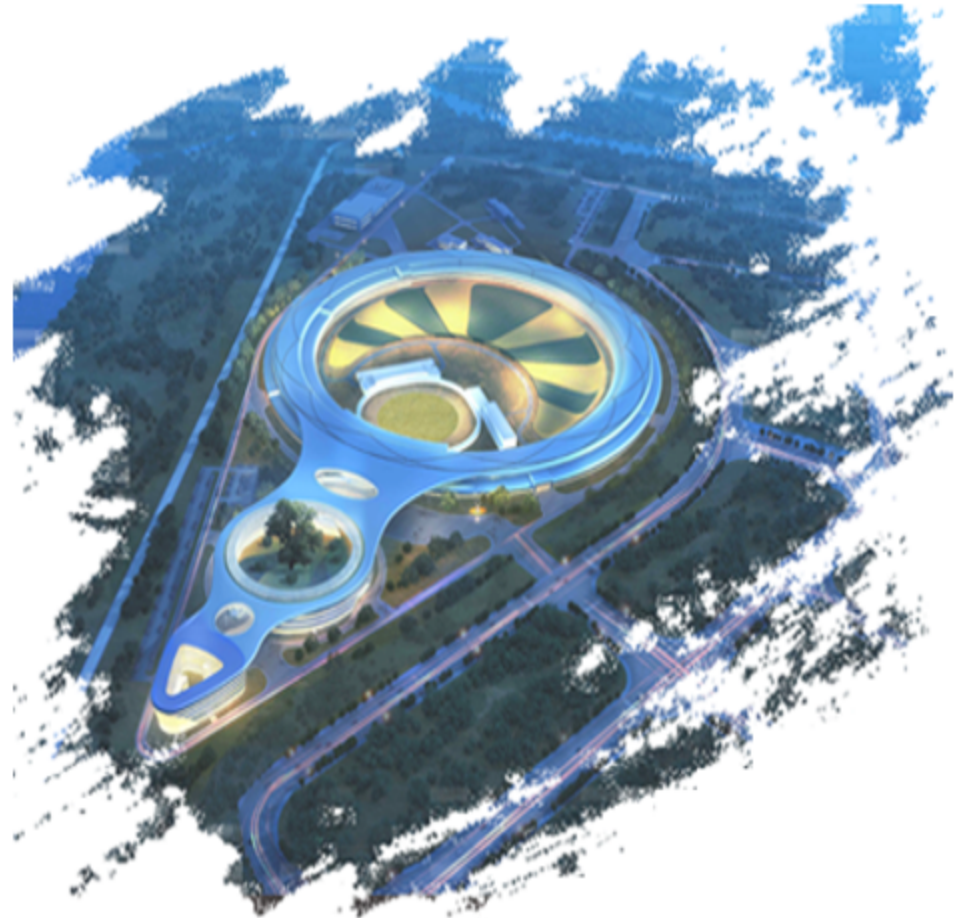


beamline division of High Energy Photon Source (HEPS)

Yi Zhang

2024/01/29

heps.beamline@ihep.ac.cn



Introduction to High Energy Photon Source (HEPS)

01

HEPS, the first greenfield high energy low emittance light source
Energy 6GeV, emittance $<40\text{pm}\cdot\text{rad}$, ring circumference 1360 m. It could
accommodate more than **70 beamlines**

