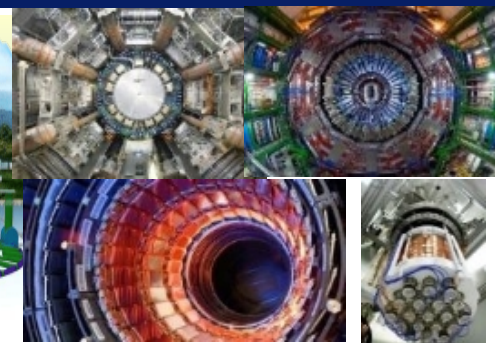


# Introduction to Experimental Physics Division

Liangjian Wen

Institute of High Energy Physics, CAS

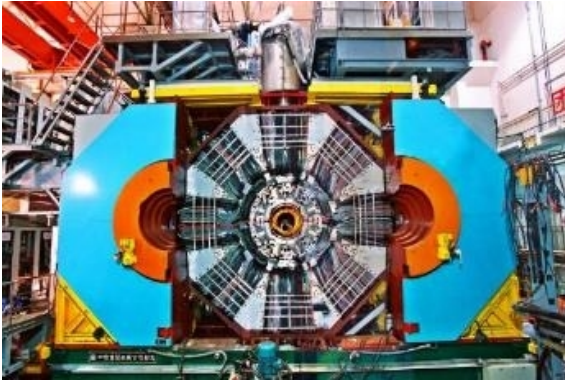
Jan. 29, 2024 @ CAREER INFORMATION SESSION OF IHEP CAS 2024





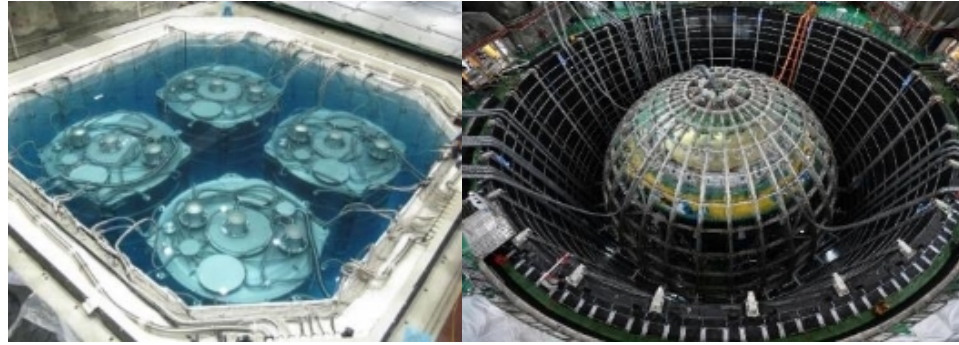
# Experimental Physics Division (EPD)

2



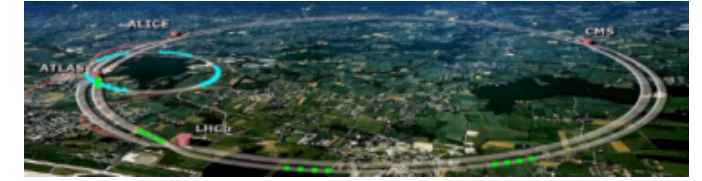
## Charm Physics

BESIII, BelleII, PANDA, GlueX



## Neutrino Physics

Daya Bay, JUNO, EXO, DarkSide, COMET



## High Energy Frontier

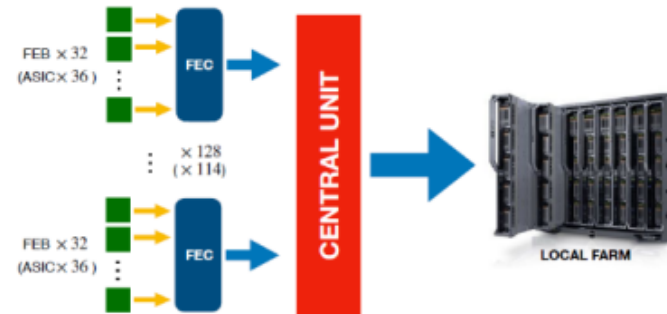
CEPC, LHC (ATLAS/CMS/LHCb)



