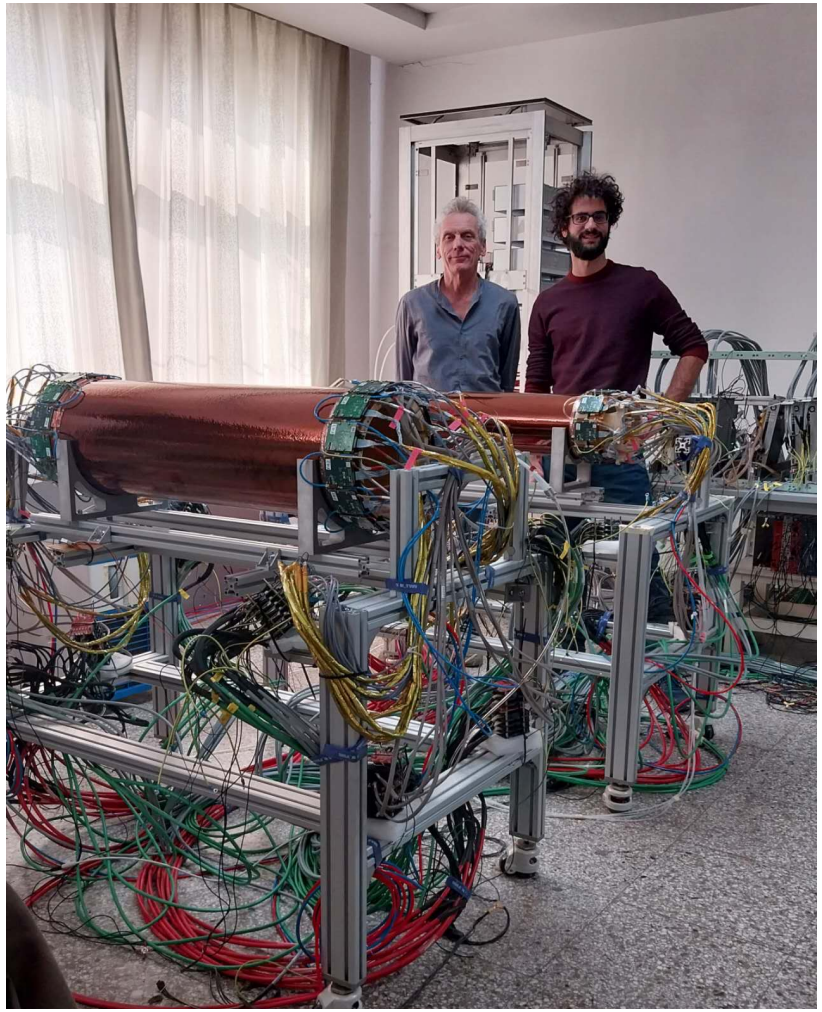
- ✓ **Phase I (2024): @ 2.35GeV, Luminosity tripled to11x$10^{32}$$cm^{-2}s^{-1}$**
- ✓ **Phase II (2028): Push higher energy, 2.47GeV-» 2.80GeV**

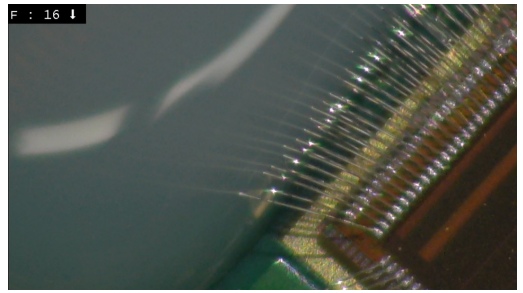
CGEM: L1&L2 operations



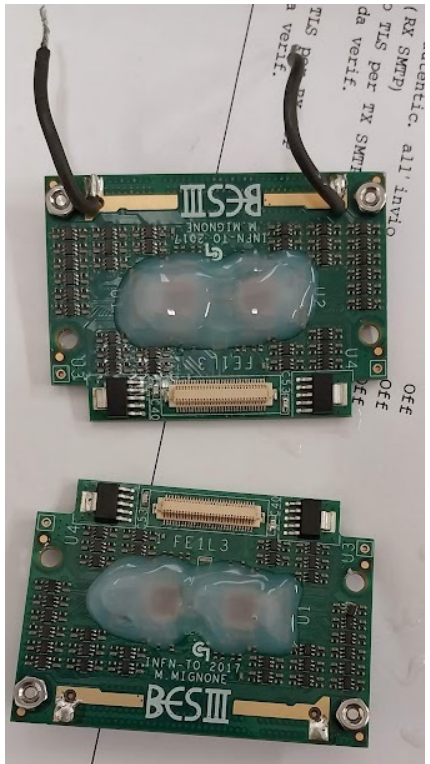
Layer 1+Layer 2 at IHEP
About 3 yrs of remote operation