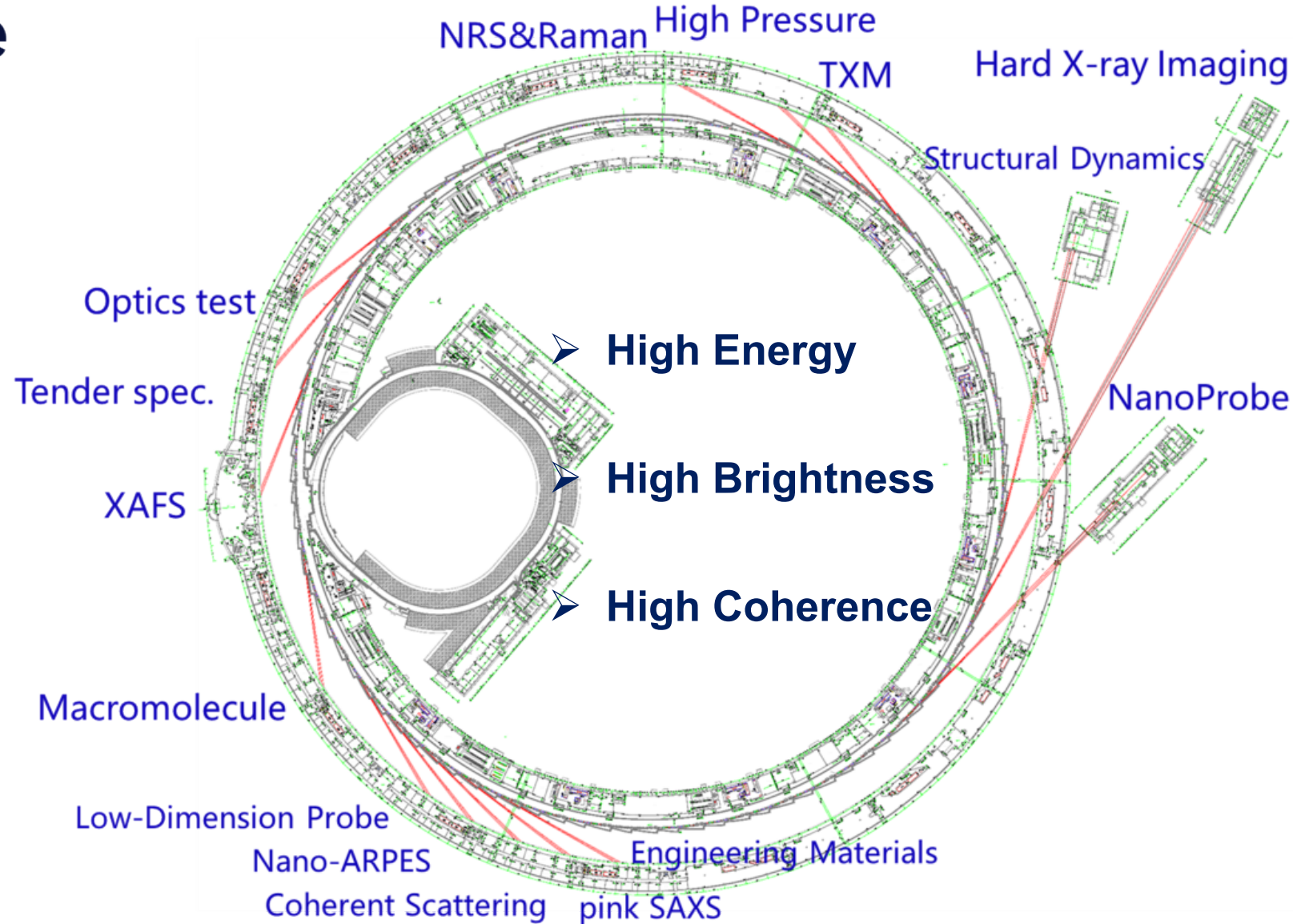


First fourth-generation synchrotron source in China

Phase I, 14 user beamlines and 1 test beamline

The construction period was estimated to be 6.5 years.

- Date of Groundbreaking ceremony: **Jun. 29, 2019**
- User operation: **Dec. 31, 2025**

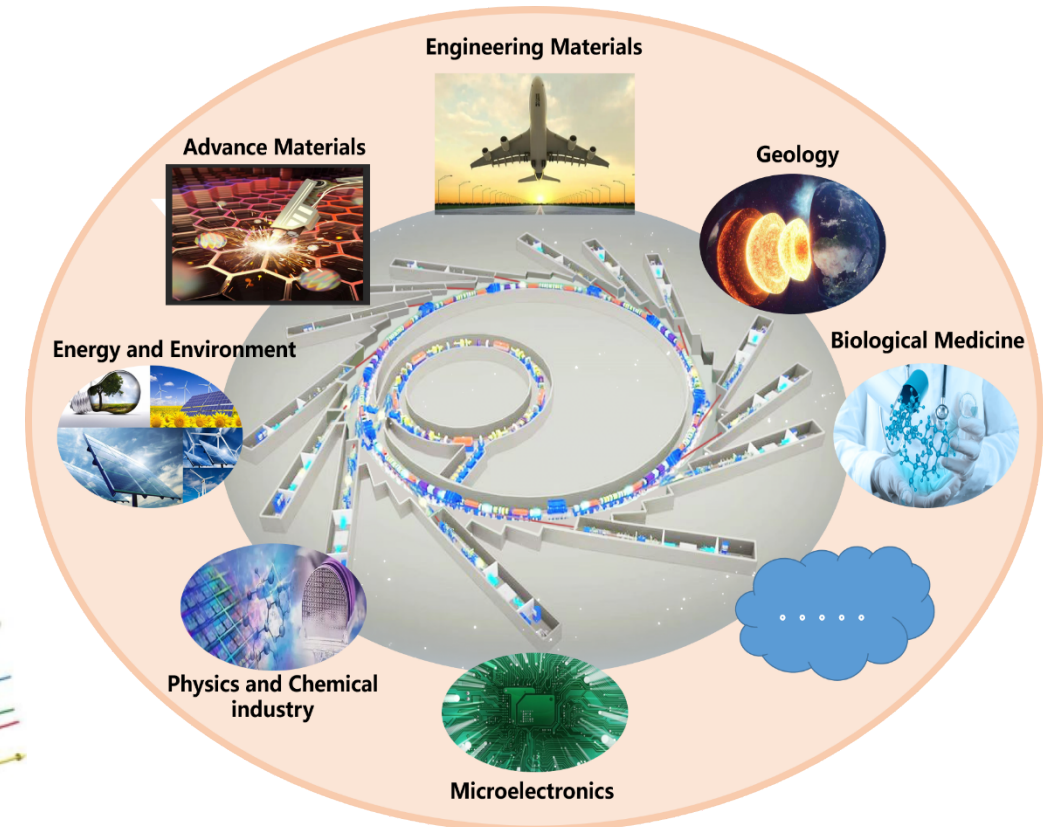
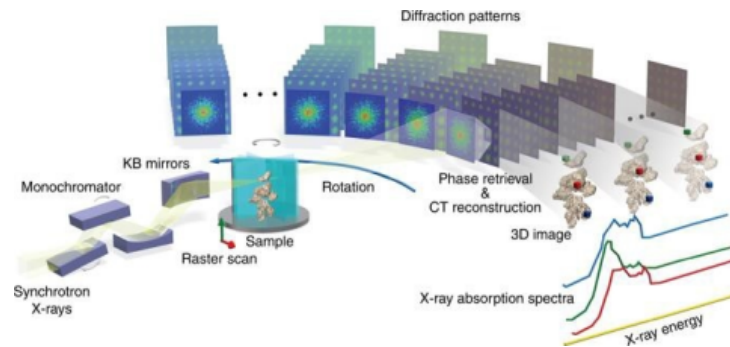
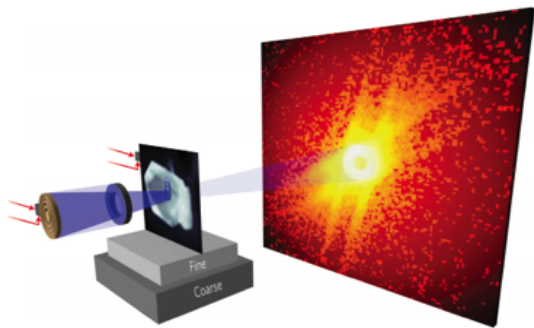




