IHEP and its large scientific facilities

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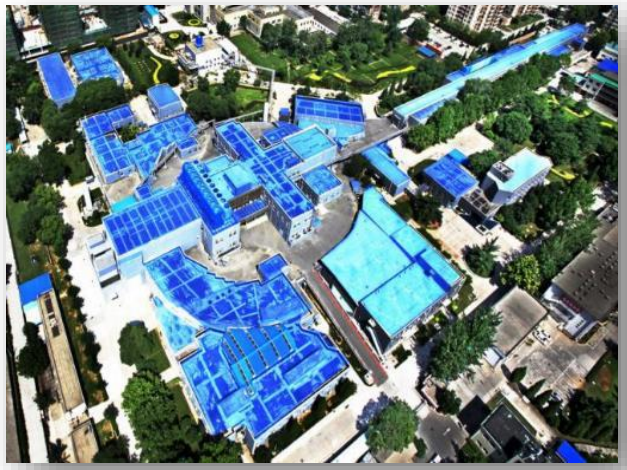
Overview

- The largest research institute on basic science in China, with 4 campuses, ~1,500 employees, ~1,000 graduate students and an annual budget of ~ $500M
- A world-class research center for high energy physics, astro-particle physics and multi-disciplinary research based on synchrotron radiation and spallation neutron facilities



Shijingshan, Beijing

Dongguan, Guangdong

Huairou, Beijing

Jinan, Shandong

History

1950	1953	1958	1973
Institute of Modern Physics	Institute of Physics	Institute of Atomic Energy	Institute of High Energy Physics

The institute starts from the construction of Beijing Electron Position Collider (BEPC) in 80s, and now becomes a large research center

Frontiers of Basic Science

Particle Physics

- Accelerator-based HEP Experiments
- Particle Astrophysics & Neutrino Experiments
- Particle Detection and Electronics
- Particle Physics Theory

Strategic High-Tech

Accelerator Physics and Technologies

- High Luminosity Electron Accelerators
- High Intensity Proton Accelerators
- Applied Research and Technology Transfer

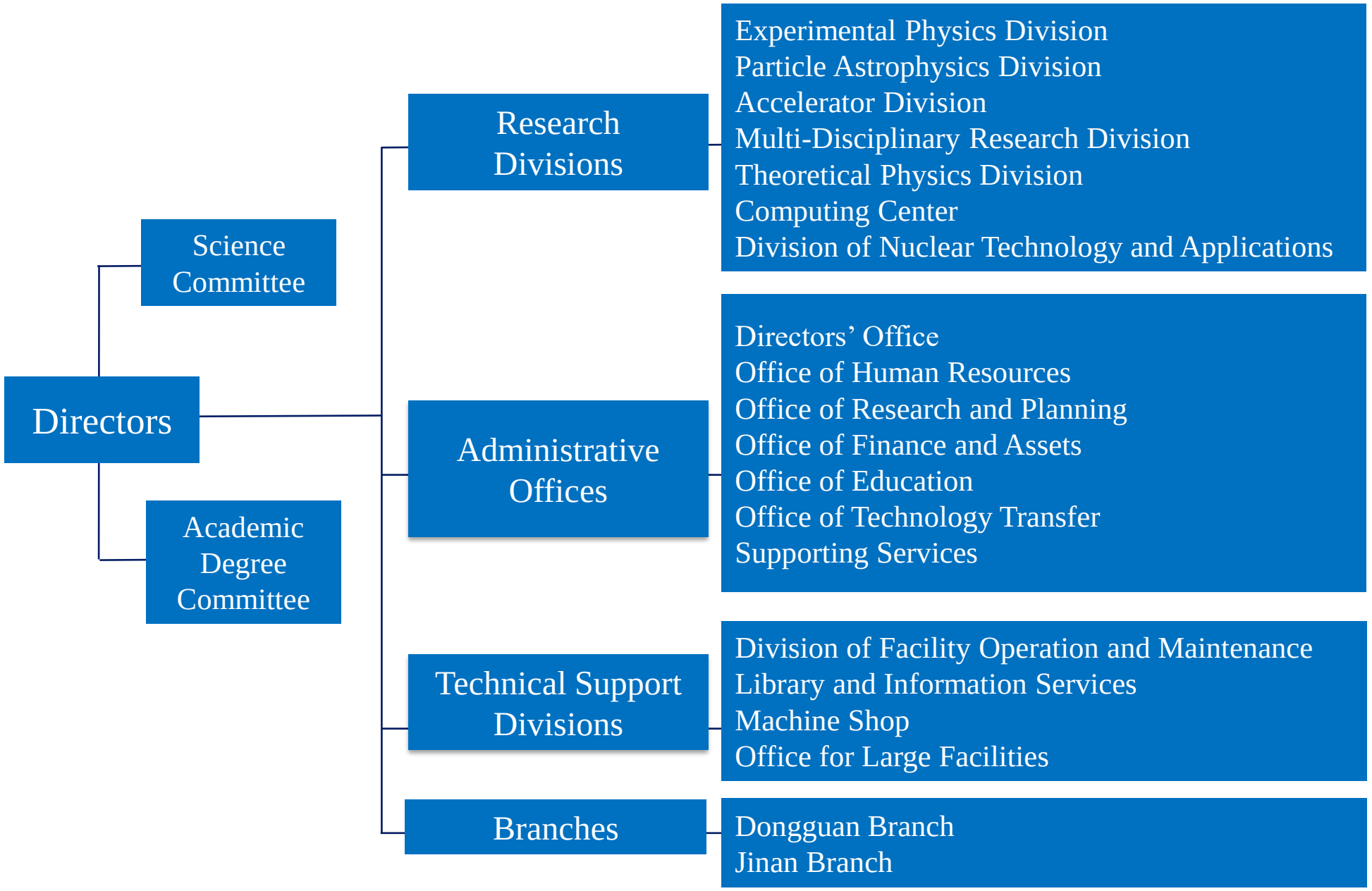
Multi-disciplinary research platforms

Radiation Technologies and Applications

- Synchrotron Radiation & Applications
- Neutron Scattering & Applications
- Nuclear Analytical Techniques & Applications

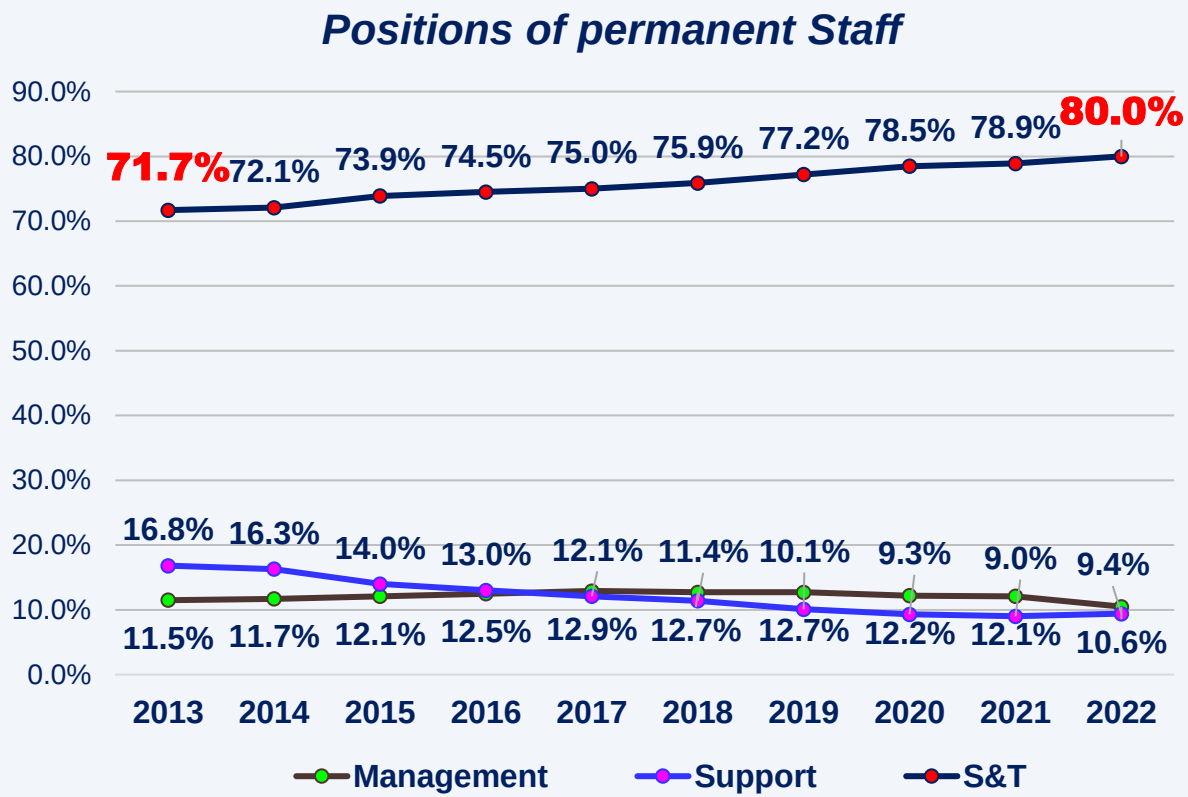
Basic research, Technological Research and Development, Engineering Construction and Management