Maintenance
-Feb/March 2023
-July 2023





Wirebond encapsulation

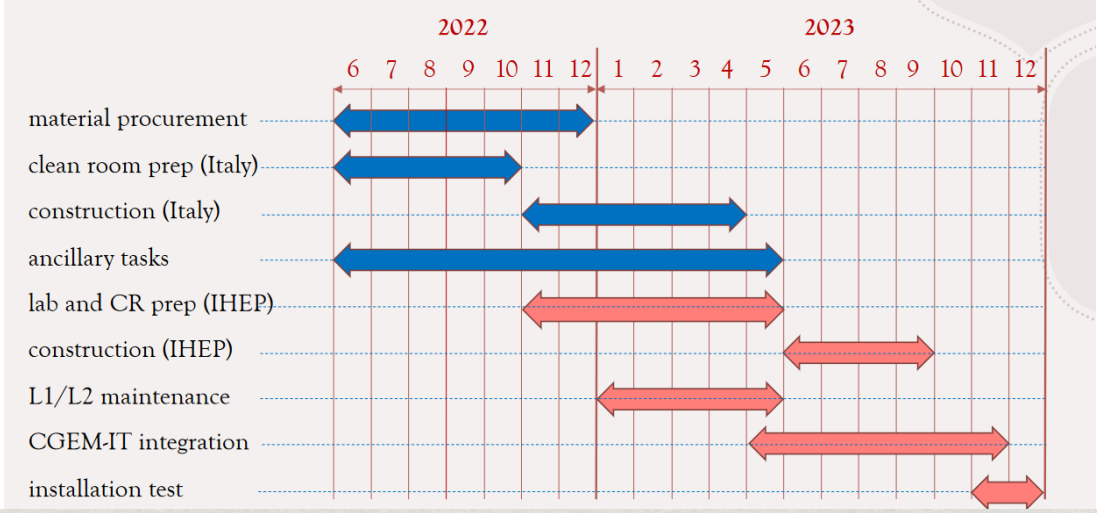


Layer 1&2 :
wb encapsulation
now@IHEP

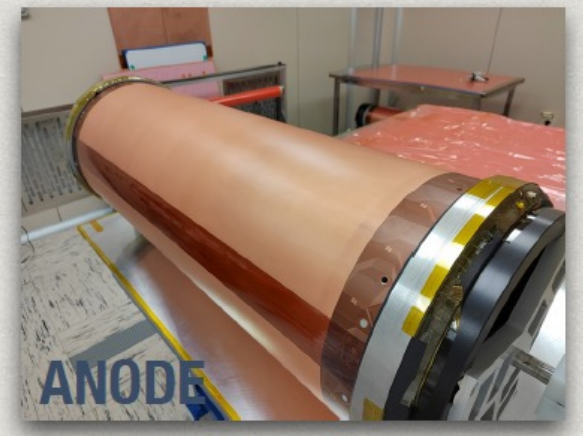
Layer 3:
wb encapsulation
before mounting FEBs
@INFN-Torino

CGEM: L3

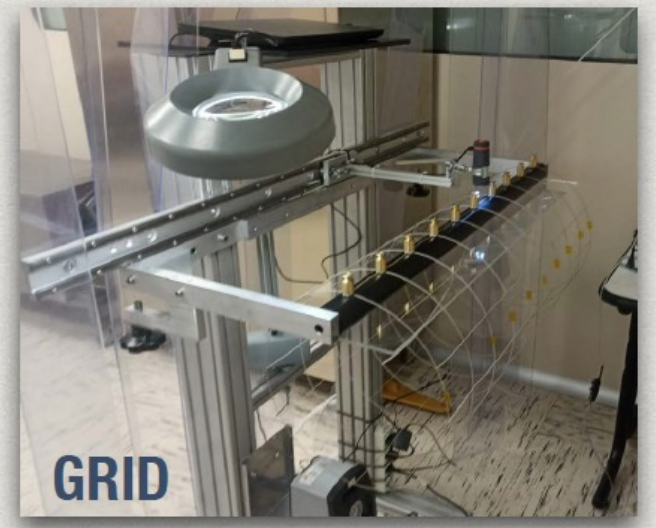
Layer 3 → Hybrid construction solution as the only possibility to match 2024 shut down