HEPS: a powerful light source

HEPS will provide **high-energy, high-brilliance, high-coherence** synchrotron light with **energies up to 300 keV and more**, with the capability for **nm spatial resolution, ps time resolution**, and **meV energy resolution**.

While providing conventional technical support for the general users, HEPS will operate as a platform to analyze the structures, as well as the evolution of structures of engineering materials in the whole process, by in-situ, multi-dimensional and real-time observation.



The progress of HEPS project

HEPS Achieves the First Electron Beam Accelerated to 500 MeV

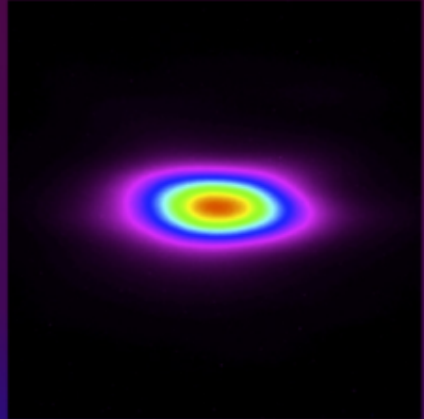

Mar 15, 2023



1st high energy photon source in China
one of 4th GEN. SR facilities in the world

HEPS

2023 Electron Beam Ramped Up to 6 GeV



以梦为马 加速奔跑 追光不歇

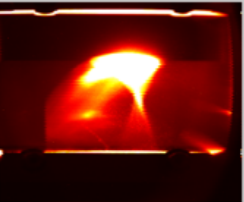
HEPS

The image shows a long linac tunnel with a red banner hanging from the ceiling. The banner contains the Chinese text '以梦为马 加速奔跑 追光不歇'. To the right of the tunnel is a circular beam profile visualization showing a central bright spot surrounded by concentric rings of decreasing intensity.

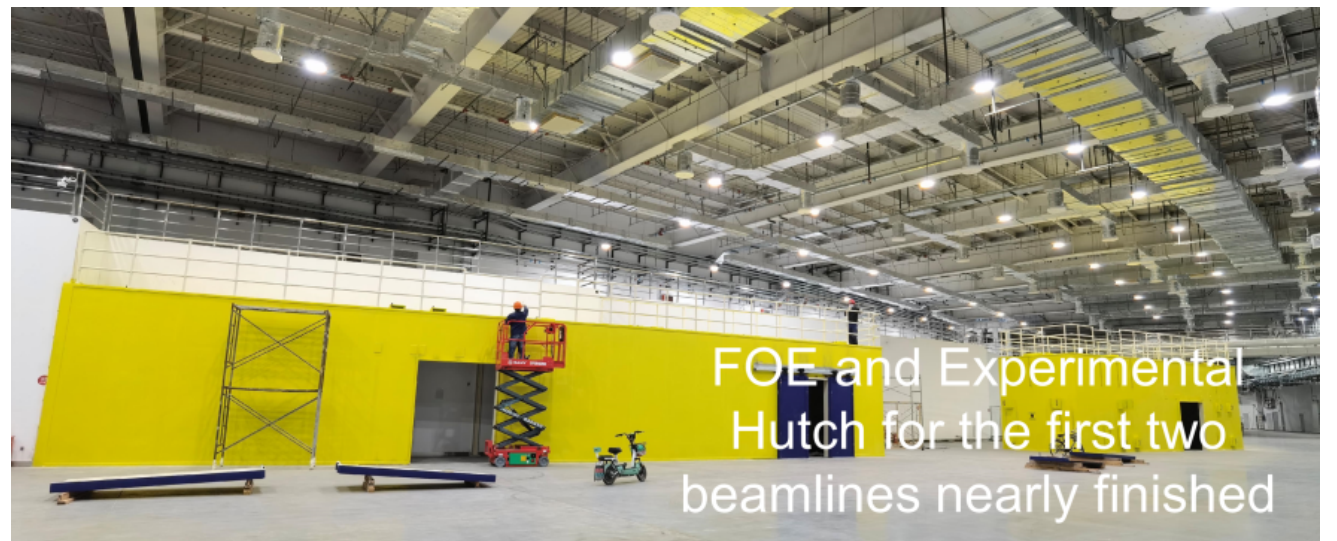


HEPS LINAC

Beam Energy	500 MeV
Bunch Charge	2.61 nC
Trans. Efficiency	94 %



A beam profile visualization showing a bright, elongated spot of light, likely representing the electron beam.

