

Summary of 3rd EIC-ASIA Workshop

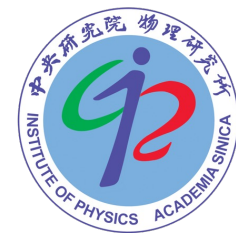
22 February 2024 @ ePIC General Meeting

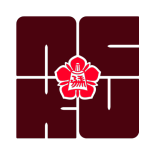
Yi Yang *National Cheng Kung University*

Wen-Chen Chang *Academia Sinica*

<https://indico.phys.sinica.edu.tw/event/88/>

Participant: 40 in-person, 19 online





About this workshop



Following the previous EIC-Asia workshops in [Korea](#) (2022) and [Japan](#) (2023) we are organizing a third one at National Cheng Kung University, Tainan, Taiwan during January 29-31, 2024. The main goal of this Workshop is to discuss in depth the physics opportunities and related experimental activities of the upcoming U.S. Electron-Ion Collider (EIC), with an emphasis on collaboration among Asian colleagues.

○ **Will have this workshop every year**

2024 JAN 29-31 EIC Asia Workshop

National Cheng Kung University
Department of Physics, Rm 36189 (1F)
No.1, University Road, Tainan City, Taiwan

International Advisory Committees

- Elke Aschenauer (BNL)
- Wen-Chen Chang (AS)
- Jinhui Chen (Fudan)
- Shuddha Shankar Dasgupta (NISER)
- Abhay Deshpande (SBU)
- Yuji Goto (RIKEN)
- Taku Gunji (CNS, UTokyo)
- Yongsun Kim (SJU)
- Seung-II Nam (PKNU)
- Ent Rolf (JLab)
- Bowen Xiao (CUHK)
- Qinghua Xu (SDU)
- Yi Yang (NCKU)
- Yifei Zheng (USTC)

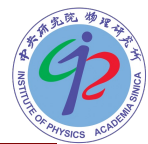
Local Committees

- Wen-Chen Chang (AS)
- Jiunn-Wei Chen (NTU)
- Kai-Feng Chen (NTU)
- Pai-hsien Jennifer Hsu (NTHU)
- Chung-Wen Kao (CYCU)
- Chia-Ming Kuo (NCU)
- Chi-Jen David Lin (NYCU)
- Po-Ju Lin (NCU)
- Rong-Shyang Lu (NTU)
- Jen-Chieh Peng (UIUC, NCU)
- Zhangbu Xu (BNL, NCKU)
- Yi Yang (NCKU)

Diagram labels: Storage Ring, Detector, Electrons, Electron Accelerator, Ion Collider Ring, Ions.



Local Committee



○ Experimentalists:

- Yi Yang (NCKU)
- Wen-Chen Chang (AS)
- Chia-Ming Kuo (NCU)
- Po-Ju Lin (NCU)
- Kai-Feng Chen (NTU)
- Rong-Shyang Lu (NTU, director of TIDC)
- Pai-hsien Jennifer Hsu (NTHU)
- Zhangbu Xu (BNL, NCKU)
- Jen-Chieh Peng (UIUC, NCU)

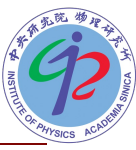
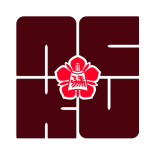
○ Theorists:

- Jiunn-Wei Chen (NTU)
- Chi-Jen David Lin (NYCU)
- Chung-Wen Kao (CYCU)



陽明交大
NYCU





Advisory Committee

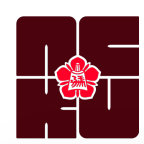
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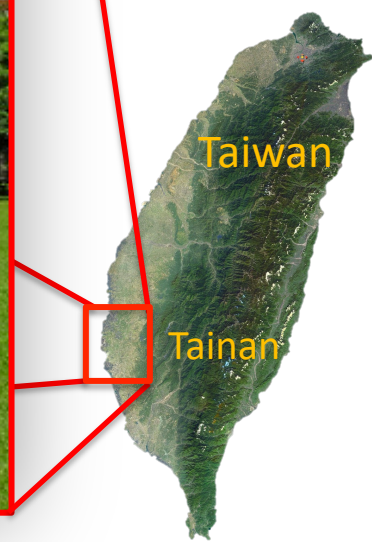
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- Bowen Xiao (CUHK)
- Seung-II Nam (PKNU)