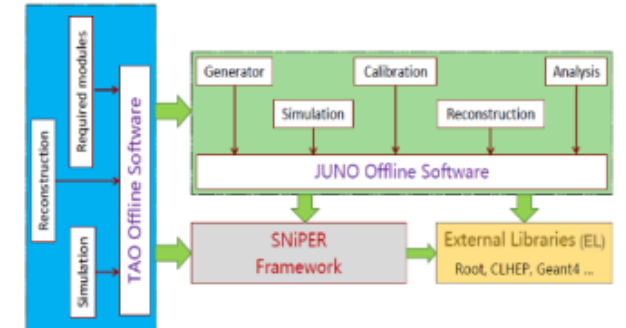
## Detector



## Electronics

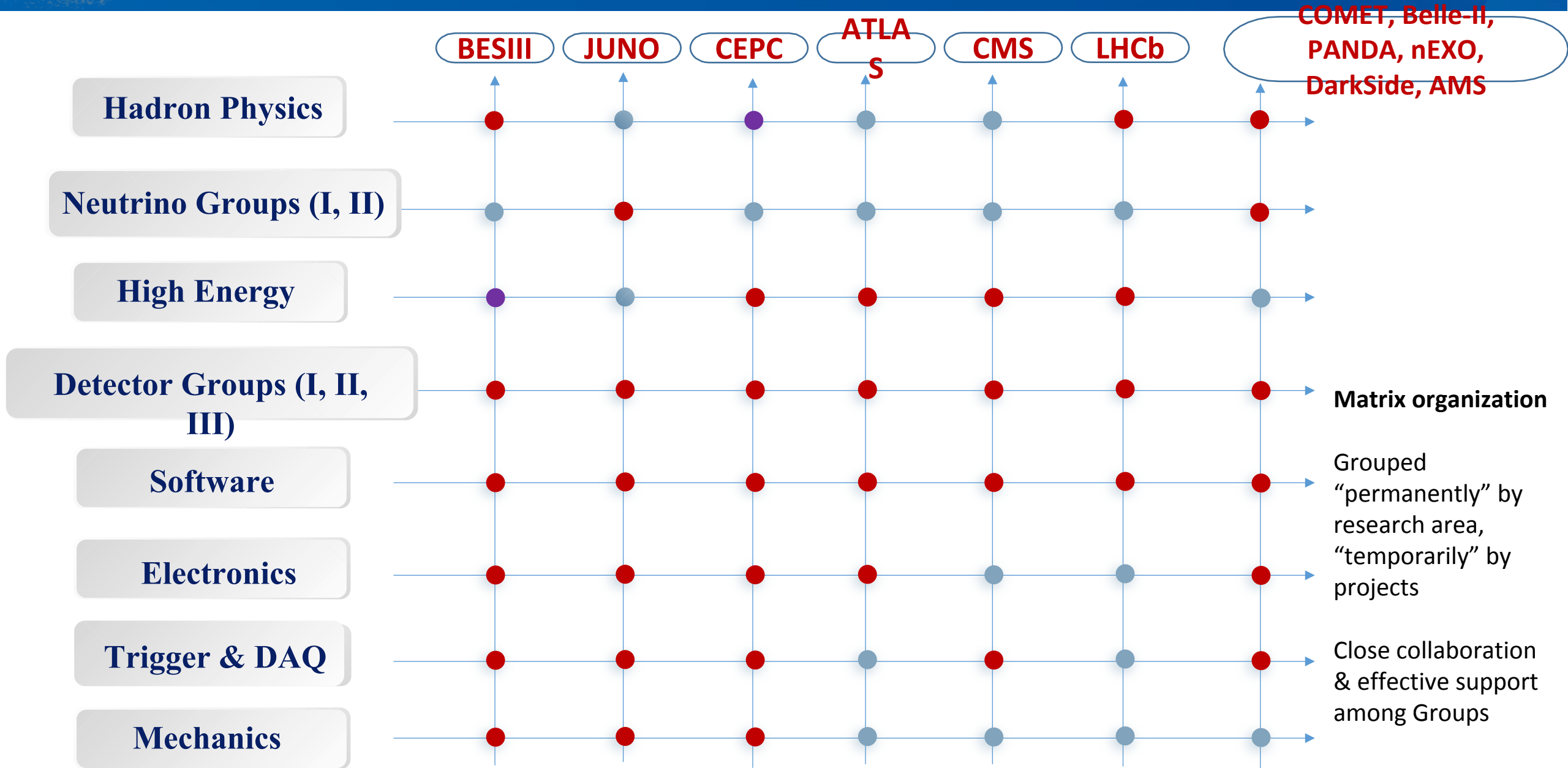


## Trigger, DAQ, DCS



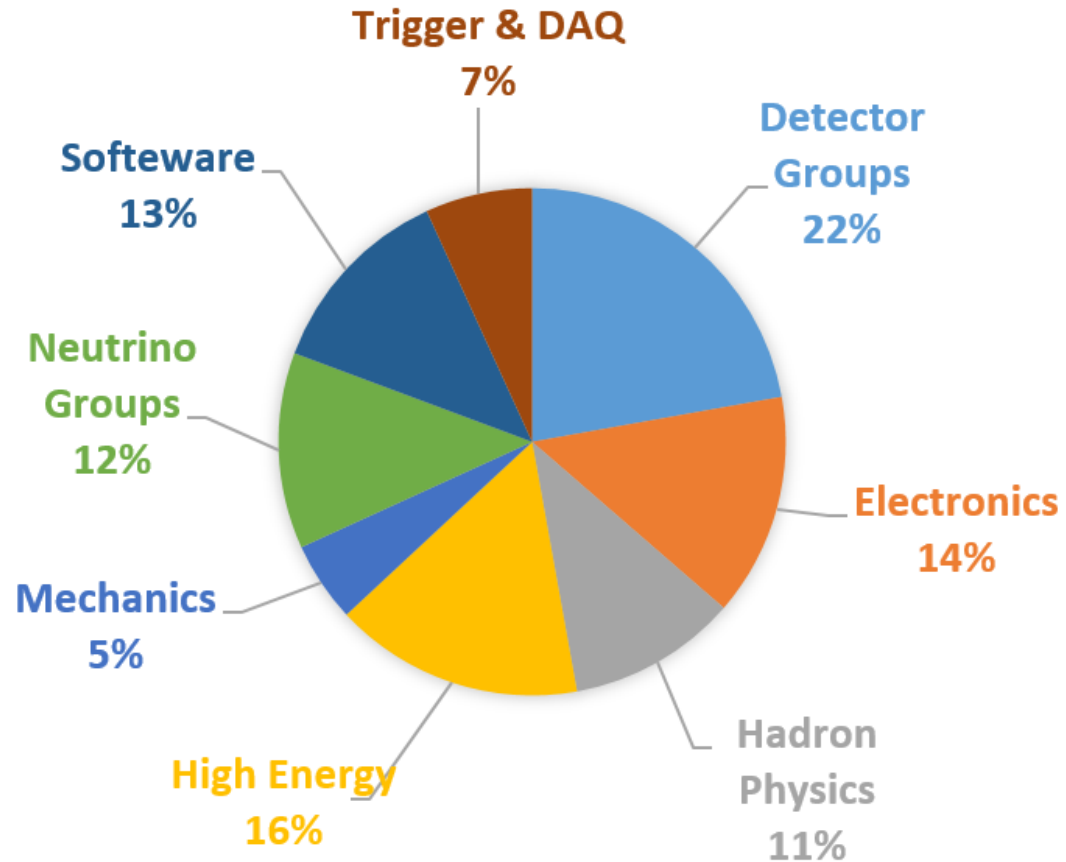
## Software

Complete chain of design, construction, and operation of large-scale experiments, R&D of advanced technology  