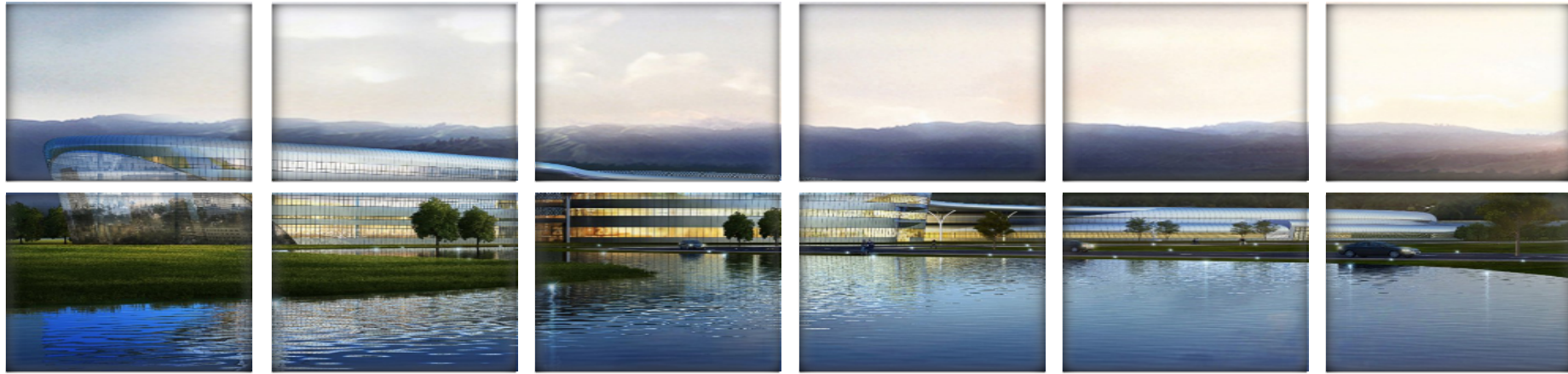


The progress of HEPS project



第一台自研液氮双晶单色器进行标定
即将上线安装





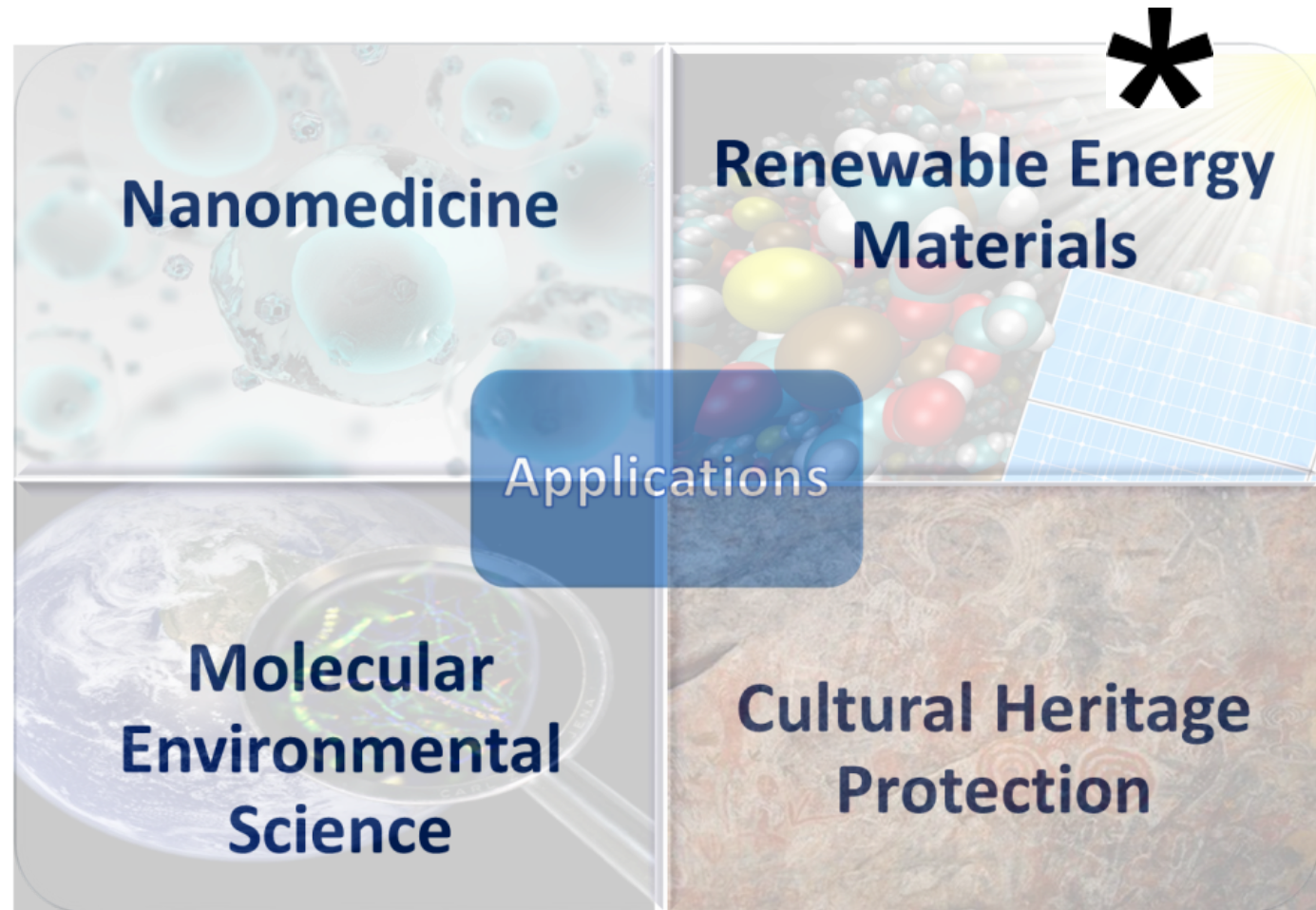
Open Positions

Join us to design, build and commission
Phase I and future beamlines

**applicants worldwide are welcome (including
foreign nationality)**

➤ Beamline Instrumentation and Methodology

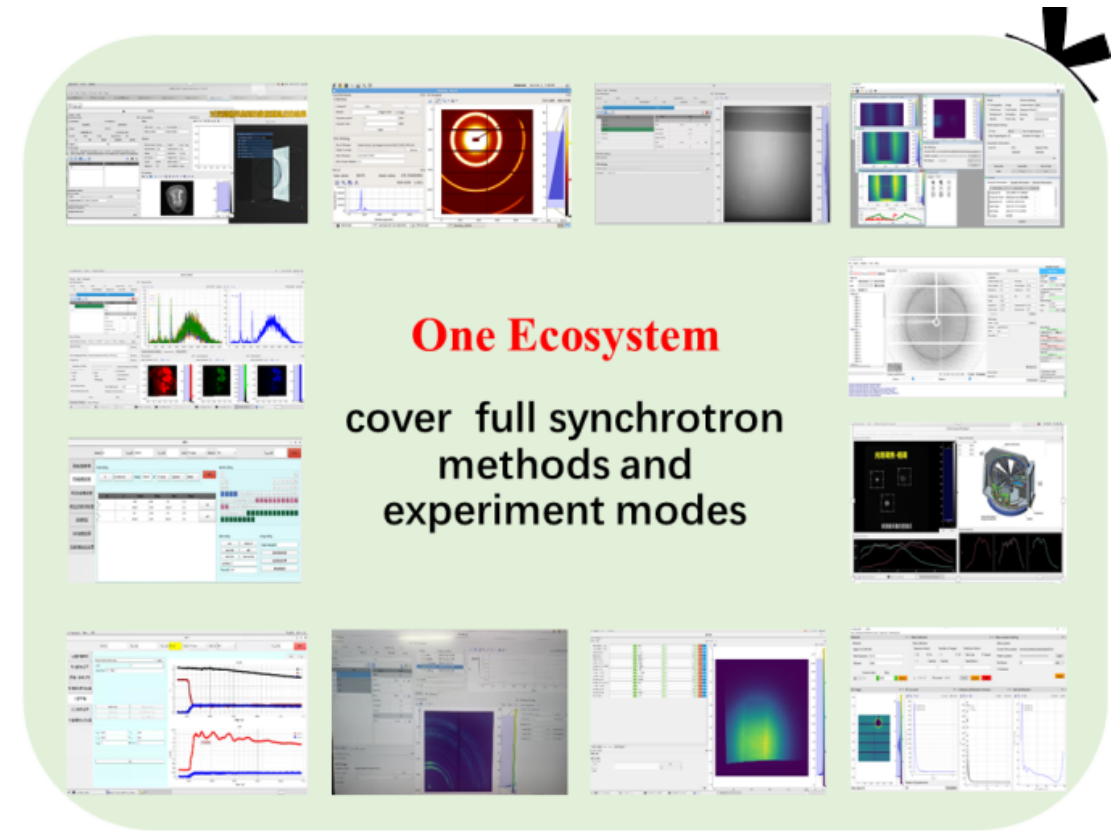
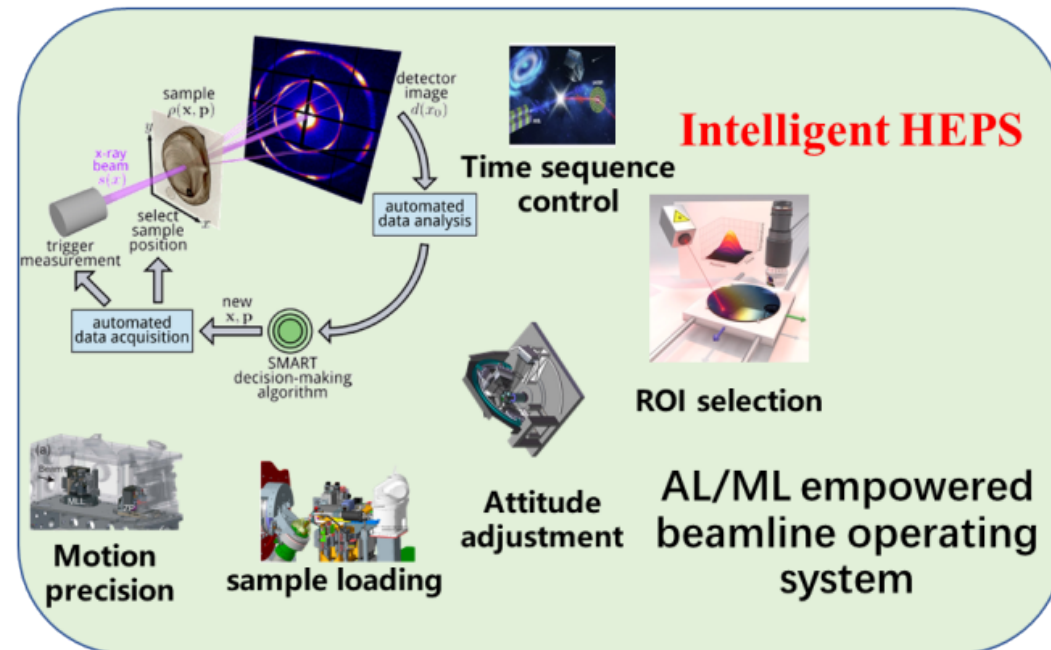