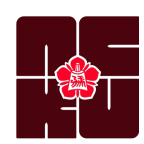




Location



National Cheng Kung University (NCKU)
One of the top research universities in Taiwan



Program – Day 1 (morning)



Registration

Department of Physics, Rm 36169 (1F), National Cheng Kung University

08:30 - 09:00

Welcome

Yi Yang

Department of Physics, Rm 36169 (1F), National Cheng Kung University

09:00 - 09:10

EIC status

Dr Rolf Ent [🔗](#)

Department of Physics, Rm 36169 (1F), National Cheng Kung University

09:10 - 10:00

Coffee break

Department of Physics, Rm 36169 (1F), National Cheng Kung University

10:00 - 10:20

New topics in GPDs (remote)

Prof. Yoshitaka Hatta [🔗](#)

Department of Physics, Rm 36169 (1F), National Cheng Kung University

10:20 - 11:10

TMDs

Prof. Ralf Seidl [🔗](#)

Department of Physics, Rm 36169 (1F), National Cheng Kung University

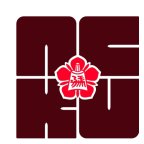
11:10 - 12:00



Program – Day 1 (afternoon)



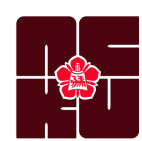
Meson Structure via EIC <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Dr Parada Hutaaruk</i> 13:30 - 13:55
RHIC STAR experiment <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Prof. Zhangbu Xu</i> 13:55 - 14:20
RHIC sPHENIX experiment <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Prof. Yuji Goto</i> 14:20 - 14:45
Coffee break <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	14:45 - 15:15
3D Structure of the Nucleon with CLAS12 <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Prof. Kyungseon Joo</i> 15:15 - 15:40
CERN COMPASS experiment <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Prof. Po-Ju Lin</i> 15:40 - 16:05
UPC Physics at LHC experiment (remote) <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Prof. Shuai Yang</i> 16:05 - 16:30
Coffee break <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	16:30 - 17:00
Memorial session for Prof. Yongseok Oh <i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>	<i>Yongsun Kim et al.</i> 17:00 - 18:00



Program – Day 2 (morning)



ePIC status	Prof. John Lajoie	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	09:00 - 09:40	
AC-LGAD	Prof. Satoshi Yano	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	09:40 - 10:00	
ZDC	Prof. Yuji Goto	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	10:00 - 10:20	
PID Detectors R&Dfor EIC Tsinghua-Part (remote)	Prof. Zhihong Ye	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	10:20 - 10:40	
Endcap EMCAL (remote)	Prof. Wei-Hu Ma	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	10:40 - 11:00	
Coffee break		
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	11:00 - 11:20	
Prospects of lattice computations for TMDPDF physics in Taiwan	Prof. David Lin	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	11:20 - 11:45	
UPC (remote)	Prof. Jian Zhou	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	11:45 - 12:10	
Kaon GPDs and GFFs	Dr Hyeondong Son	🔗
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		
	12:10 - 12:35	



Program – Day 2 (afternoon)