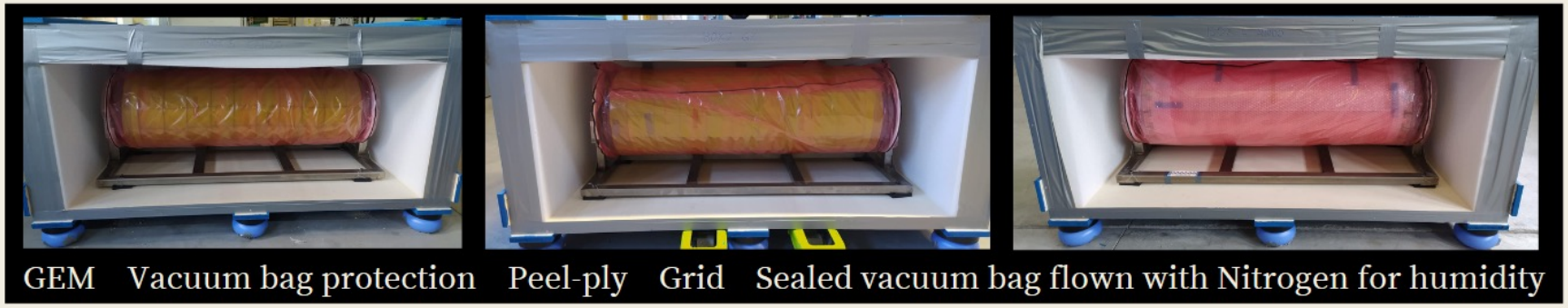
I.Balossino



@ INFN-Ferrara



CGEM: shipment



Ready to be shipped

Arriving @ IHEP

Vertical Inserting Machine

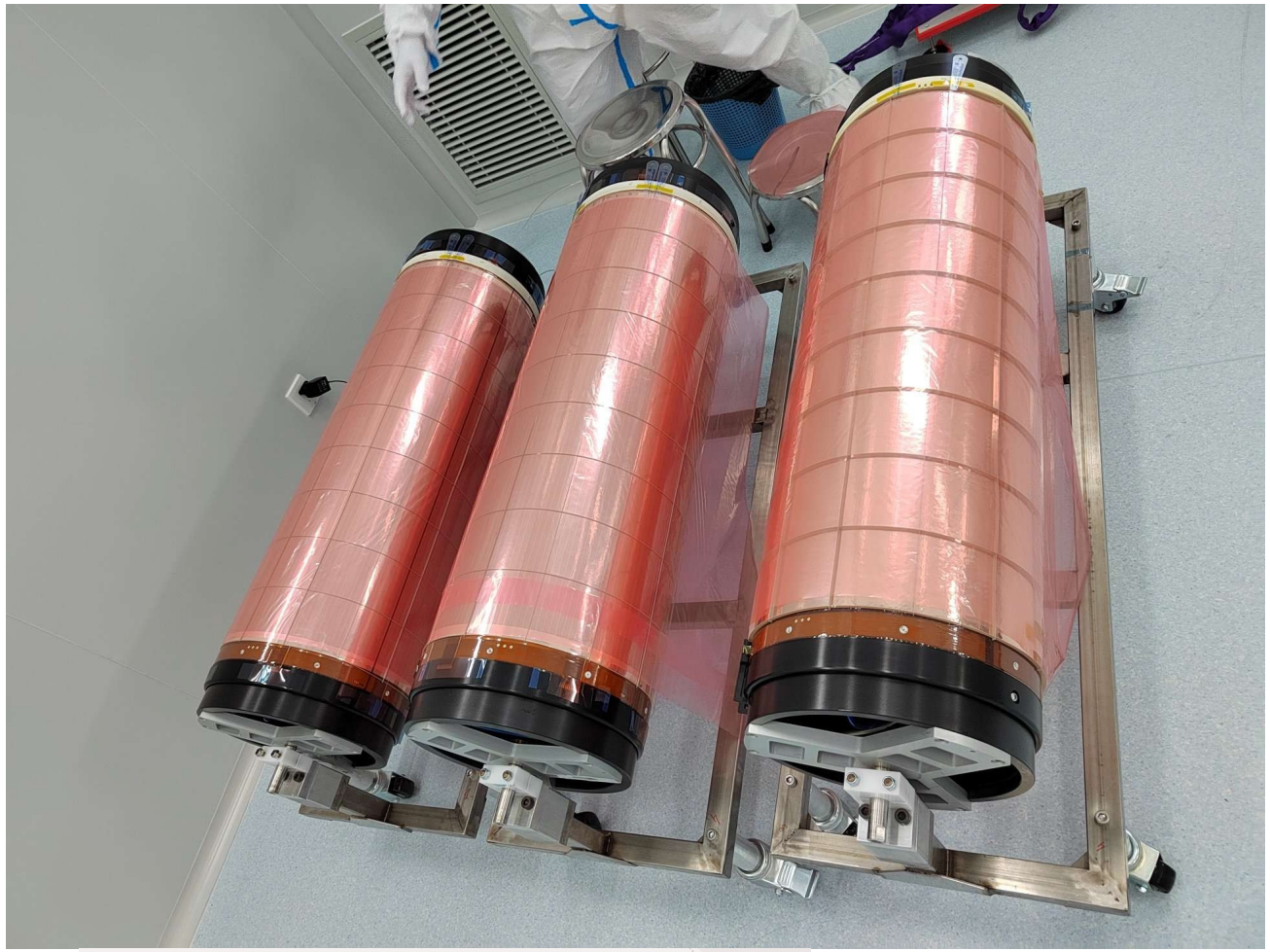
From LNF,
to FE,
to IHEP!