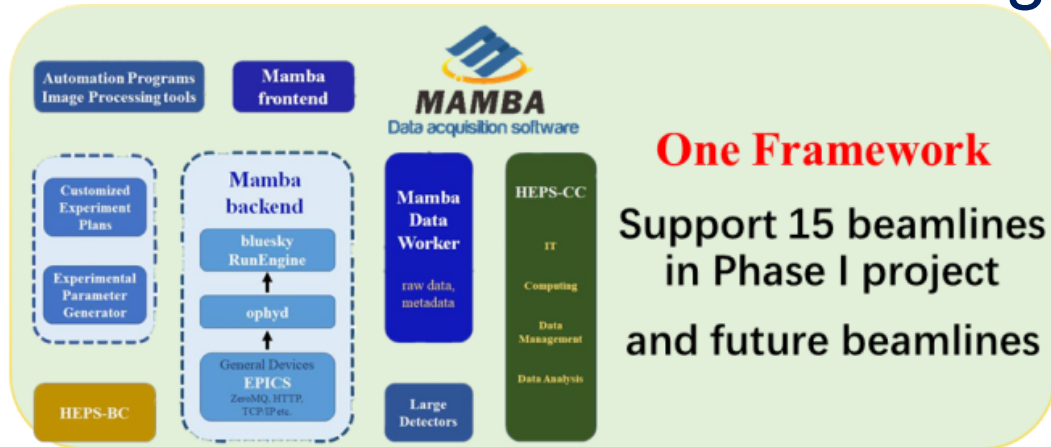
- Frontier **methodology development** in coherent imaging and scattering, inelastic scattering, high energy X-ray scattering and diffraction and imaging, nano-imaging and spectroscopy
- Cutting-edge scientific **beamline instrumentation** development
- State-of-the-art **application research**, especially exploiting features of coherence, brightness and high energy X-rays