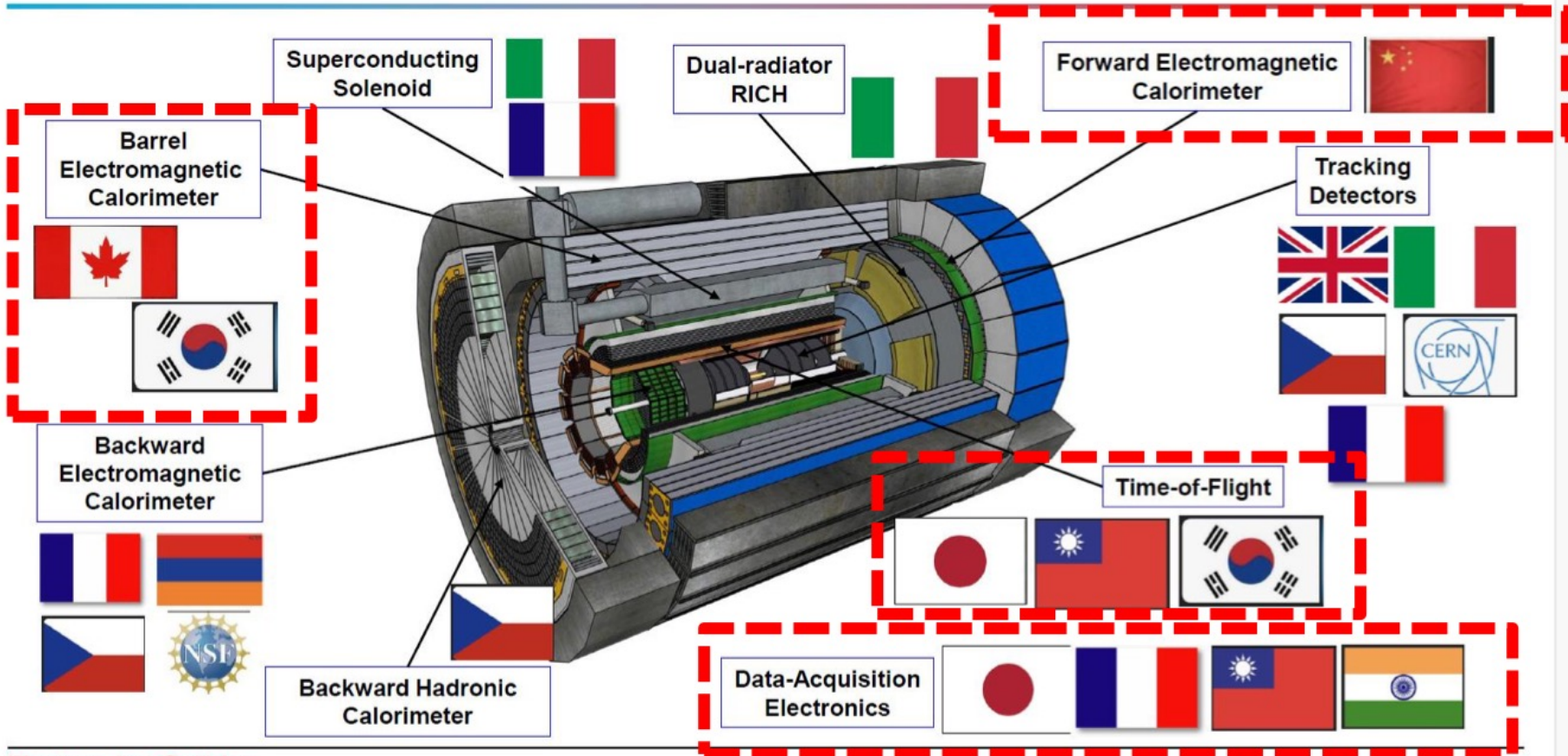
Prospects of the EIC India Group (remote)	<i>Prof. Shuddha Shankar Dasgupta</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		14:00 - 14:20
Prospects of the EIC Korea Group	<i>Prof. Yongsun Kim</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		14:20 - 14:40
Prospects of the EIC Mainland China Group (remote)	<i>Prof. Qinghua Xu</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		14:40 - 15:00
Prospects of the EIC Japan Group	<i>Prof. Taku Gunji</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		15:00 - 15:20
Prospects of the EIC Taiwan Group	<i>Prof. Chia-Ming Kuo</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		15:20 - 15:40
Coffee break		
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		15:40 - 16:00
Round Table Discussion	<i>Prof. Taku Gunji</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		16:00 - 17:30
Summary	<i>Wen-Chen Chang</i>	
<i>Department of Physics, Rm 36169 (1F), National Cheng Kung University</i>		17:30 - 18:00