Organization

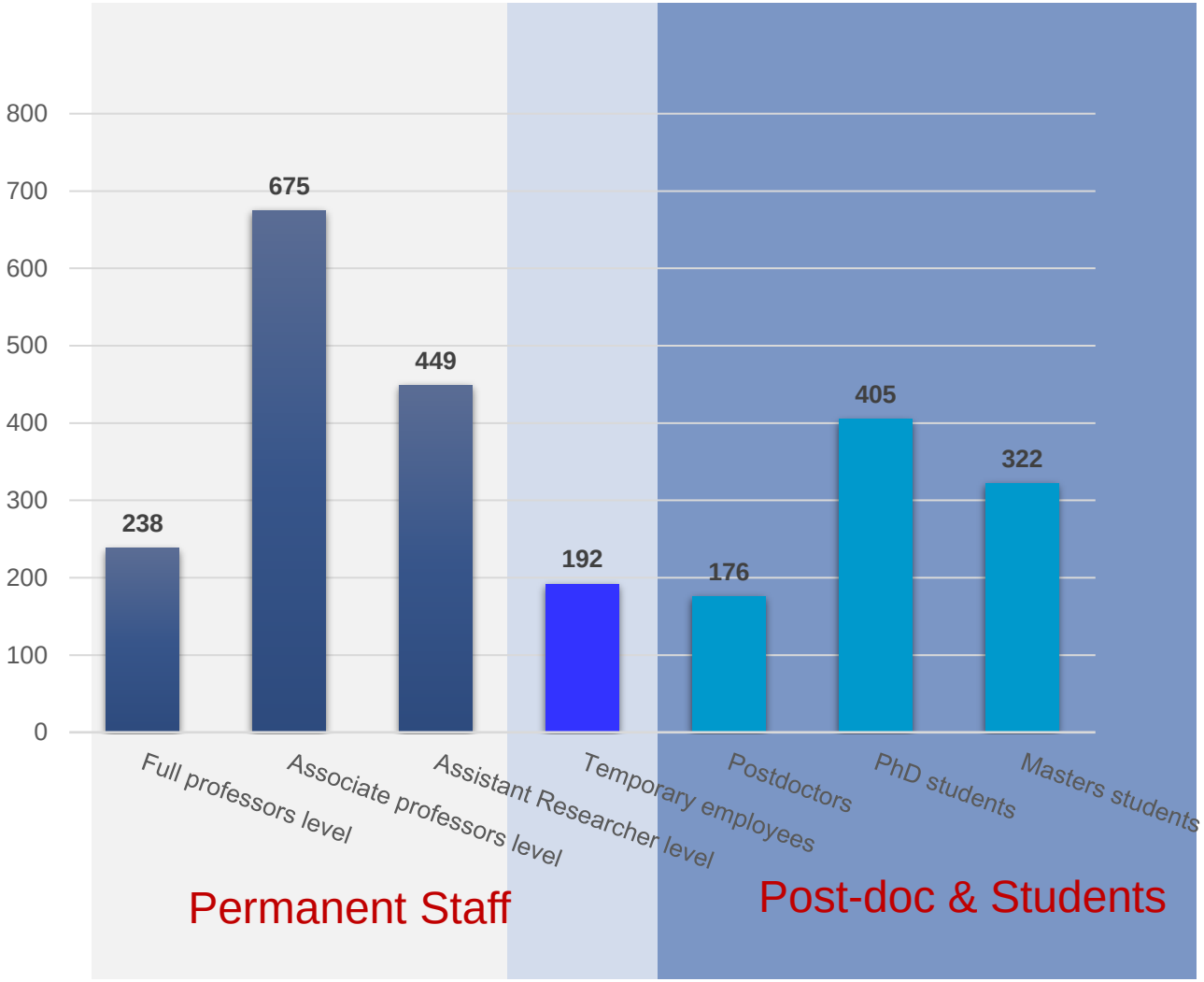


Human Resources

- Total number of permanent staff has remained stable
- Optimize the staff structure to develop a more competent innovative team



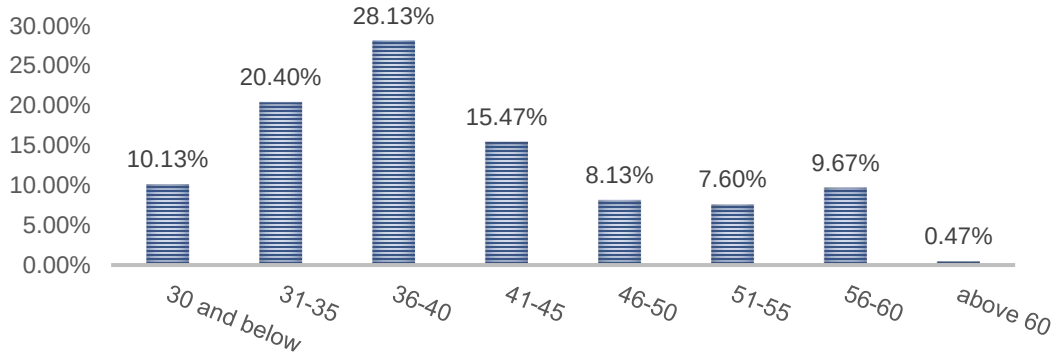
Human Resources



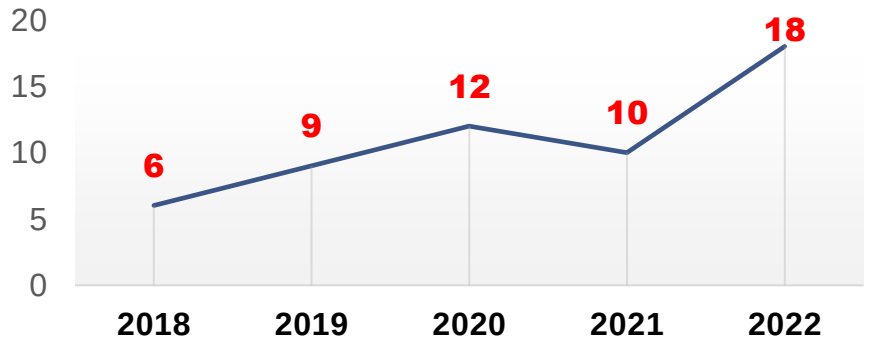
Permanent Staff

- **~74%** under 45 years old
- **33.4%** Master's degrees, and **51.4%** doctorates