**177 staff, 397 temporary (including postdoc, students), totaled 574 people** (Dec. 2023)





# Members in EPD



Number	
Faculty	~ 180 (4 international Prof.)
Postdoc	41 (13 international)
Student	~ 200
Visiting student	~ 140

Planned recruitment:

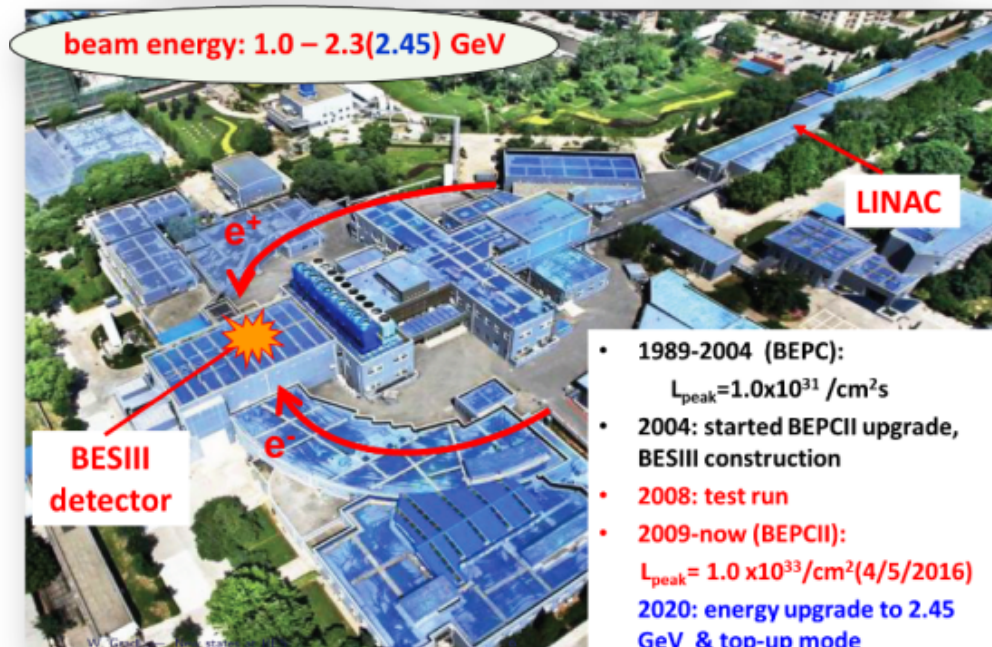
- Faculty: 5 ~ 10 /yr
- Postdoc: 50 – 60 /yr