Asian contributions/interests to ePIC



From Rolf

Central Detector Non-DOE Interest & In-Kind



Electron-Ion Collider

EIC-Asia Workshop, January 29-31, 2024 @ NCKU

R. Ent

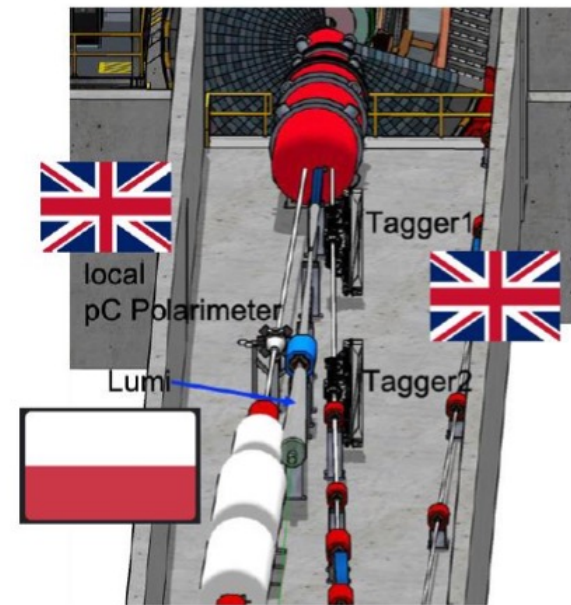
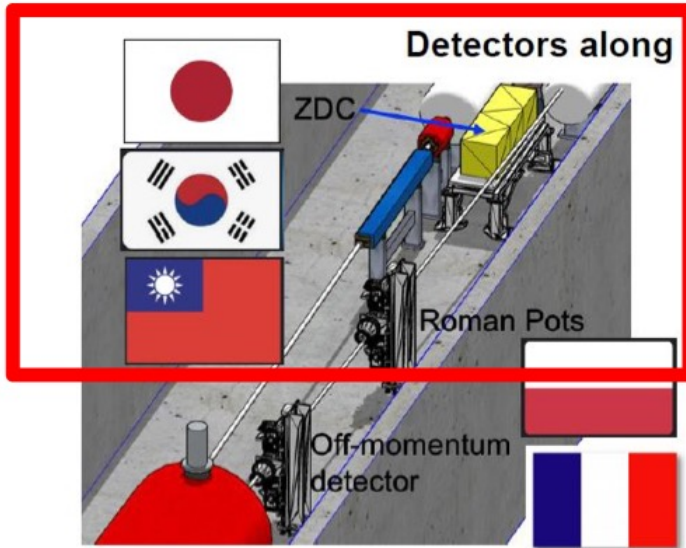
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Asian contributions/interests to ePIC

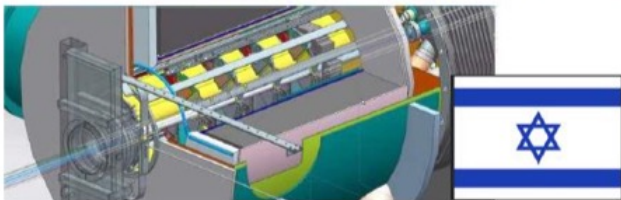


From Rolf

Far-Forward/Far-Backward Detectors Non-DOE Interest & In-kind



B0-Tracker & Electromagnetic Calorimeter



Electron-Ion Collider

EIC-Asia Workshop, January 29-31, 2024 @ NCKU

R. Ent

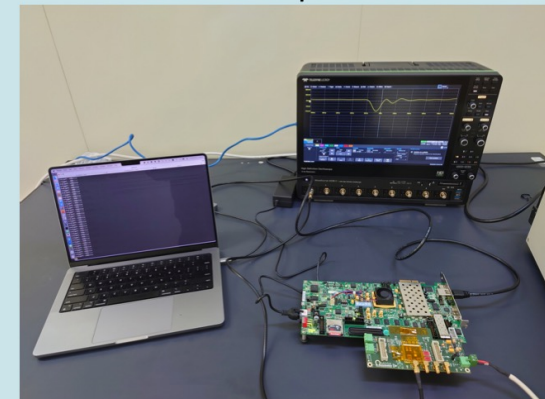
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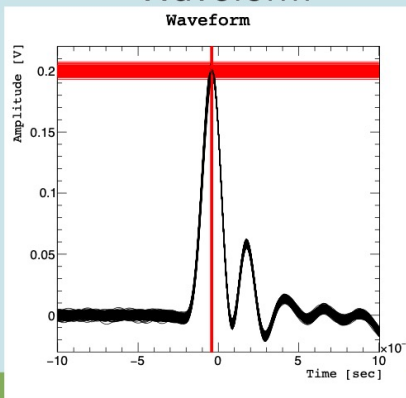
TOF activity in Hiroshima University (JP)