Age Group



Recruited by talent programs

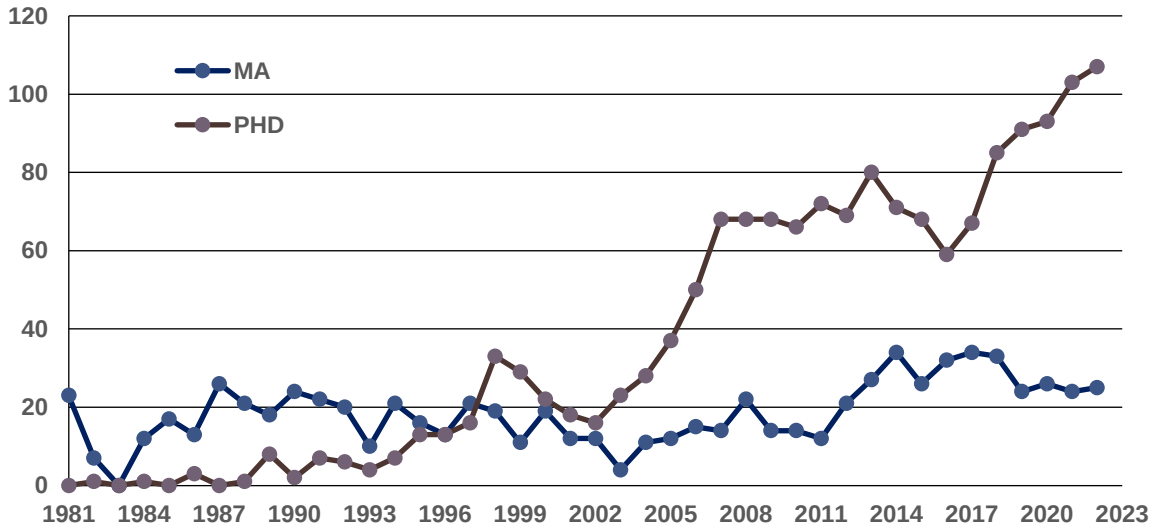


Education

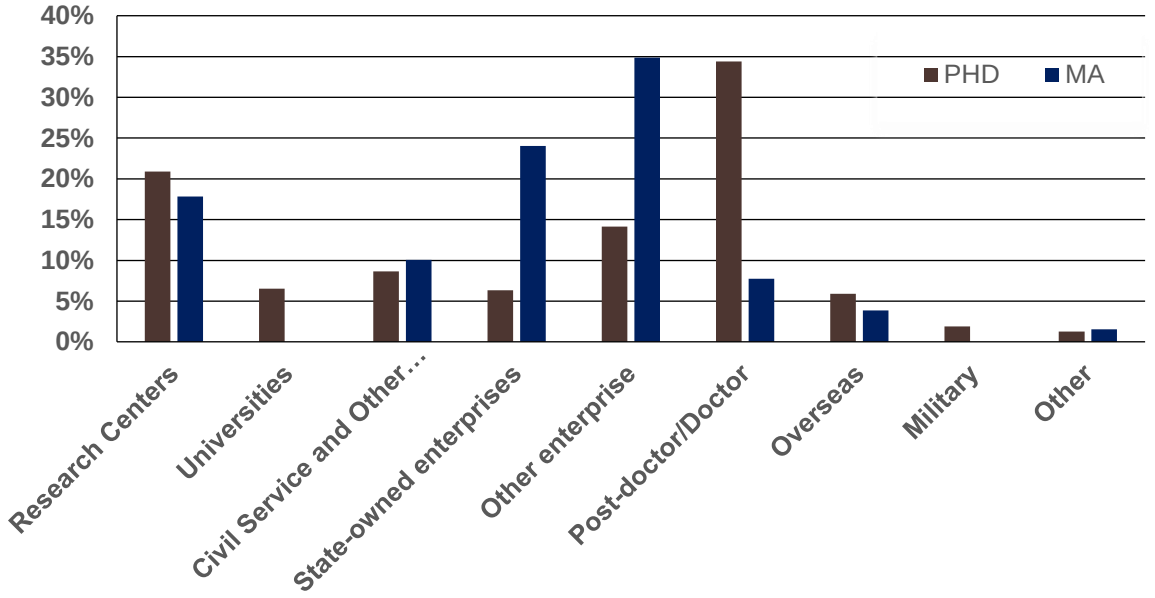
- A total of **611** (2018-2022) [498 (2013-2017)] postgraduate degrees awarded:

  479 [345] PhDs, **132** [153] Masters

- Currently (2022), **405** PhD students (including 10 international students) [360 in 2017] and **322** [239] Masters students

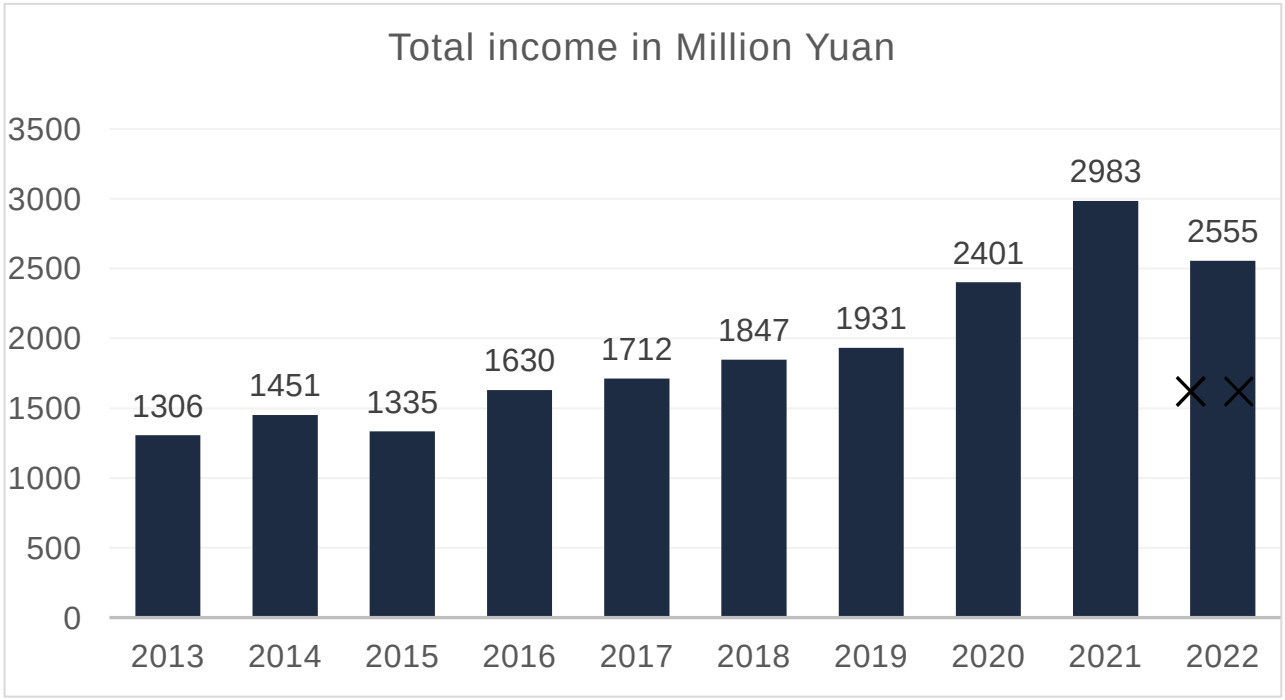


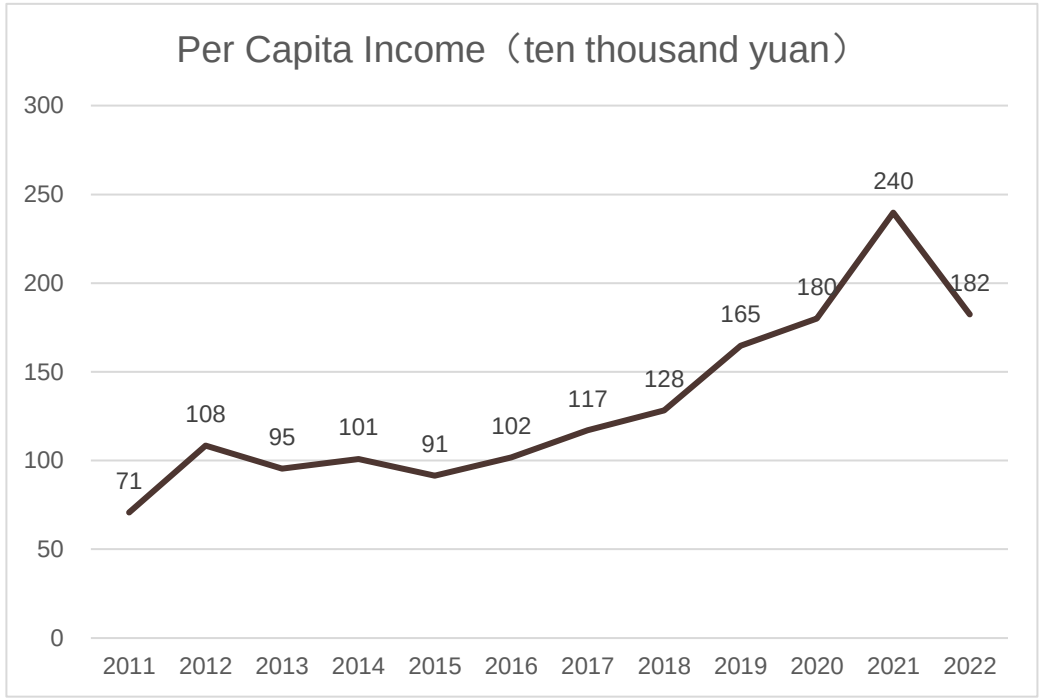
Statistics of Master's and doctoral degrees



Destinations for IHEP postgraduates (2018-2022)