Contact : heps.beamline@ihep.ac.cn

Scientific software (control and data analysis)

Software framework design for next generation synchrotron source



- An ambitious and challenge project
- No legacy issue

Contact : zhangyi88@ihep.ac.cn

AI for synchrotron science

- Open new opportunities in science

Fully leverage **AI/ML** and **digital twin** capabilities to **extract information** from big data streams, **steer experiments**, **design experiments**, and use on-demand data for **ML-driven discovery**

Algorithm-driven methodology optimization

Efficient Ptychography Reconstruction Strategy Using Large Pre-trained Deep Learning Model

- Big Model training strategy enhances the phase reconstruction efficiency, high accuracy at very low overlapping rate;
- Speed up experiment acquisition significantly.

X.Y. P et al, *Cell Reports Physical Science*, second revision
X.Y. P et al, *Acta Physica Sinica*, 2023

Fast Extraction of Nanofiber Orientation from WAXD Patterns Using Supervised Machine Learning

Traditional

New

- Virtual reciprocal scanning approach for six-dimensional diffraction tensor tomography, without diffraction information loss
- Reduces acquisition time from days to within one hour

M. H. S et al, *IUCr*, 2023
X. Y. Zh et al, *IUCr*, Second Revision

Data-driven methodology optimization

Physical Information-Embedded Unsupervised Denoising Using AI

- Minimum radiation dose, maximum information, systematic x-ray image denoise solutions for a wide range of techniques
- Achieved great performance boost under zero-shot mode

Zhongzheng Zhou et al, *npj Computational Materials*, 2023

Full-stack Synchrotron Tomography Data Processing Pipeline (STDPP)

- End-to-end AI/ML tools for a full-stack pipeline
- Dynamic correction under acquisition, push the time and spatial resolution