- AC-LGAD sensor R&D
 - We have started AC-LGAD R&D for ePIC (pixel and strip) in Japan
 - The R&D setup is being built at HU
 - The next batch (full-size sensor) will be tested at HU
- Frontend ASIC (EICROC) R&D
 - We have started EICROC R&D with IJCLab/Omega and BNL teams
 - The R&D setup has been built at HU

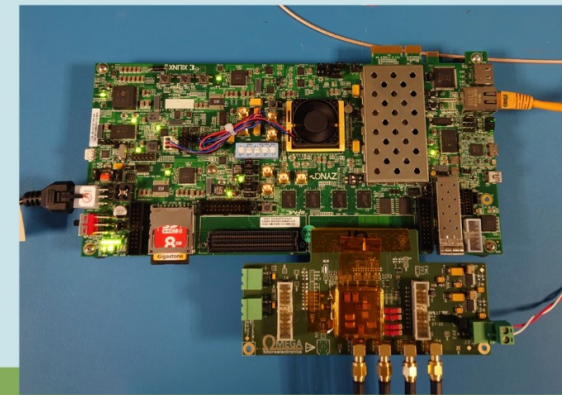
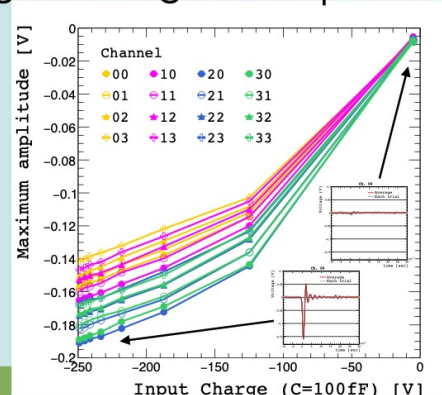
R&D setup at HU

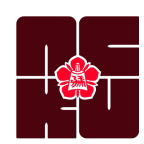


Waveform



Signal strength v.s. input charge

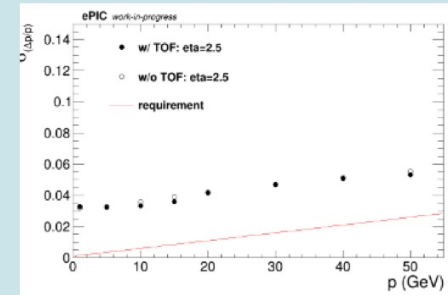
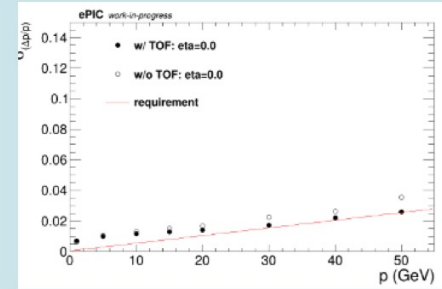




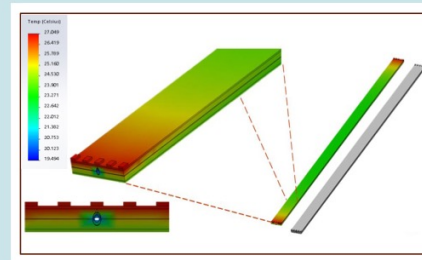
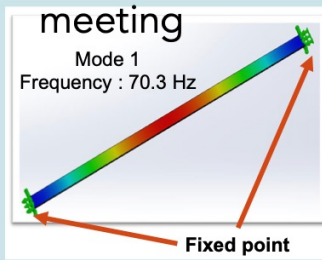
From Satoshi

TOF activity in Taiwan

- National Central University group has started the simulation study
 - I encourage them to present the nice results at the general TOF meeting
- National Cheng Kung University (NCKU) is working on the support structure design
 - Simulation study of the frequency and thermal analysis
 - Thermal test will be conducted at NCKU