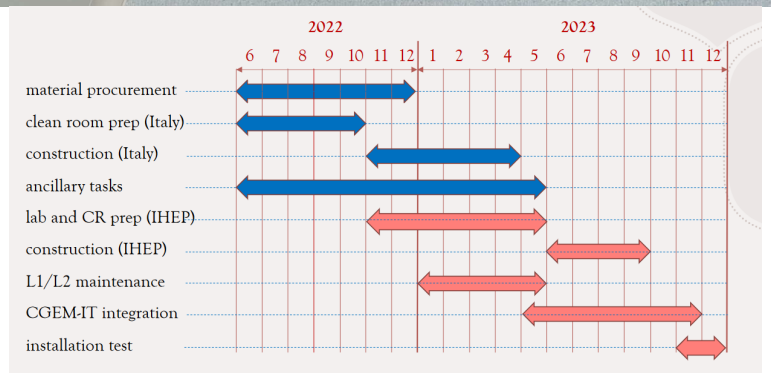
Overall status of the shipment was good

Checked the alignment of the VIM parts -> ALL OK -> ready for the mandrels

installed @ IHEP in June 2023

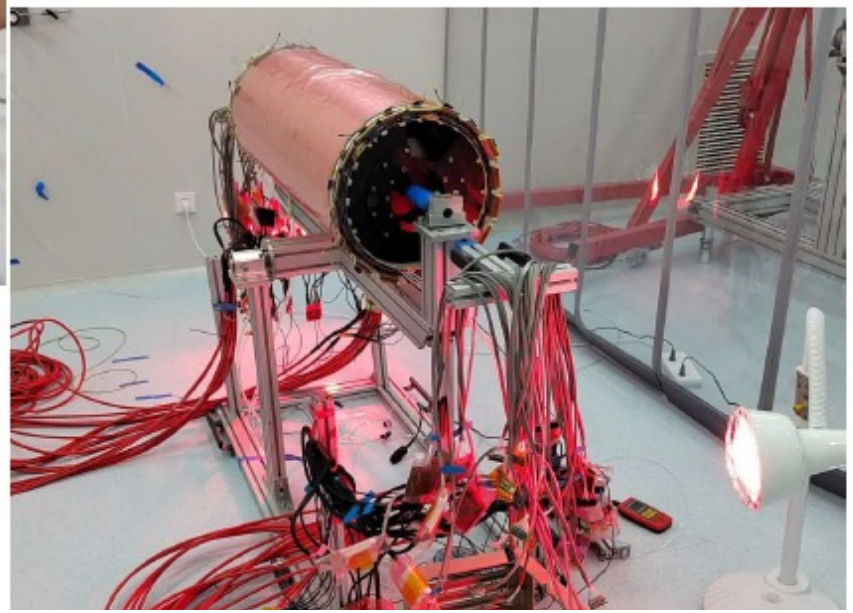
CGEM: L3 assembly@IHEP clean room





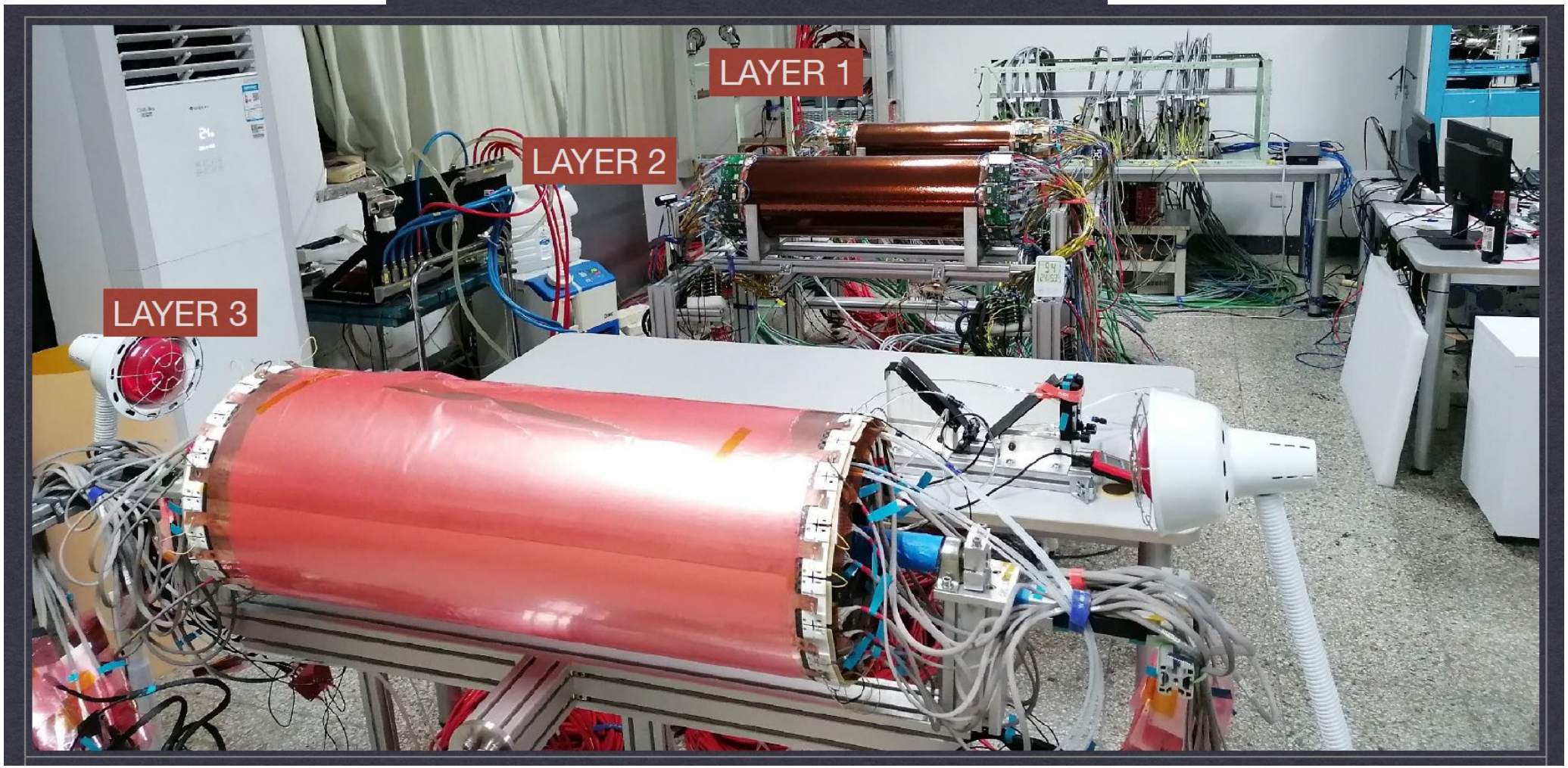
CGEM: Layer 3 timeline

Layer 3 completed successfully@ IHEP



- [x] Assembly of individual cylinders (Mar-Apr)
- [x] Spedizione dei cilindri e della clessidra ad IHEP (apr)
- [x] Messa in opera e allineamento della clessidra (may-jun)
- [x] Assemblaggio del layer 3 (jul)
- [x] Sigillature e test di tenuta gas (jul-aug)
- [x] Validazione HV (jul-aug)