IHEP Funding





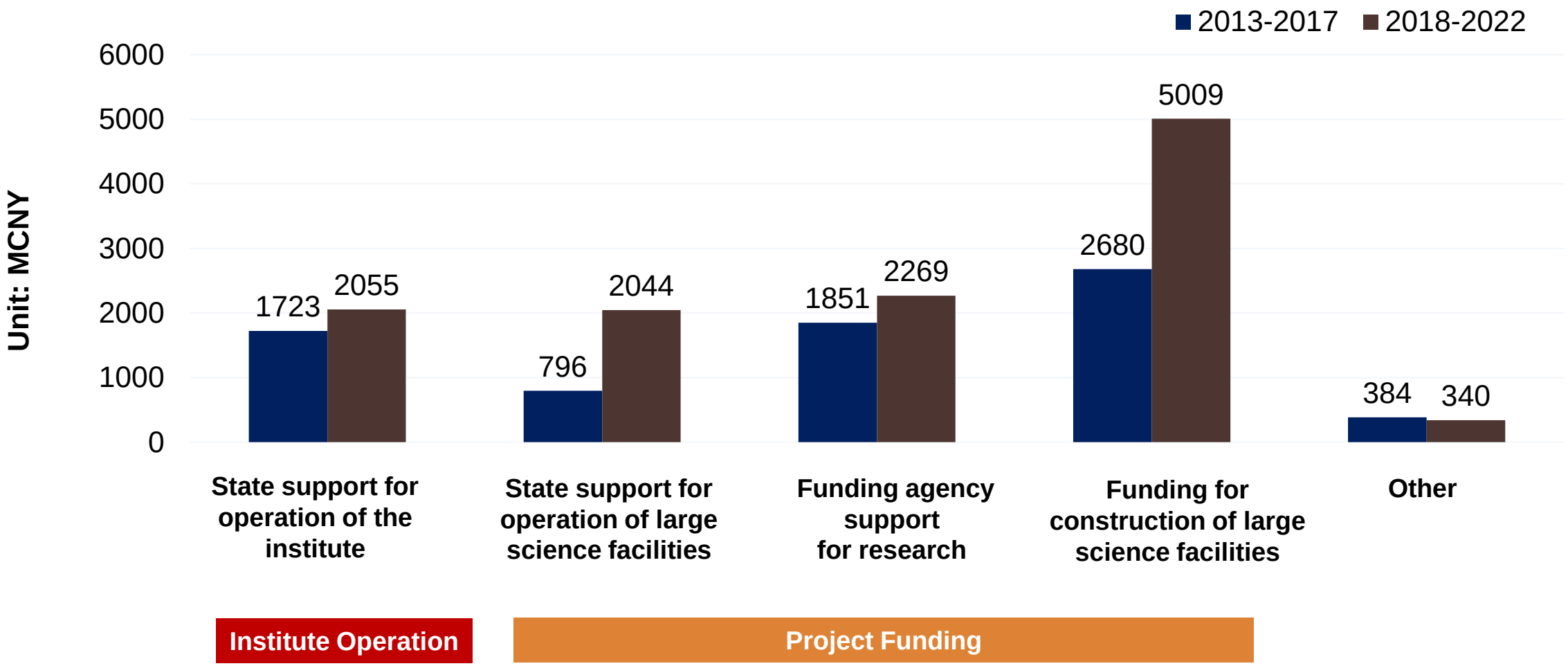
Total	2018-2022	11717
	2013-2017	7434

↑ 58%

2011-2022，Per capita funding income

↑ productivity

IHEP Funding



Scientific Output: Publications

Database	Papers	2018	2019	2020	2021	2022
SCI- Indexed	All	1193	1248	1250	1437	1487
EI-Indexed	All	642	757	739	869	872
	Duplicates removed	105	138	67	58	119
ISTP- Indexed	All	92	107	86	16	14
	Duplicates removed	28	28	28	13	5
Other full-text databases	All	240	253	258	313	280
2018-2022 TOTAL	All	1566	1667	1603	1821	1891
2013-2017 TOTAL	All	1322	1470	1338	1519	1262

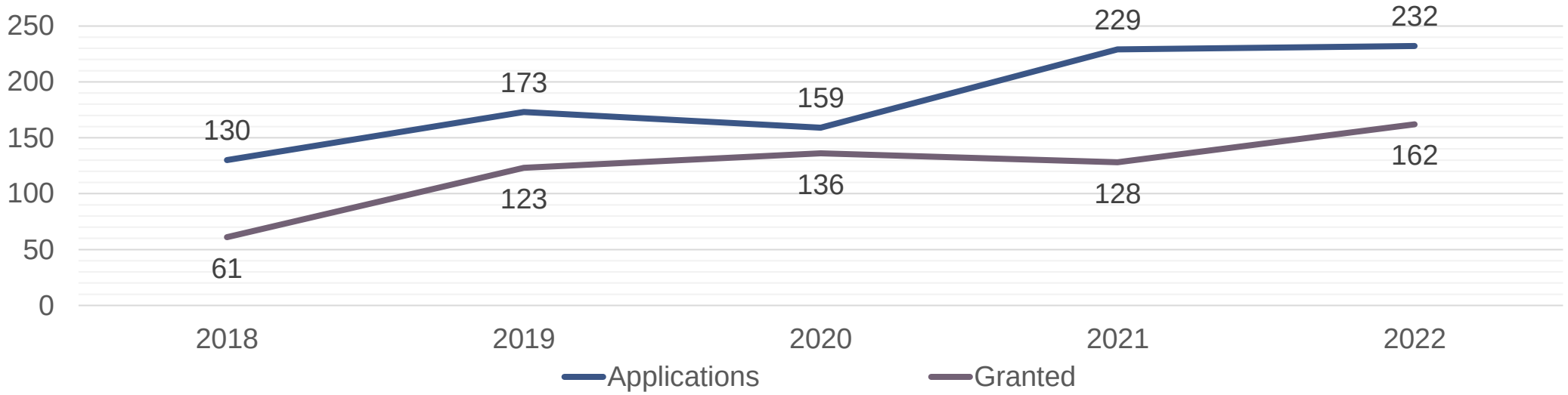
Total	**2018-2022**	8548
	2013-2017	6911

Five years: 23.7%

- User articles are not included in the statistics
- ATLAS, etc, only IHEP contribution included

Technology Output: Patents

- Patent applications: **923** [2013-2017: 322]
- Patents granted: **610** [2013-2017: 230]



Numbers of patent applications and patents granted, 2018-2022.

Research Field

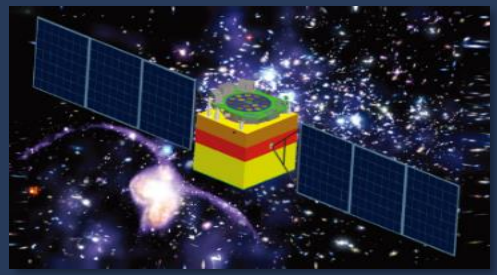
Experimental Physics

- e^+e^- collider (BEPCII，CEPC)
- Neutrino (Daya Bay, JUNO)
- Higgs (LHC)
- Detector technology

Particle Astrophysics

Combine particle physics & astrophysics

- X-ray astro-physice in space (HXMT)
- Cosmic-rays (LHAASO)
- Space technology



Accelerator Physics & Tech.

Design, construct & operates particle accelerators

- Machine design Electron collider(BEPC,CEPC)
- Spallation neutron sources(CSNS)
- Light sources(HEPS)
- Accelerator technology

Multi-Disciplinary Research

Synchrotron radiation & cross-disciplinary study

- Synchrotron radiation beams (BSRF,HEPS) and in-house research
- Nuclear technology for trace analysis, Radiochemistry, etc.
- X-ray technology

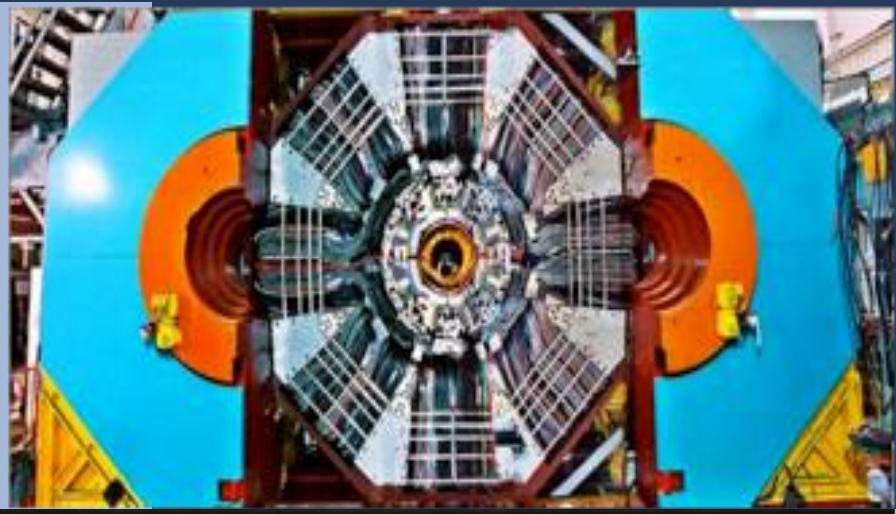
\+ Theoretical Physics　Computing Tech.　Nuclear Technology and Applications