From Yu-Tang Wang (NCKU) presentation at the general TOF meeting

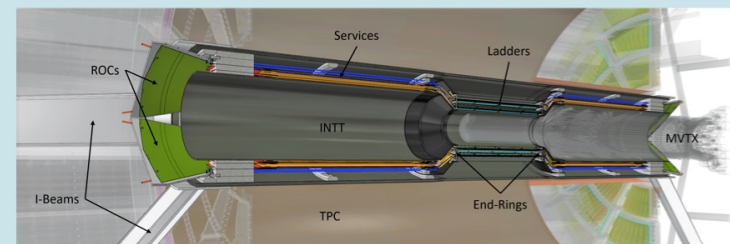
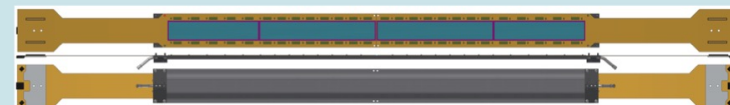


- Dimensions :
 - 40 x 50 x 60 (cm³)
- Temperature
 - Range : -40 °C ~ 100 °C
 - Stability : ± 0.2 °C
- Humidity
 - Range : 10% ~ 98%
 - Stability : ± 2.5%



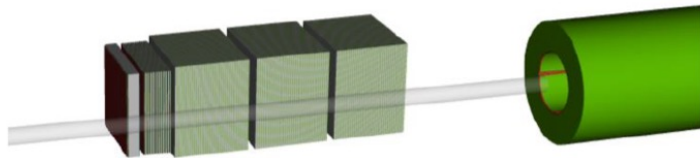
Contribution from sPHENIX INTT Group

- Collaboration with the sPHENIX INTT group will play an important role in the ePIC-TOF project
 - INTT is the strip-type semiconductor detector in sPHENIX, which is similar to BTOF
 - 9 institutes from Japan, Taiwan, and the U.S.A. participate in the project
- Contributions from Japan and Taiwan institutes are:
 - Silicon sensor R&D and production
 - Carbon stave R&D and production
 - PCB R&D and production
 - Stave assembly
- **Their technologies and experiences must make the ePIC-TOF project more robust**



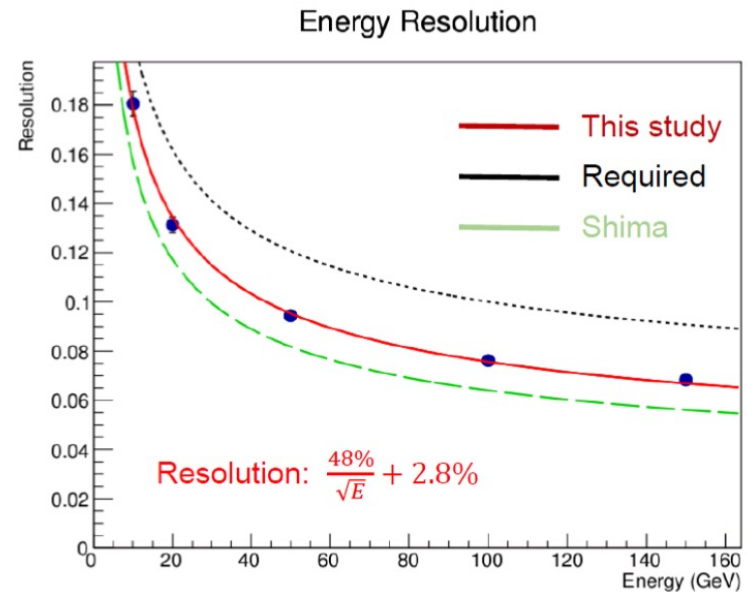
ZDC updated design

- Cost reduction design
 - Smaller EMCAL
 - Pb-Si imaging HCAL removed
 - By Po-Ju Lin (NCU) and Michael Pitt (Kansas)



Use only three Pb/Si blocks to fit the dimension limitation

- Overall length approximately 182.7 cm
- Gaps between crystal-W/Si and W/Si-PbSci: 2 cm
- Gaps between Pb/Si blocks: 5 cm
- In Pb/Si: **Lead thickness = 10.0 mm, scintillator thickness = 2.5mm**



Slide by Po-Ju Lin (NCU)



Summary

- ePIC ZDC updated design
 - EM calorimeter
 - Dimension
 - Crystal scintillator evaluation
 - Hadron calorimeter
 - No imaging layer
 - SiPM-on-tile design
 - Position (& timing) layer
- Preliminary design
 - LYSO crystal calorimeter
 - SiPM-on-tile Fe/Sci calorimeter
- Integration issues