Z. Zhang et al, *The Innovation*, 2023
Z. Zhang et al, *Science*, 2023

Contact : **zhangyi88@ihep.ac.cn**

➤ Scientific software and computing at HEPS

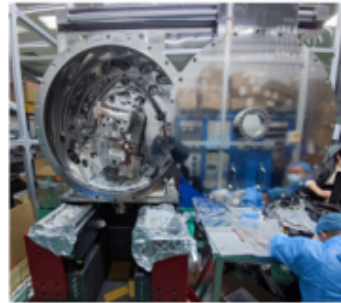
◆ Candidate requirements

- The successful candidate is expected to a PhD degree at physics, applied mathematics, computer science etc. and have *Knowledge and experience in*
- Software framework design
- Beamline automation
- Image processing
- Big data science
- Machine learning in synchrotron data analysis

Contact :
zhangyi88@ihep.ac.cn

➤ Optics and beamline engineering

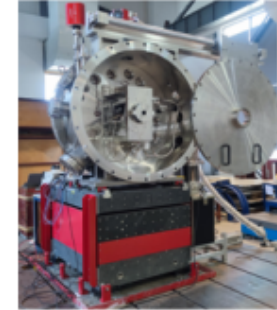
- X-ray optics
- Thermal management
- Optics metrology
- Wavefront preservation and crystal/device fabrication



VDCM



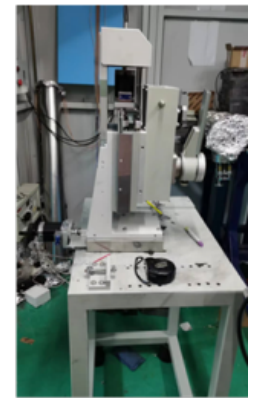
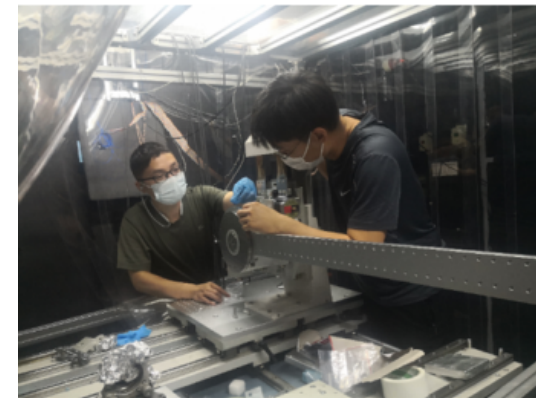
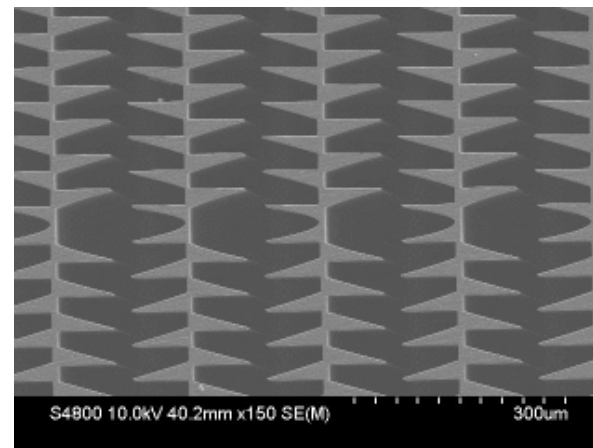
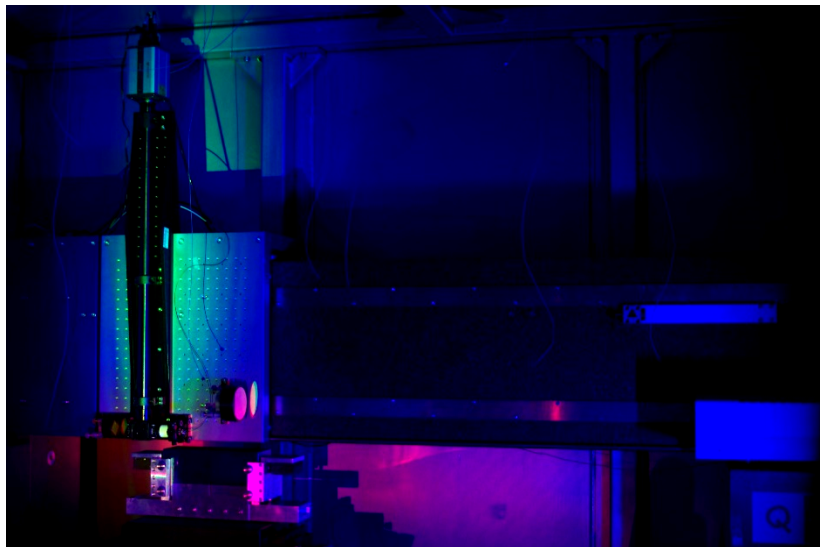
HDCM



Fast-scan
DCM



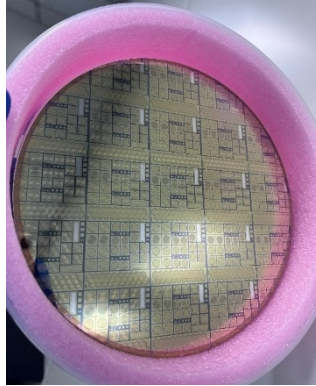
HR-DCM



Contact :
lim@ihep.ac.cn

➤ Detector developments at HEPS

◆ The HEPS detector group **Contact: lizj@ihep.ac.cn**



- We are developing the domestic detectors including the pixel array detector, the nanosecond time resolved detector, the diamond XBPM detector and silicon drift detector for the HEPS.
- We have built a professional detector research and development laboratory, including 500m² Clean room, Electronics Laboratory, Semiconductor Packaging Laboratory and Sensor research Laboratory.