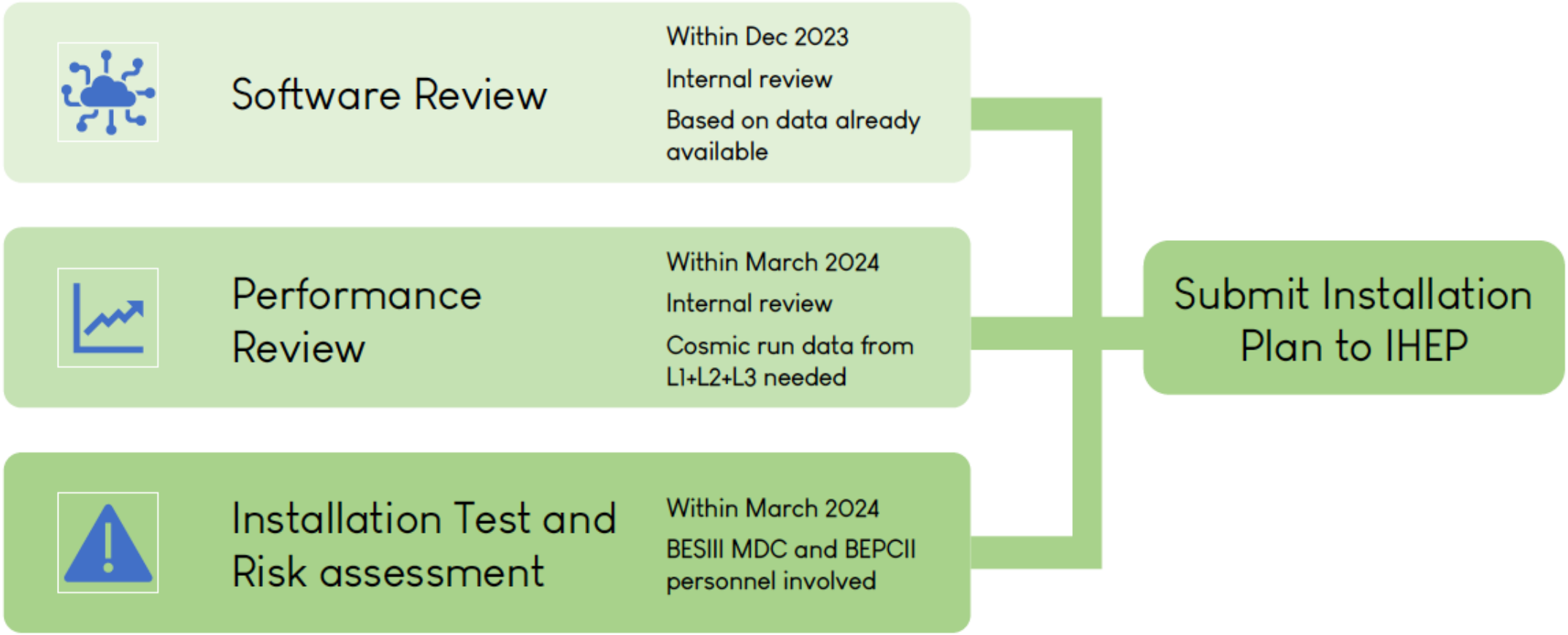
THE THREE CGEM LAYERS @ IHEP



CGEM timeline

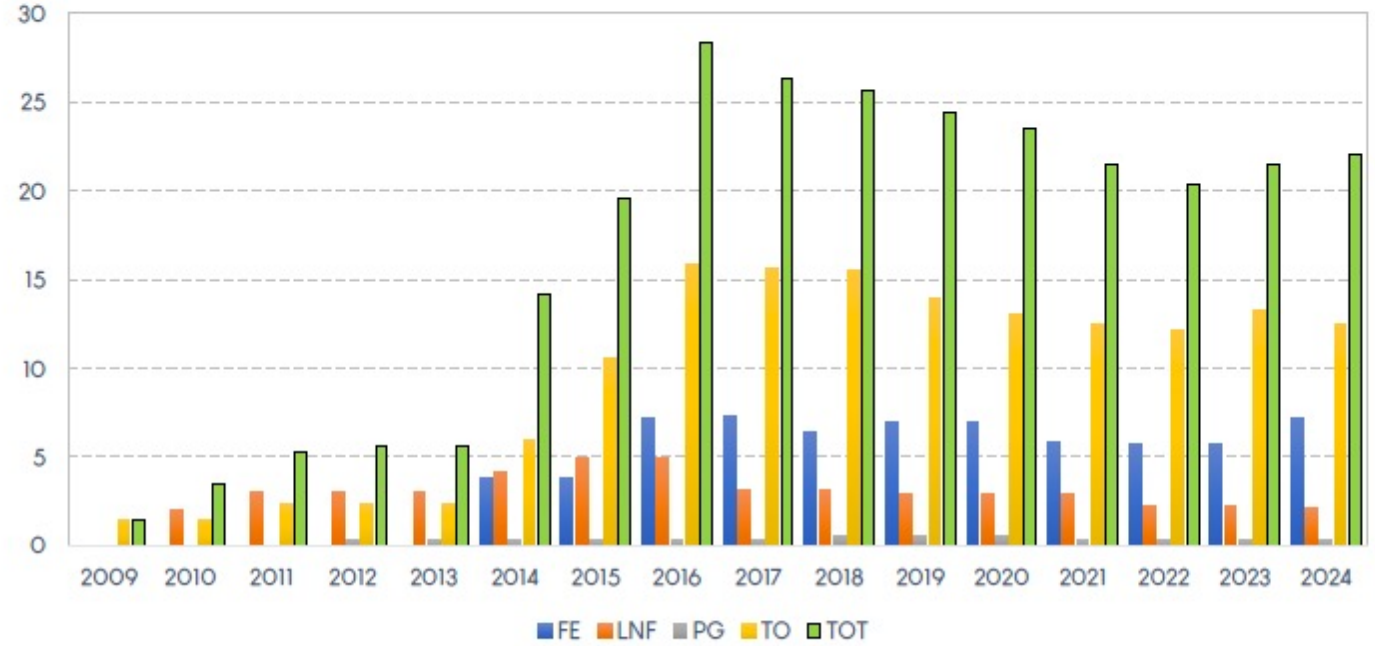
Settembre	Manutenzione catena HV ✓ Installazione dell'elettronica di Layer 3 ✓ Standalone test con cosmici o con sorgente
Ottobre	Assemblaggio dei tre layer del CGEM-IT Cablaggio elettronica e preparazione per run di cosmici
da Novembre	Run di cosmici Misura delle prestazioni dei rivelatori

CGEM qualification



CGEM software activities

Geometry	Implementation of the definitive design of the complete CGEM detector Estimation of the radiation length, and of possible effects on the EMC	Definitive design of L3 recently implemented Validation in progress
Digitization	Complete description of the MC signal modelling, from ionization to the electronics readout response Comparison of simulation with real data from 2-layer cosmics data (run 17)	Complete digitization chain ready Good agreement with run 17 after tuning Published in Journal of Instrumentation
Global Tracking	Complete reconstruction of charged tracks using outer MDCs and CGEM Characterization of tracking performances (resolution, efficiency) with particle gun, comparison with standard MDC	Global tracking ready Improvement ongoing based on CA Quality Assurance code ready
Analysis of benchmark channels	Performance (reconstruction efficiency, invariant mass resolution, vertex resolution) compared to standard MDC tracking	Currently creating the Working Group Choice of benchmark channels under evaluation