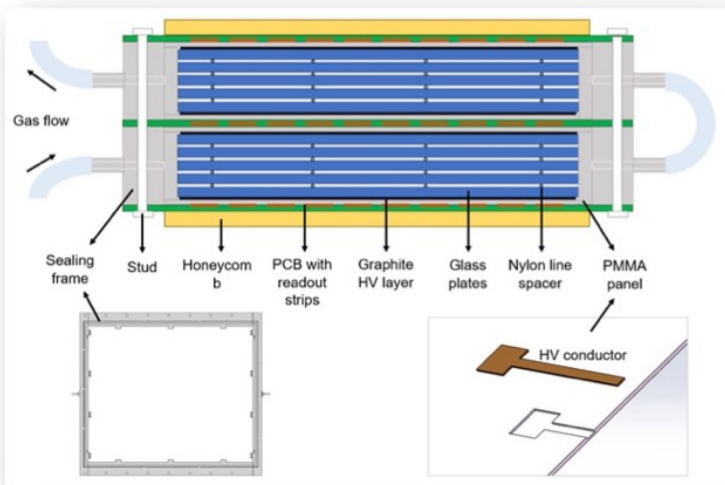
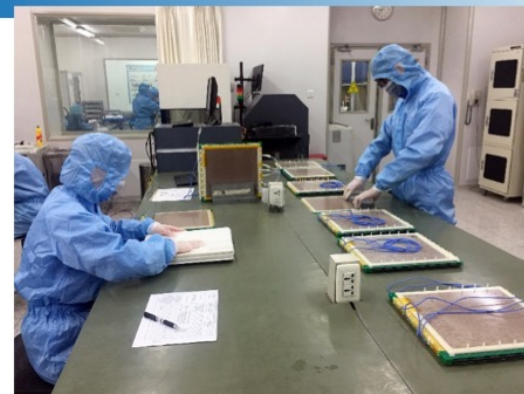


MRPC

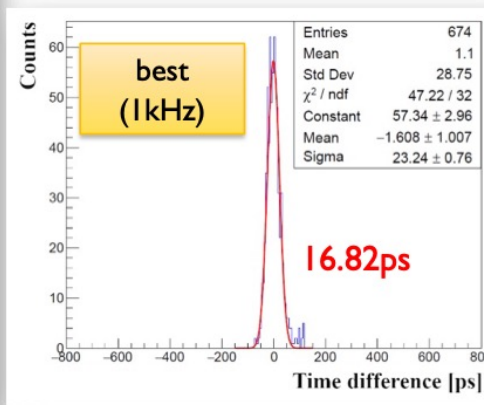
4/17

➤ Tsinghua's new Sealed MRPC (sMRPC)

- ❑ Gen3 MRPC with sealed gas (metal box not needed anymore)
- ❑ More compact, less radiation length
- ❑ Reduce greenhouse gas emission (20cc/cm²/min)
- ❑ Mass production capability of at Tsinghua



Y. Wang et al 2019 JINST 14 C06015



❑ ~17ps archeived with cosmic-ray & 10Gs/s osiloscope

❑ To-do: ~ 30ps with integrated FEE and in-beam

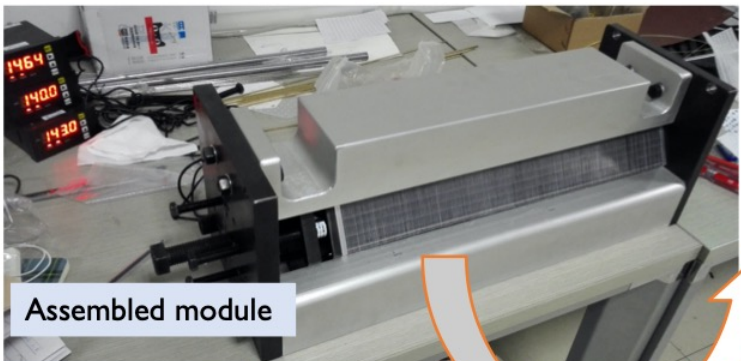
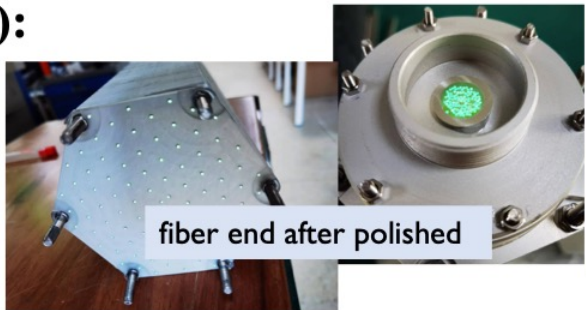