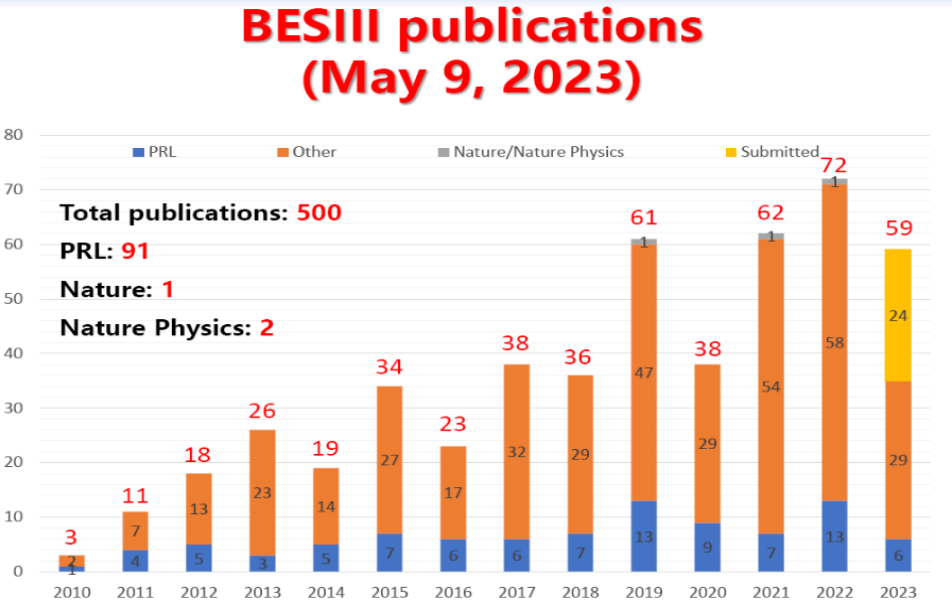
Large Science Facilities

Beijing Electron-Positron Collider II
Beijing Spectrometer (BESIII) Experiment

- For hadron physics and τ-charm physics with the highest accuracy
- The peak luminosity of the double-ring e^+e^- collider (BEPCII) is $10^{33}cm^{-2}s^{-1}$ at center-of-mass energy 3.78 GeV
- BESIII International Collaboration

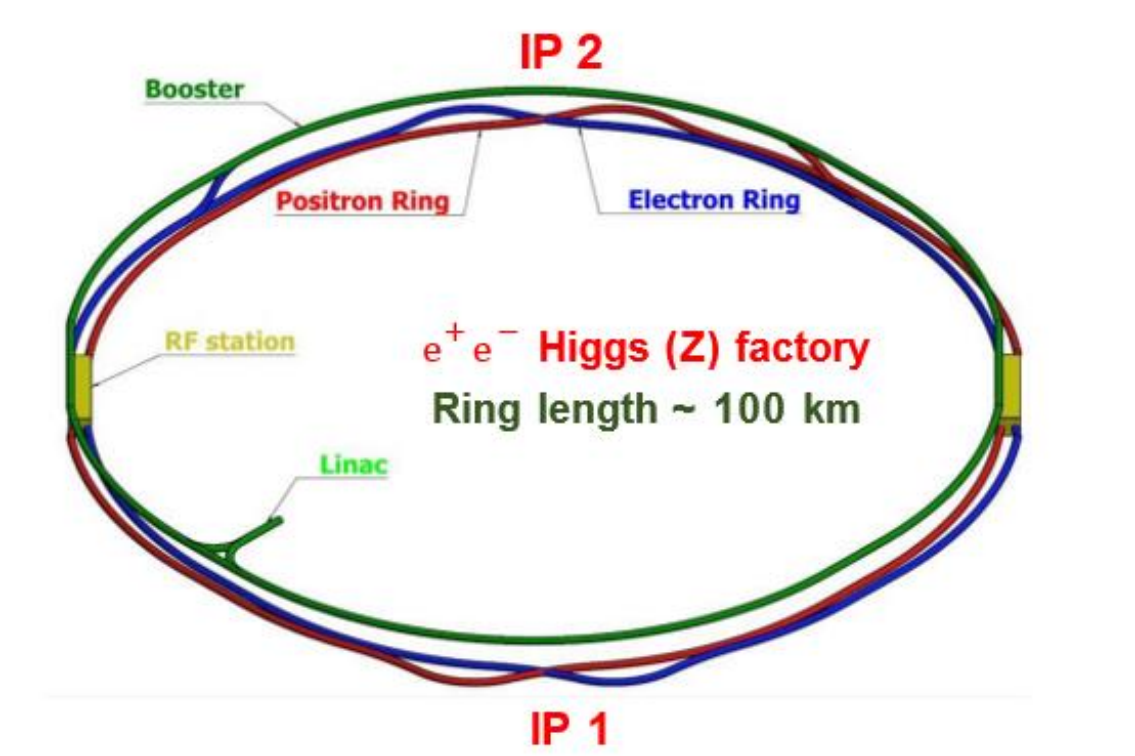
Country/region: 16；University/Institutions: 85；Collaborators: ~600

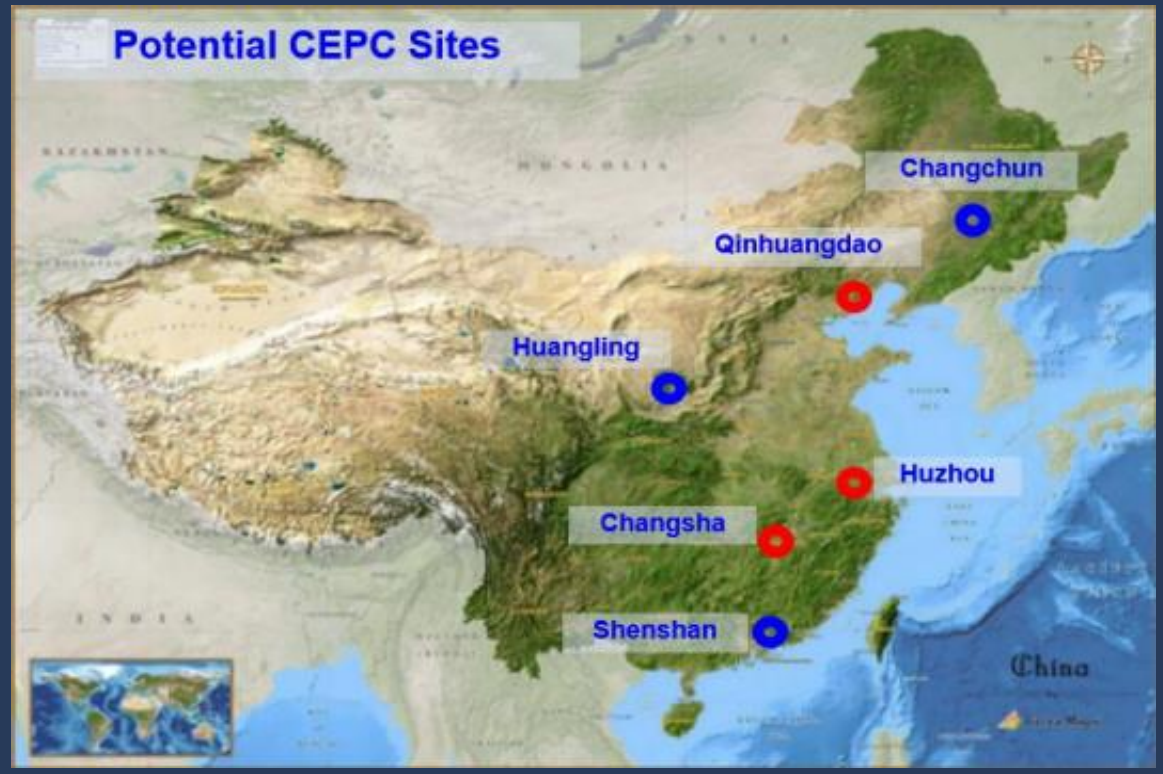




Circular Electron Positron Collider (CEPC)

- CEPC is an e^+e^- Higgs factory producing Higgs / W / Z bosons and top quarks, aims at discovering new physics beyond the Standard Model
- Proposed in September 2012 right after the Higgs discovery
- Upgrade: Super pp Collider (SppC) of *S* ~ 100 TeV in the future





http://cepc.ihep.ac.cn

Circular Electron Positron Collider (CEPC)

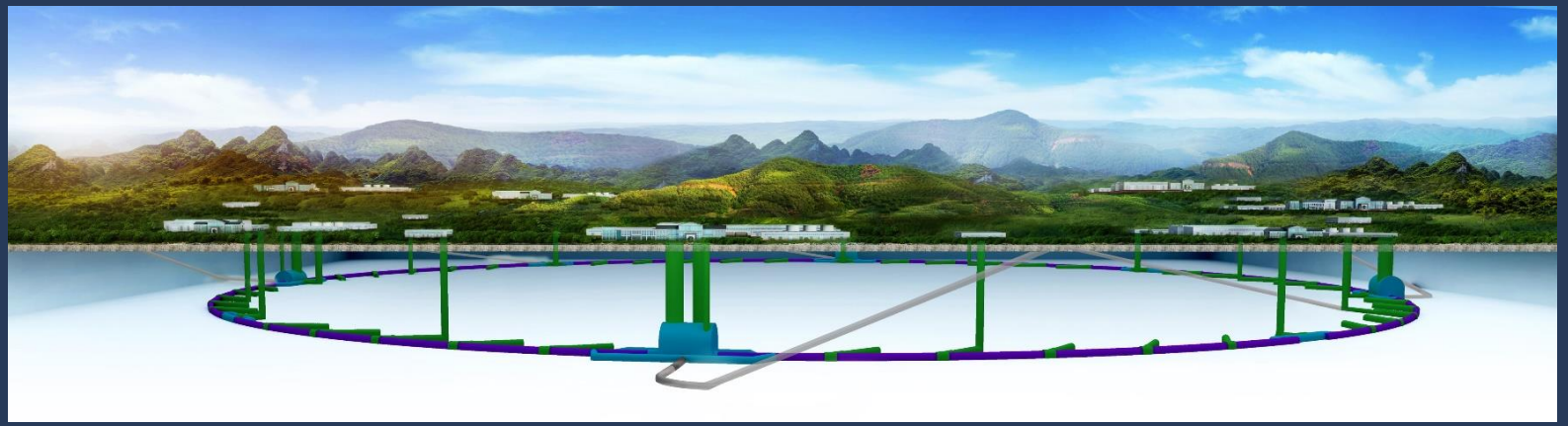
2018 CEPC CDR released in November

2020: European Strategy for Particle Physics, "*An electron-positron Higgs factory is the highest priority next collider*."