22.05 FTE
~40 authors (~7% of the total)
~0.6 authors/FTE
55 physicists + technologists+technicians

	FTE/f	FTE/t
FE	7	0.20
LNF	1.4	0.70
PG	0.3	-
TO	8.6	3.85

FTE	2024	2023
FE	7.2	5.7
LNF	2.10	2.25
PG	0.3	0.3
TO	12.45	13.25

Responsibility roles

- **G. Cibinetto, SM BESIII CGEM-IT Project**, Member of Technical Board
- **M. Maggiora**: Director of IHEP-INFN Joint Laboratory, Member of BESIII Executive Board, RISE FEST Coordinator;
- **M. Bertani, G.Mezzadri, M. Maggiora**, Members of BESIII Institutional Board
- **M. Greco**: Italian BESIII Coordinator for INFN, Convener of BESIII CGEM and FEST electronics, Convener of BESIII CGEM Integration
- **F. Bianchi**: Deputy Chair of BESIII Speakers' Bureau
- **I. Garzia:** Convener Light Hadron WG
- **F. De Mori**: Coordinator working group on phase
- **M. Rolo**: Convener of BESIII CGEM microelectronics, Convener of FEST microelectronics and medical applications
- **S. Spataro**: Convener SW BESIII CGEM, Publication Committee Member

谢谢

谢谢

HEP operation in 2022~2023

Physical data 8.2 fb^{-1}, new record for BEPCII !

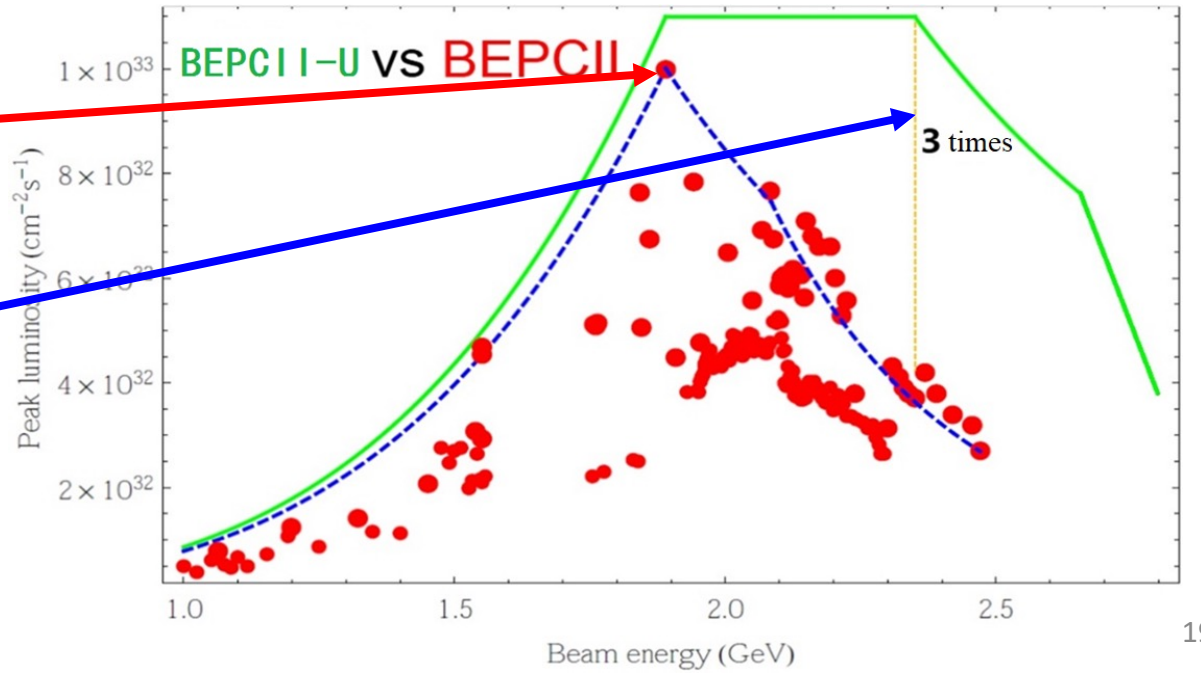
Table 7.1: List of data samples collected by BESIII/BEPCII up to 2019, and the proposed samples for the remainder of the physics program. The most right column shows the number of required data taking days in current (T_C) or upgraded (T_U) machine. The machine upgrades include top-up implementation 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)	250/130 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