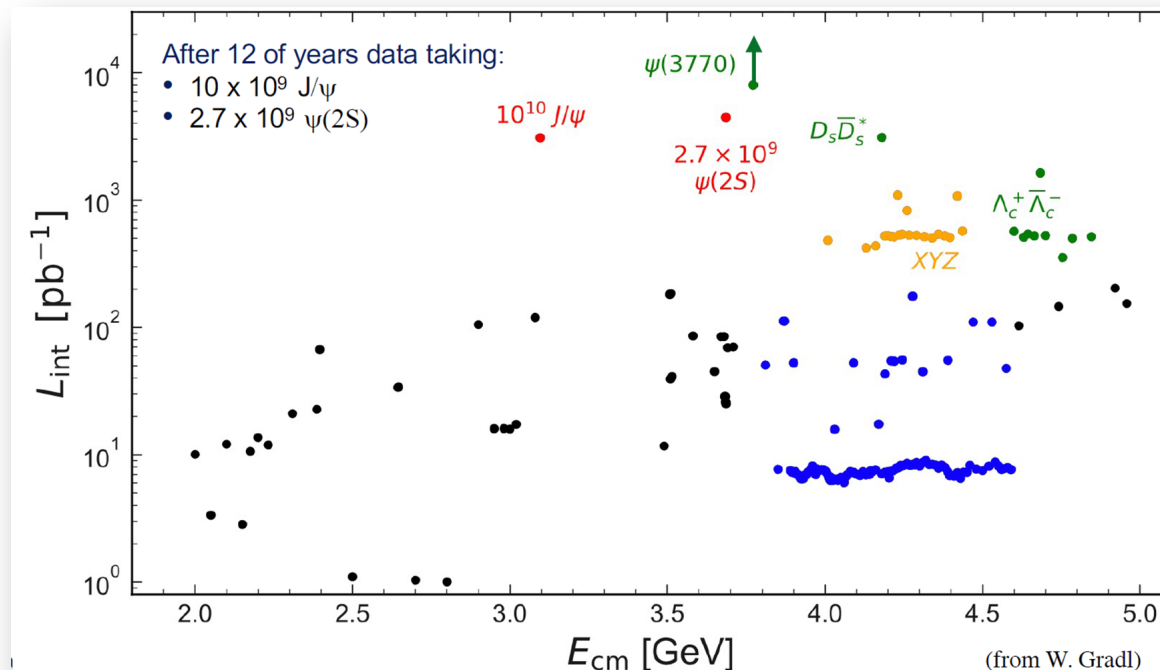
# Hadron Physics - BESIII

5

## Beijing Electron Positron Collider (BEPCII)



## World's largest $\tau$ – charm data sets in $e^+e^-$ annihilation



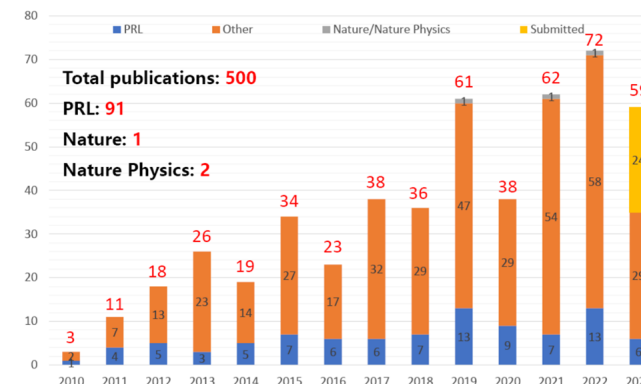
~600 members (more than 130 from outside of China)  
 from 84 institutions in 17 countries

## Rich physics programs:

- Hadron spectroscopy, QCD exotics: **glueballs**, hybrids, XYZ's,...
- **Charm flavor physics**: CKM matrix, decays constants, ...
- **Precision measurements**: R-values, time-like form factors, ...

BEPCII-U: 3x upgrade on luminosity;  $E_{\text{cms}} \rightarrow 5.6 \text{ GeV}$  (summer 2024)

## BESIII publications (May 9, 2023)





# Neutrino Physics - JUNO

6

## A multi-purpose neutrino observatory

- Determine **neutrino mass ordering** ( $\sim 4\sigma$ )
- **Precision measurement**  $\nu$ -oscillation parameters ( $\ll 1\%$ )
- Other rich physics: **Supernova  $\nu$** , Geo-  $\nu$ , Solar  $\nu$ , Proton decay, Exotic searches, ...

- Civil construction completed.
- Installation work has started in Dec. 2021
- Expect first data in 2024

**Exciting results will come in next a few years!**

- By 2030s, upgrade to search for  $0\nu\beta\beta$





# High Energy Frontier - ATLAS

7

- 14 Staff with International style
- 30 postdocs + Ph.D. students
- Topics:
  - ✓ High granularity time detector (HGTD)
    - ✓ LGAD sensors chosen by CERN
    - ✓ IHEP played a leading role in HGTD
      - ✓ Project leaders, L2/L3 conveners
  - ✓ Upgrade of Inner Track (ITK)
  - ✓ Physics with rich directions:
    - SM: Higgs, Di-Higgs, W mass
    - New Physics: SUSY, Higgs-related BSM