2022: ICFA "*reconfirmed the international consensus on the importance of a Higgs factory as the highest priority for realizing the scientific goals of particle physics*"

2023: US P5 Report stresses "*US contribution in a specific higgs factory*"

2023: CEPC Accelerator TDR released



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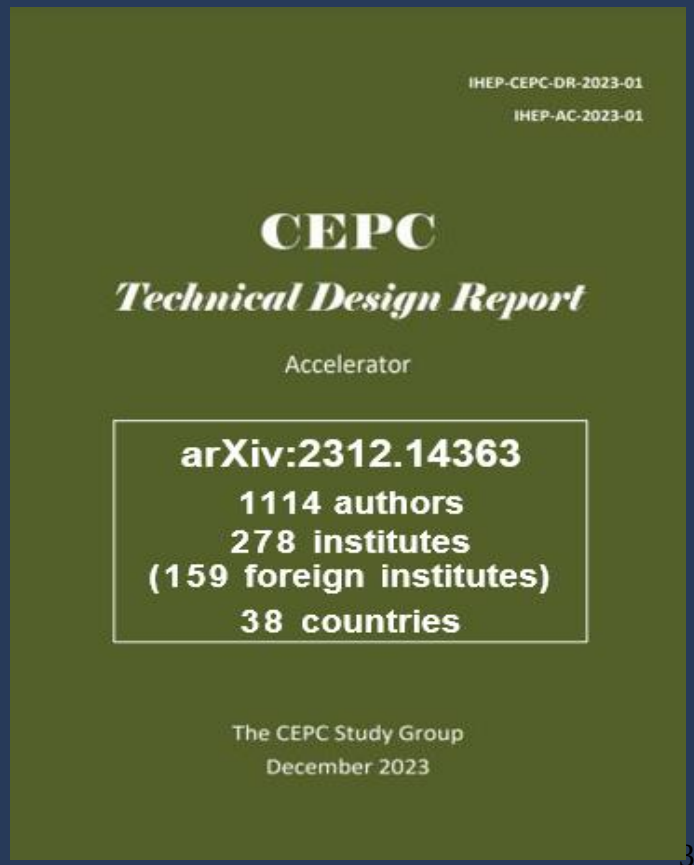
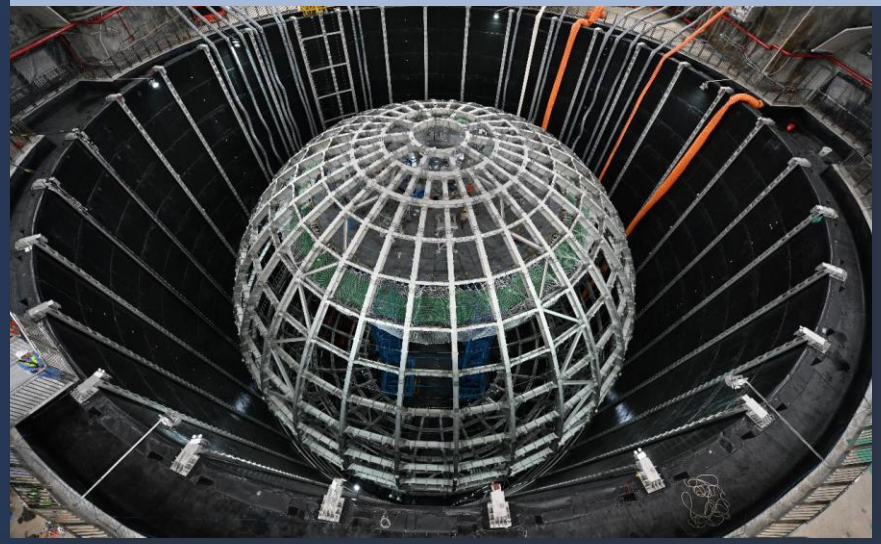


Jiangmen Underground Neutrino Observatory (JUNO)

- A 20 kt liquid scintillator detector with unprecedented 3% energy resolution (at 1 MeV) under the 700-meter overburden
- **Science:** To determine neutrino mass hierarchy and precisely measure oscillation parameters, observe supernova neutrinos, solar neutrinos，geoneutrinos，…
- Construction will be completed in 2024
- JUNO International Collaboration

Country/region: 17；University/Institutions: 75；Collaborators: 754

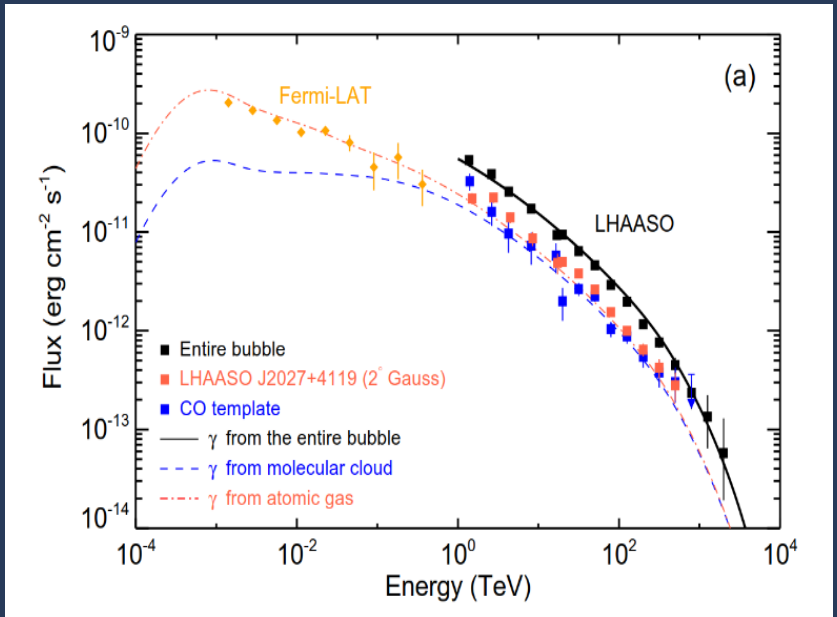


JUNO Experiment

24th JUNO Intl Collaboration meeting held from Jul. 1- 5, 2024

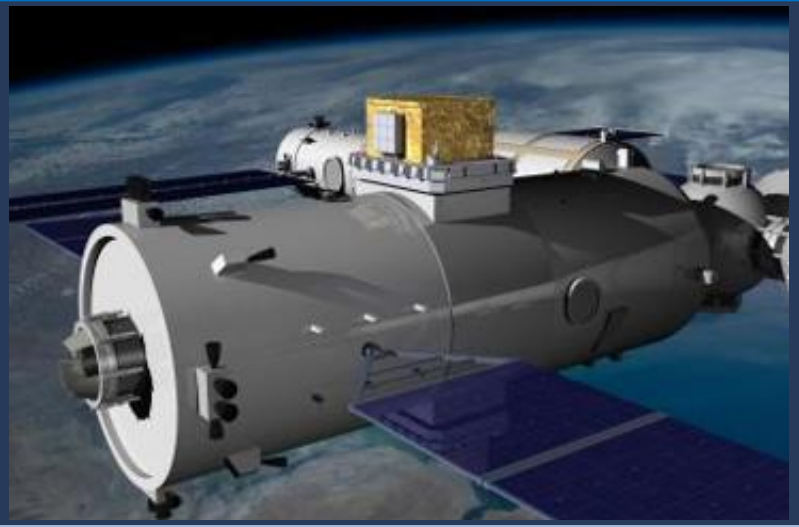
Large High Altitude Air Shower Observatory (LHAASO)