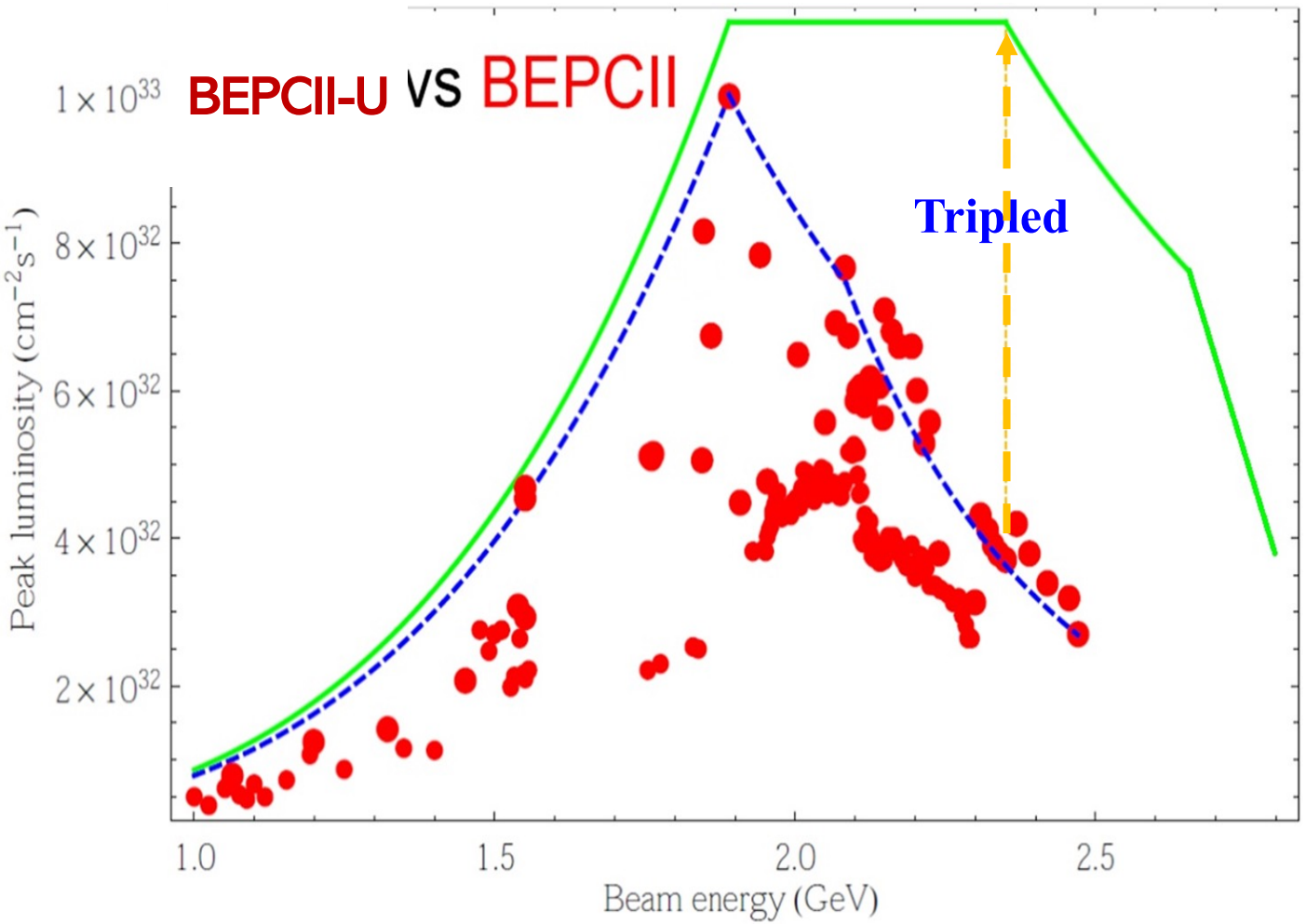
Goal：Integral luminosity > 6 fb^{-1}

$\psi(3770)$, 8.2 fb^{-1} ← 219 days

Remaining 3.8 fb^{-1}, lower pressure for accelerator operation in 2023~2024



BEPCII-U: Energy and Luminosity Goal



	BEPCII	BEPCII-U
luminostiy $[10^{32}cm^{-2}s^{-1}]$ @2.35GeV	3.5	11
β_y^* [cm]	1.5	1.35
Beam current[mA]	400	900
SR Power [kW]	110	250
$\xi_{y,lum}$	0.029	0.033
emittance[nmrad]	147	152
couple [%]	0.53	0.35
Bucket Height	0.0069	0.011
$\sigma_{z,0}$ [cm]	1.54	1.07
σ_z [cm]	1.69	1.22
Rf voltage	1.6MV	3.3MV

- 2024 .7-12, Shut down for hardware dismantling and installation
- 2025-2028, Operation at 2.3~2.5GeV, prepare for energy upgrade
- 2028.6-9, Energy upgrade to 2.8GeV
- 2028.9~2030, Operation at 2.5~2.8GeV

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

The Energy and Luminosity Update on BEPCII

Urgency from HEP

Future Physics Program of BESIII, Chin. Phys. C 44, 040001 (2020)

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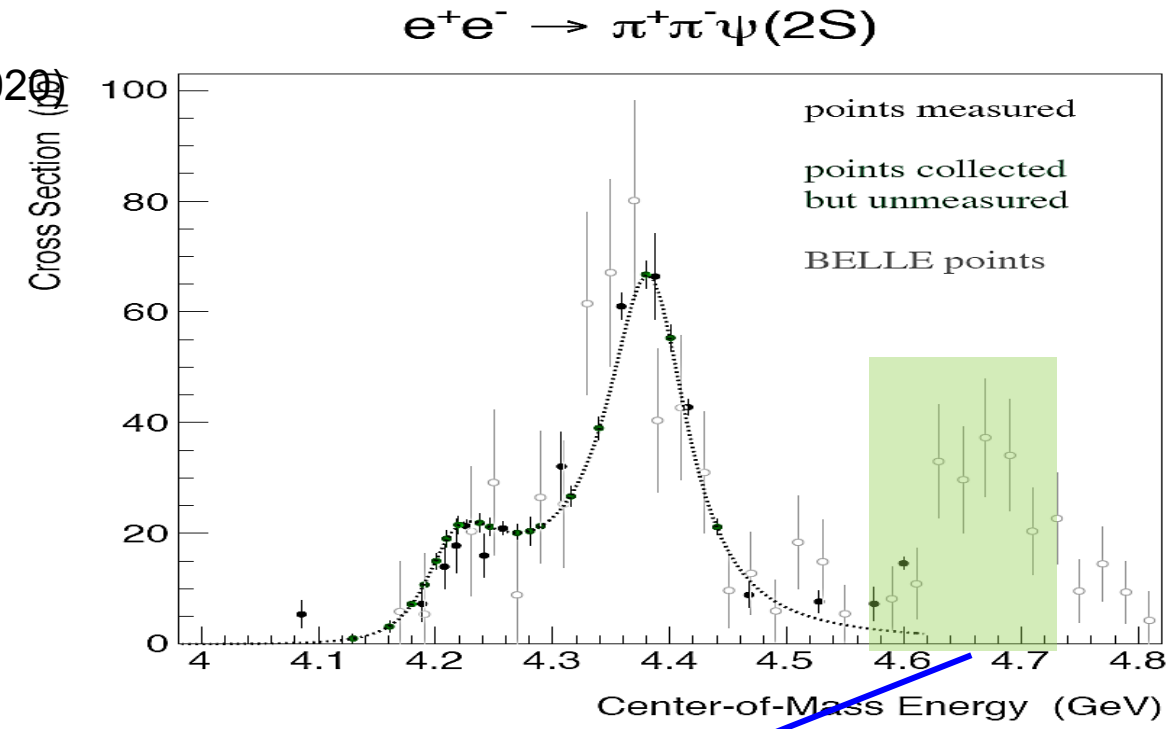


ripresi da qualche mese i viaggi in Cina dopo la pandemia

➢ **Run 2022- 23; sette mesi di presa dati come programmato:**

✓ 8.0 fb^{-1} proseguimento presa dati al picco di $\psi(3770)$ per lo studio dei decadimenti D^0/ $D^{+,-}$