Joao Guimaraes Costa  
Group Leader



Xinchou Lou



Xuai Zhuang



Yaquan Fang



Yanping Huang



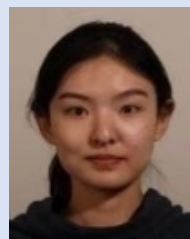
Zhijun Liang



Xin Shi



Zhaoru Zhang



Pielian Liu



Feng Lu



Lianyou Shan



Da Xu



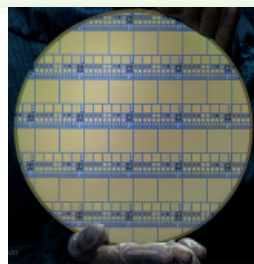
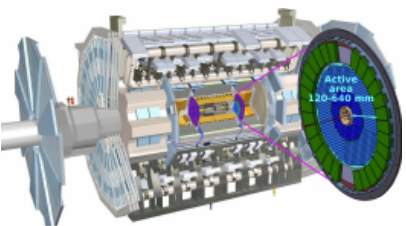
Hideki Okawa



Yunyun Fan



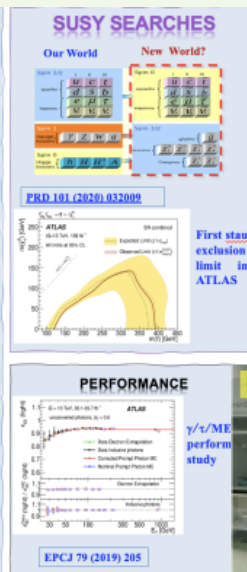
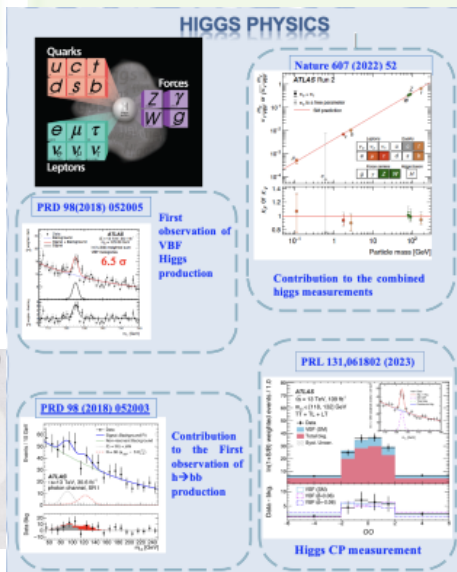
## HGTD detector: IHEP plays a leading role



IHEP LGAD silicon sensor

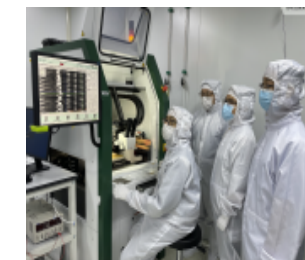


## Physics highlights

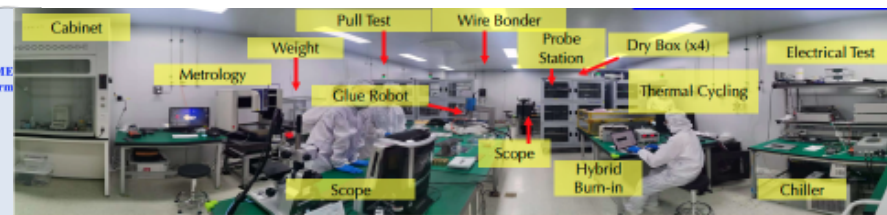


## ITK: Responsible for 10% barrel strip module

### ITk Strip Detector Module



Clean room in IHEP





# High Energy Frontier - CMS

8

- **IHEP CMS group:** 9 staff, 30+ postdocs and PhD students
- **Strong involvement in a broad physics program**
  - Higgs, new physics searches, Top and EW precision measurements
  - Detector performance and physic object studies
- **Well-established labs and heavy commitment in the upgrade projects**
  - CMS **High Granularity Calorimeter** (HGCAL) module assembly center
  - CMS **iRPC/RPC endcap backend electronics** and trigger system R&D
  - Participation in HGCAL beam and system tests, CSC GIF++ at CERN





# High Energy Frontier - LHCb

9

All faculty members joined IHEP in the past 5 years

Jianchun Wang

Yiming Li

Shanzhen Chen

Zijun Xu

Xuhao Yuan



5 professors, 1 computing engineer, 2 visiting scientists  
2 post-doctoral researchers, 8 post-graduate students

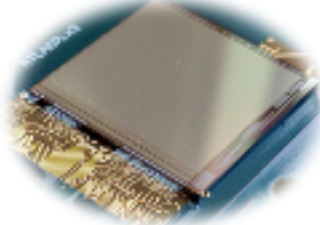
High-precision, radiation-hard silicon detector

- LHCb Upstream Tracker (UT)
- Silicon pixel detector for LHCb upgrade and CEPC
- Silicon detector for AMS projects