➤ Detector developments at HEPS

Contact: lizj@ihep.ac.cn

◆ Candidate requirements

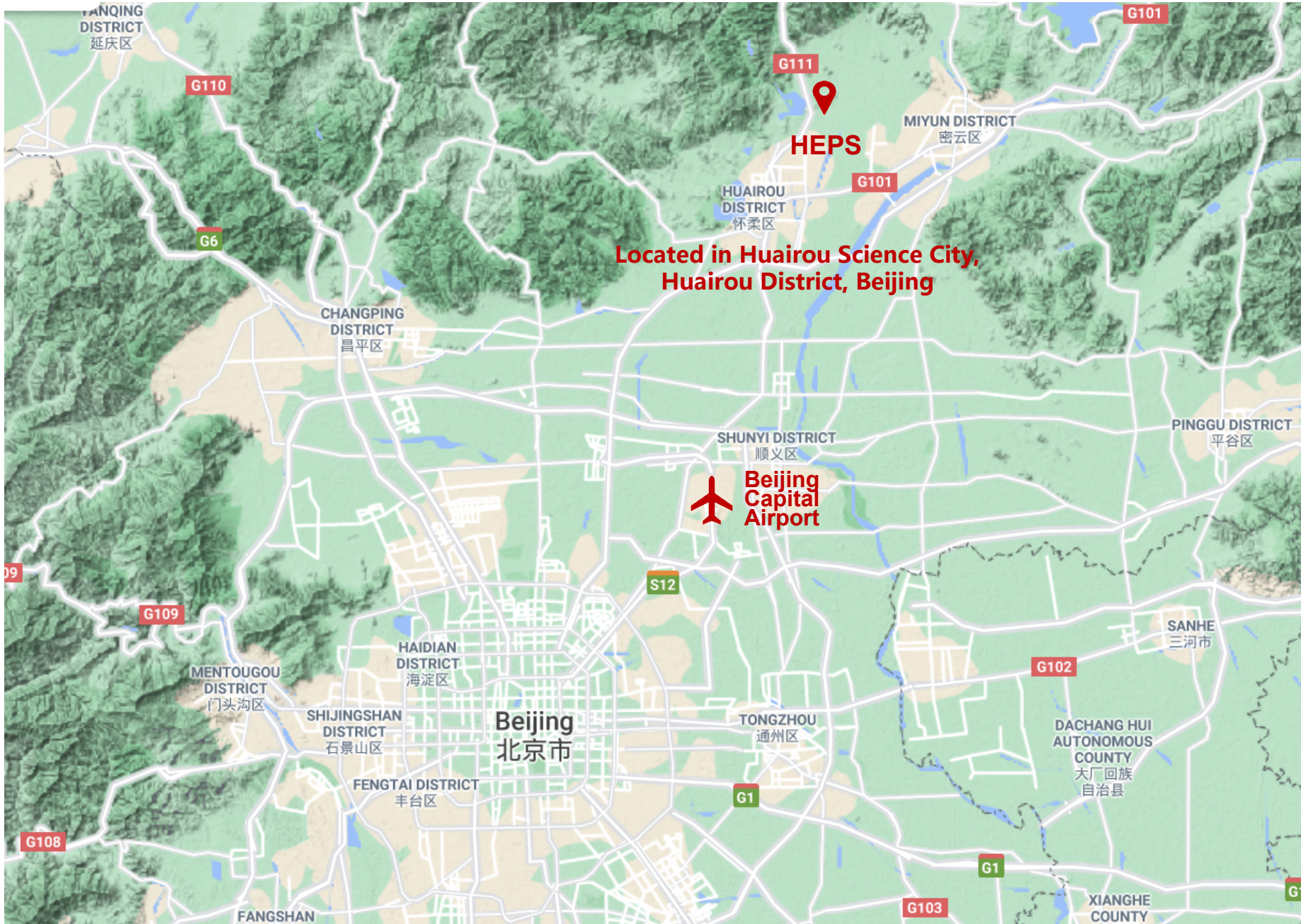
- The successful candidate is expected to play a leading role in the detector development for at least one of the following aspects:
- The IC design (integrated circuit design) --Ph.D degree required
- The system electronics design-- Ph.D degree required
- Data acquisition and processing of the detector
- The X-ray Sensor design and process development -- Ph.D degree required

Experiences with IC design , photosensor and readout system, or data acquisition are preferred.



Life and Work
In HEPS and Huairou Science City (HSC)

Where is HEPS ?



Huairou Science City (HSC)

HSC, one of three national science centers in China

HEPS is the flagship facility at HSC



Space Environment
Monitoring Network

Synergetic Extreme Condition
User Facility

Multimodal Biomedical
Imaging Facility

Earth System Science
Numerical Simulator Facility

Where You Will Work





Huairou, the APEC meeting site, is a pleasant place to live and work
Scenic hiking trails along lakes and in mountains near the Great Wall
Skiing – Huaibei, the nearest ski resort, is within 10 km;

2022 Winter Olympics ski resort within three hours' driving distance





We welcome all applicants worldwide

From Beijing Daily