- World largest air shower array (with e, m, water Č detectors and Č telescope) for the high energy γ-astronomy and cosmic-ray physics
- Construction completed in 2023 and interesting results came out:
  - Highest g-rays from the Milky Way: 2.5 PeV
  - 43 identified γ-ray sources up to ~1 PeV ➔ PeVatrons in the Milky Way
  - Energy spectrum of high energy γ-rays from the Crab Nebula as the standard candle
- International collaboration: countries/regions: 5, members: ~300



Space Programs

China Space Station: High Energy cosmic-Radiation Detector (HERD)



- 3D crystal calorimeter for dark matter searches and cosmic-rays
- Acceptance & energy range × 10
- Selected for the Chinese Space Station, to be launched in ~2027
- In collaboration with Italy, Sweden, Switzerland, …

enhanced X-ray Timing and Polarimetry (eXTP) Observatory

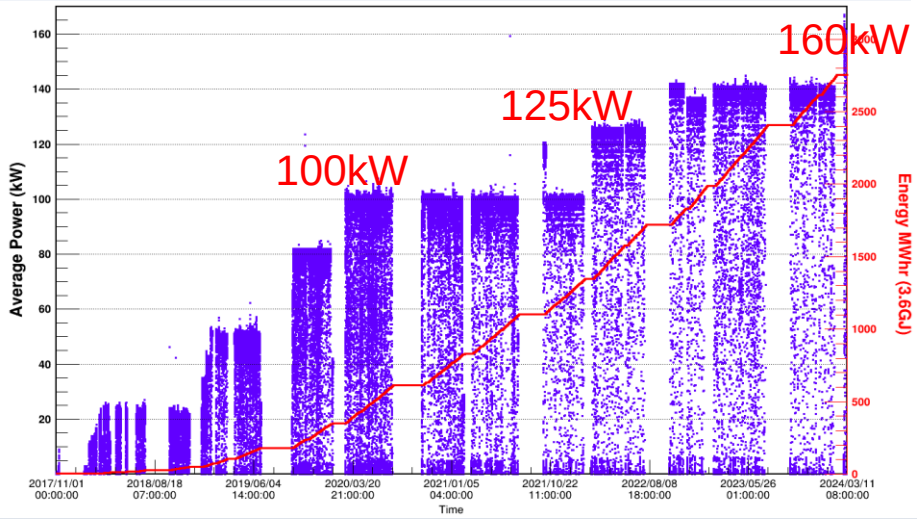
- the next generation telescope for "Enhanced X-ray Timing and Polarization Mission"
- A leading flagship observatory for black holes, neutron stars and extreme physics, to be launched in ~2027
- A large international collaboration with major German participation

China Spallation Neutron Source (CSNS)

- Located in Dongguan, south of China
- Open to user since 2018 with an availability > 97%
- Power reached 160 kW, 60% higher than design
- 11 neutron instruments, 3 of them under commissioning

- CSNS-II
- Beam power upgrade to 500kW
- Add 9 more neutron instruments
- Add a muon station, and a proton test beam station
- Construction started in Jan. 2024

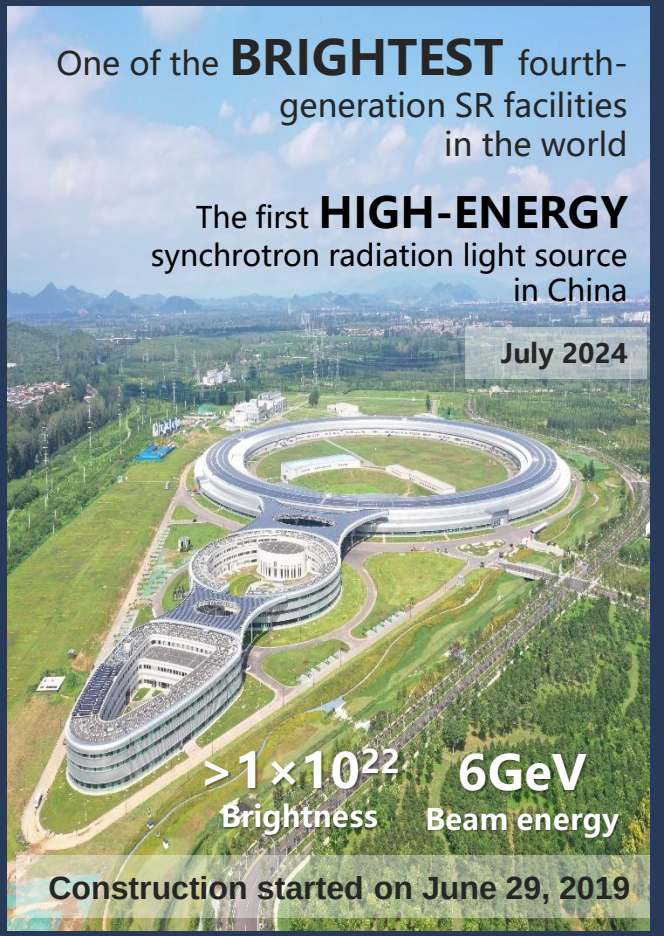
Bird's View



Beam power evolution

High Energy Photon Source (HEPS)

HEPS will provide high brightness and high coherence photon beam with high energy up to 300 keV in 2025.



CC and UT

- All buildings handover for installation.
- Utilities installation almost completed.

LINAC

- The first electron beam of HEPS was accelerated to 500 MeV with bunch charge >2.5 nC on Mar. 14, 2023.

Booster

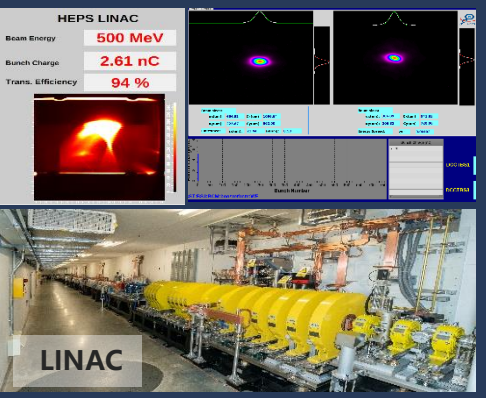
- The electron beam achieved a bunch charge of more than 5 nC at 6 GeV via the booster on Nov. 17, 2023.

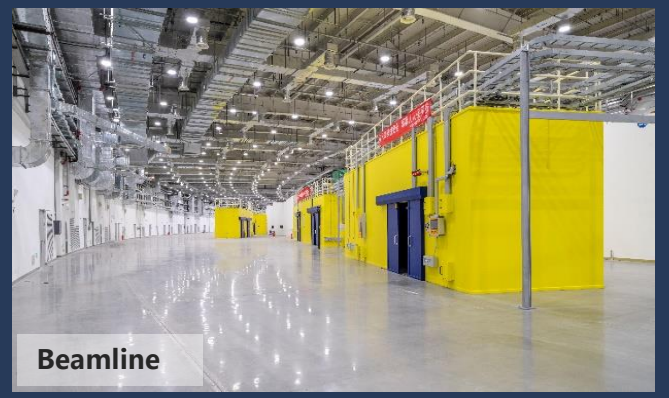
Storage Ring

- The electron beam with a current higher than 10mA was successfully stored on Aug. 18, 2024.