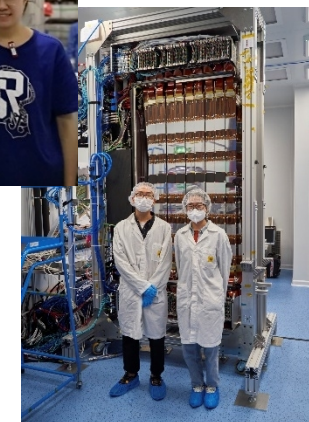
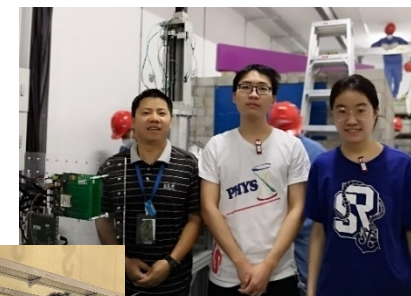
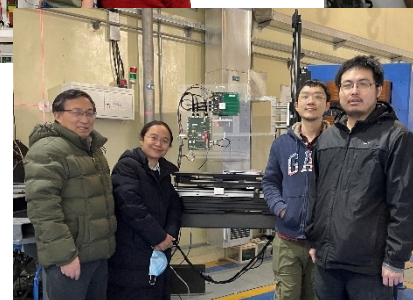
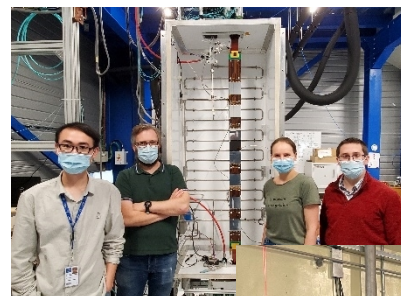
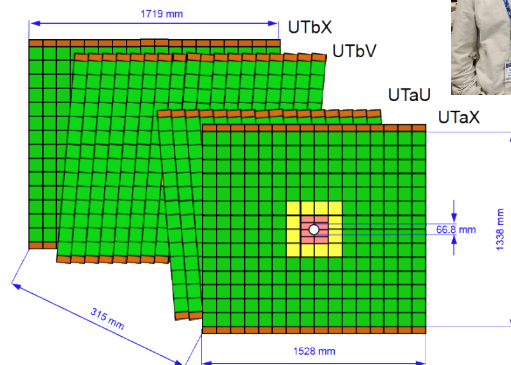
AMS L0



CEPC / LHCb

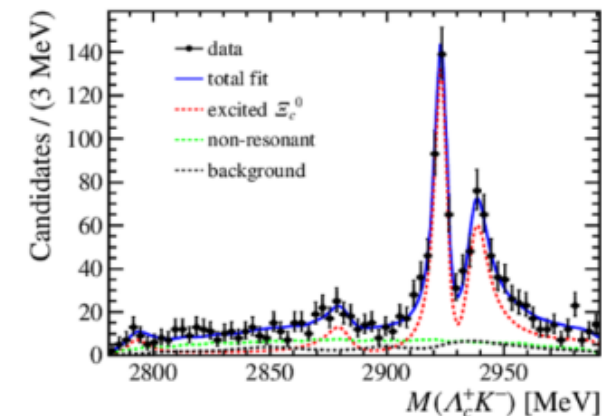


UT

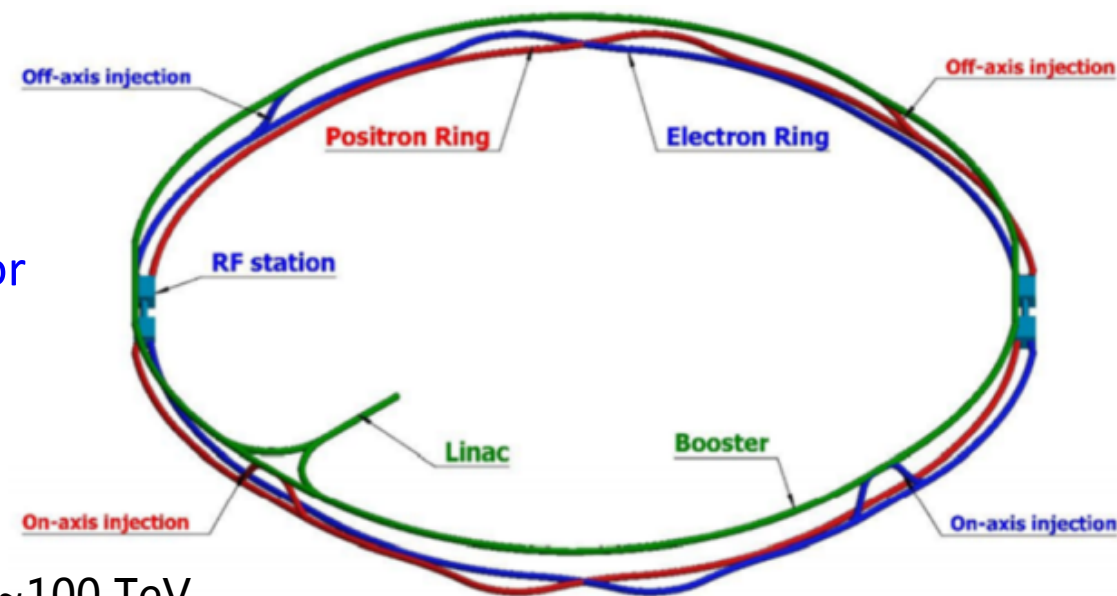


Heavy flavor physics

- Hadron spectroscopy and new particle searches
- CP violation and CKM parameter studies