✓ 7.4 fb^{-1} nei due anni passati, *da continuarsi nel 2024 fino a raggiungere 20fb^{-1}*

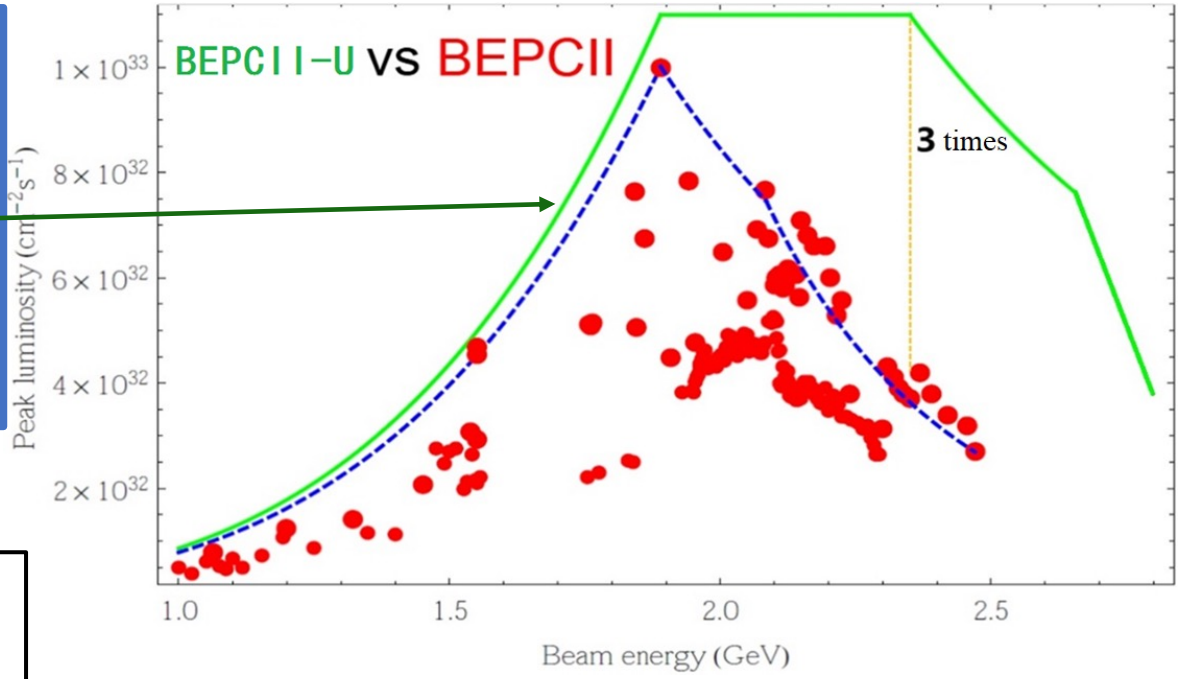
✓ I rivelatori di BESIII stanno funzionando senza problemi

Stato di BEPCII , e^+e^- collider @ Ecm = 2.0 – 4.9 GeV

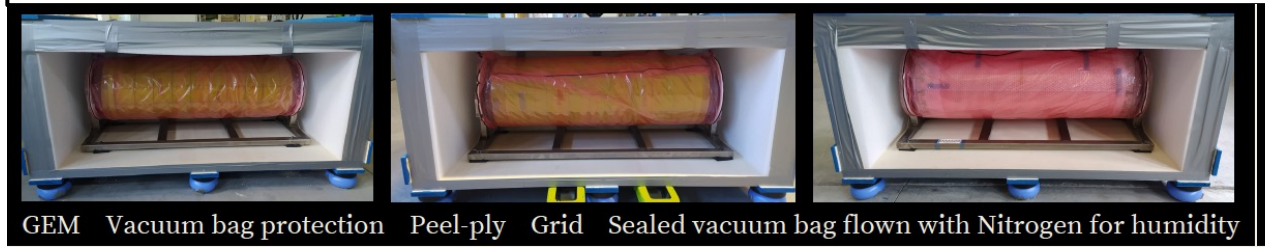
✓ opera di routine alla luminosità di disegno $1.0\times10^{33}cm^{-2}s^{-1}$ @ Ecm = 3.77 GeV, I_b=920mA*920mA e 118 bunch

✓ nel 2024 upgrade in luminosità (fattore 3@E_b=2.35 GeV)

✓ nel 2028 upgrade in energia: E_b=2.45 GeV-->2.8GeV



Il BESIII-CGEM IT è in fase di completamento all'IHEP di Pechino, verrà installato nel lungo shutdown dell'estate 2024 per l'upgrade di BEPCII. I 5 elettrodi costruiti a Ferrara e spediti in Cina:



Geometry

Implementation of the definitive design of the complete CGEM detector

Estimation of the radiation length, and of possible effects on the EMC

Digitization

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Comparison of simulation with real data from 2-layer cosmics data (run 17)

Global Tracking

Complete reconstruction of charged tracks using outer MDCs and CGEM

Characterization of tracking performances (resolution, efficiency) with particle gun, comparison with standard MDC

Analysis of benchmark channels

Performance (reconstruction efficiency, invariant mass resolution, vertex resolution) compared to standard MDC tracking

- → phase space events with n-prong pions
- → low multiplicity events (such as $e^+e^- \to p\bar{p}$)
- → standard charmonium decays $\psi(2S) \to J/\psi\pi^+\pi^-$
- → higher multiplicity events (i.e. over DD threshold)
- → hyperon production (to study displaced vertices)