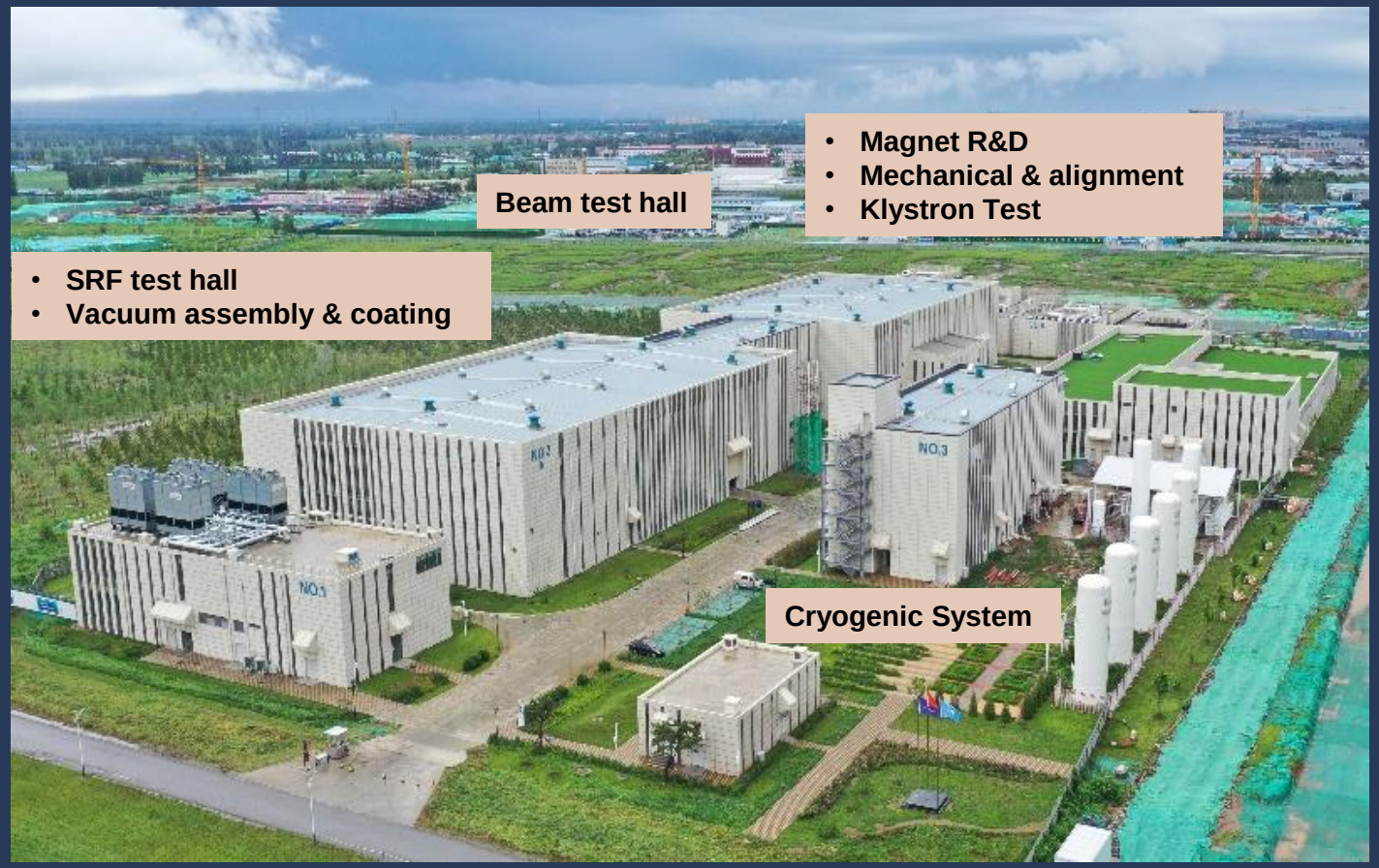
Beamline

- Installation is underway.
- 14 user BLs will be installed in phase I and up to 90 BLs can be eventually accommodated.





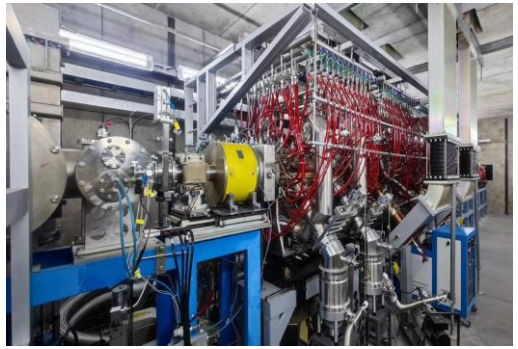
Accelerator key technology R&D platform



Accelerator key technology R&D platform was established:

- SRF cavity and module
- High-precision magnet
- Vacuum assembly & coating
- High efficiency klystron
- Mechanics & alignment
- Beam test facility

Technology transfer: products

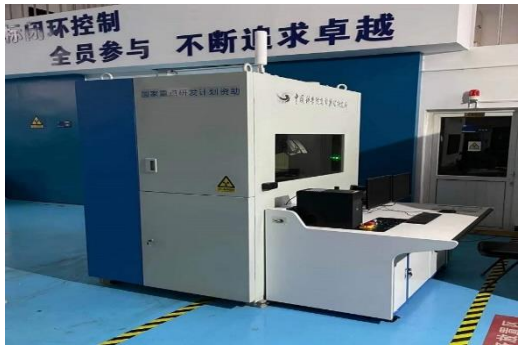


Application accelerator

- Boron neutron capture therapy (BNCT)
- Magnet-related Equipment
- A series of industry irradiation accelerators
- A series of superconducting cavities

Nuclear medicine and molecular imaging

- Dedicated breast PET scanners
- Micro SPECT/CT scanner
- Micro PET/CT scanner

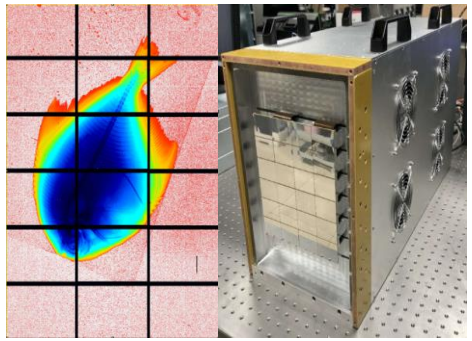


Precision testing equipment

- Multiple models of industrial CT equipment
- X-ray three-dimensional micro-CT
- High-energy industrial CT
- Gamma-ray imaging device

Radiation environment monitoring equipment

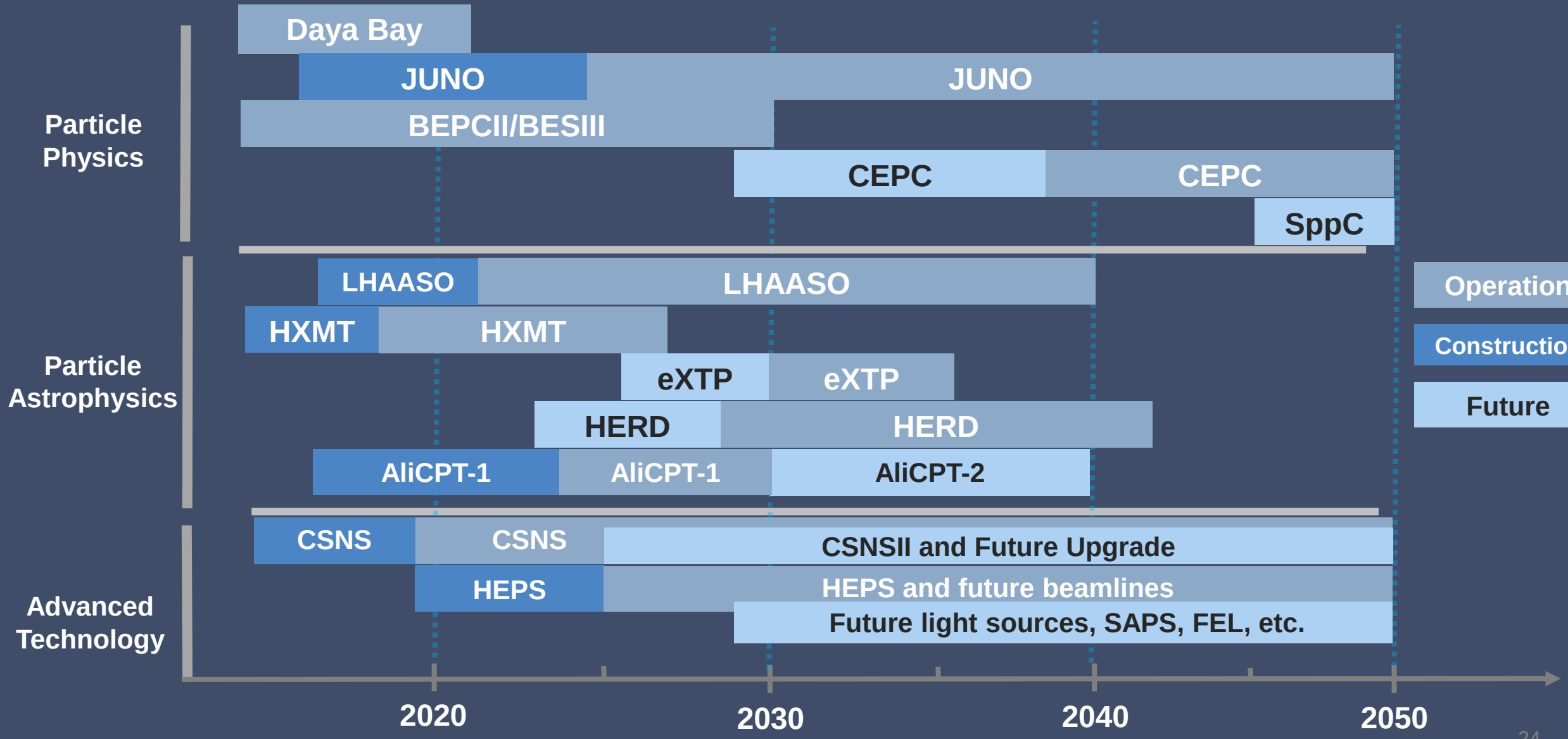
- High-speed passive enrichment detection device
- Radiation environment monitoring vehicle platforms
- Solid-state encoding cameras, channel encoding cameras
- Buried gamma neutron detectors



Silicon detector technology

- 2D X-ray silicon pixel detectors

Roadmap of IHEP



Thank you for your attention

Looking forward to more collaborations