- CEPC: an  $e^+e^-$  Higgs factory producing H and W/ Z bosons and top quarks aims at discovering new physics beyond the Standard Model with energy scale of 10 TeV or even higher. Propose to commence construction in  $\sim 2026$  and deliver data in 2030s
  - CEPC + SppC complex proposed in 2012 right after the Higgs discovery
  - Conceptual Design Report delivered in Nov. 2018, 1st for circular  $e^+e^-$  Higgs factory
  - R&D  $\sim$ ready, accelerator TDR released at Dec.2023, high-impact innovations
- Focuses in near future:
  - Accelerator Engineering Design Studies
  - Physics studies, especially Physics White Papers
  - Detector: TDR study towards a reference detector
- 100 km circumference
  - Energy 90-240 GeV, can be upgraded to 360 GeV
  - Updated to a Proton collider SppC in the same tunnel :  $\sim 100$  TeV

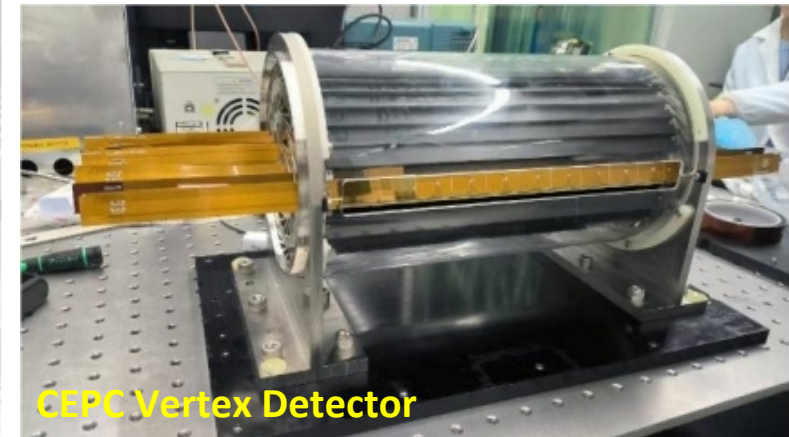
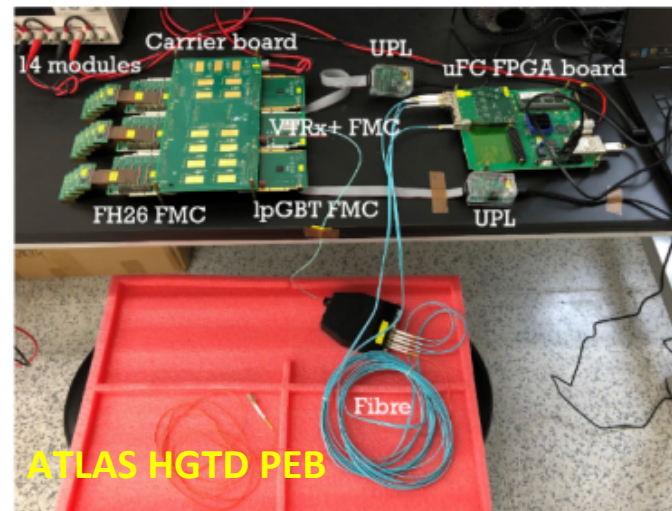
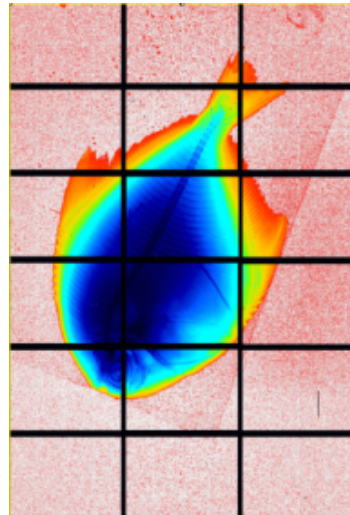
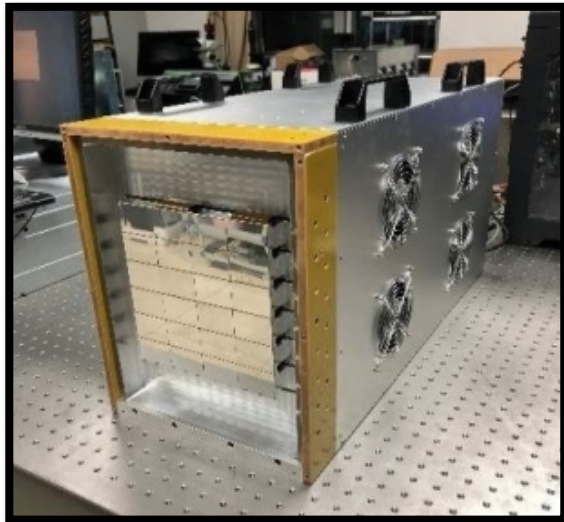




# Advanced Electronics development

11

- **EPD electronics group:** 23 staff, 15+ PhD students
- **Three major research directions**
  - Application Specific Integrated-Circuit (ASIC)
  - Advanced backend electronics system design
  - Advanced electronics technologies (packaging, cooling, communication...)
- **Long history and full chain of design capabilities for the electronics systems in large particle experiments**
  - BESIII, Dayabay, JUNO, LHAASO...
  - One of the largest electronics groups in the HEP field in China



CEPC Vertex Detector

Frontier R&D for world-leading detectors

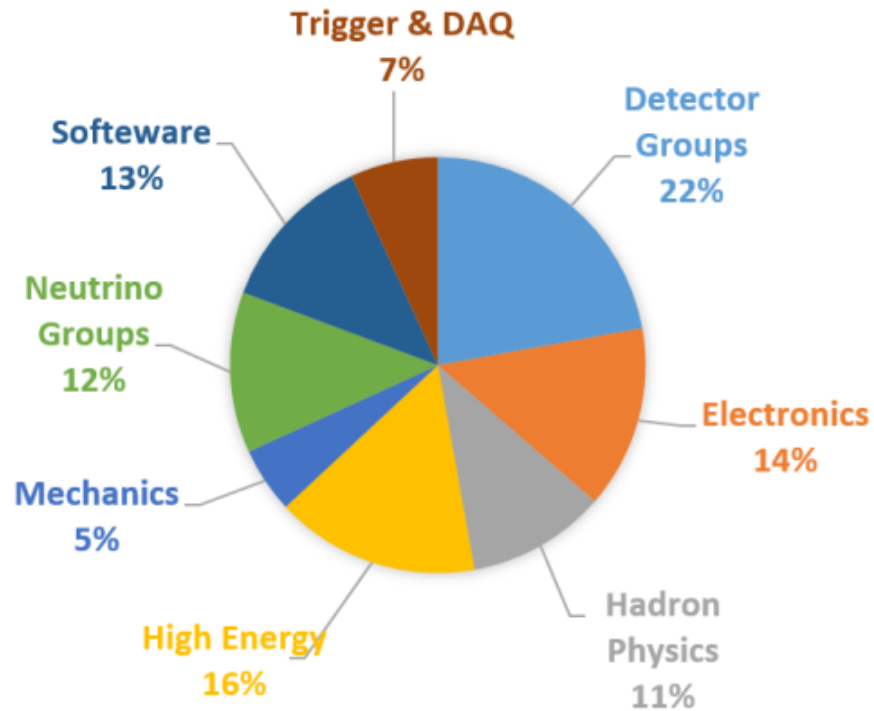
The first X-ray pixel detector in China for light sources

Deep involvement in wide int-col.



# Recruitment opportunities

12



Current composition

## Planned recruitment:

- Faculty: 5 ~ 10 /yr
- Postdoc: 50 – 60 /yr

\* Depending on project requirements, the LHC postdocs may need to station at CERN

Projects	Contacts
JUNO	Liangjian Wen ( <a href="mailto:wenlj@ihep.ac.cn">wenlj@ihep.ac.cn</a> )
BESIII	Haibo Li ( <a href="mailto:lihb@ihep.ac.cn">lihb@ihep.ac.cn</a> )
CEPC	Xinchou Lou ( <a href="mailto:xinchou@ihep.ac.cn">xinchou@ihep.ac.cn</a> )
ATLAS	Joao Guimaraes Costa ( <a href="mailto:guimaraes@ihep.ac.cn">guimaraes@ihep.ac.cn</a> )
CMS	Mingshui Chen ( <a href="mailto:chenms@ihep.ac.cn">chenms@ihep.ac.cn</a> )
LHCb	Jianchun Wang ( <a href="mailto:jwang@ihep.ac.cn">jwang@ihep.ac.cn</a> )
Electronics	Wei Wei ( <a href="mailto:weiw@ihep.ac.cn">weiw@ihep.ac.cn</a> )
Detector Tech	Yuekun Heng ( <a href="mailto:hengyk@ihep.ac.cn">hengyk@ihep.ac.cn</a> ) Mingyi Dong ( <a href="mailto:dongmy@ihep.ac.cn">dongmy@ihep.ac.cn</a> )

You are also welcome to contact our EPD director Jun Cao ([caoj@ihep.ac.cn](mailto:caoj@ihep.ac.cn))