ECAL

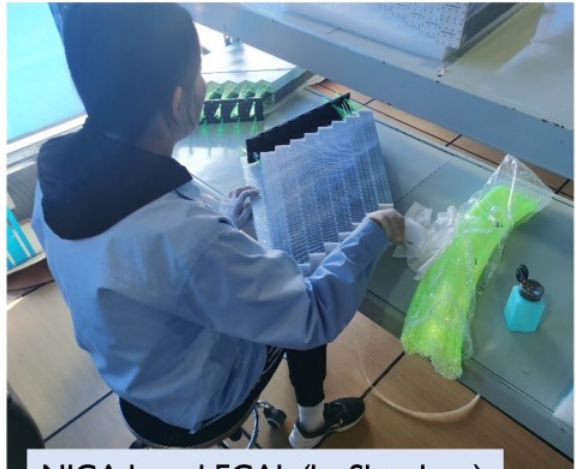
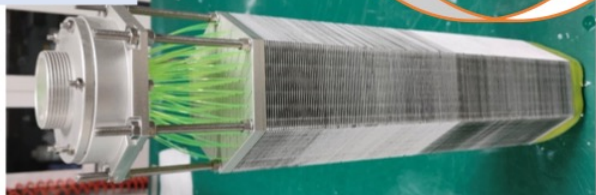
9/17

➤ Shashlyk ECal (by Shandong & Tsinghua):

- ❑ Well developed manufacture lines at Tsinghua & Shandong (see Qinghua's talk)
- ❑ Mass production for NICA-SPD (barrel) and (to-be) for SoLID (endcaps)



Inserts fibers





From Zhihong

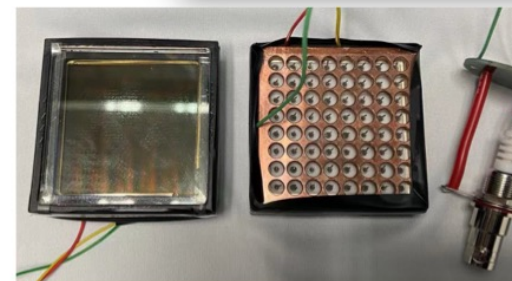
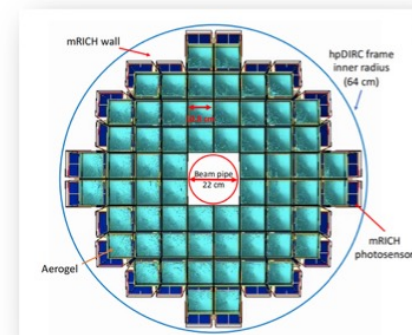
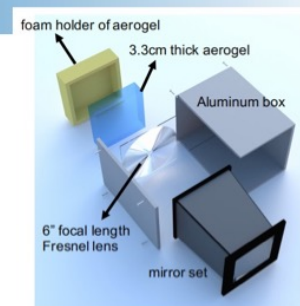
RICH & Aerogel

11/17

➤ RICH R&D:

- No much experience
- Worked on Geant4 Simulation on dRICH (not active anymore...)
- Involved in mRICH R&D
- mRICH was out-selected by ePIC, but Tsinghua is still continuously developing
 - Active support from GSU and other mRICH team members
 - Compact design for prototyping → studying aerogel tiles and photo-sensors
 - **EIC Detector#2?**
- At Tsinghua:
 - A mRICH frame designed by A. Eslinger to be manufactured soon
 - MaPMT: 2*H12700A, 2*H12700A-03, 2*H12445-100
 - 2 * MCP-PMT (8*8, same form-factor as H12700, made in China)
 - Lenses
 - Laser & LED source (down to single-photon)
 - China and BINP aerogels

To-Do: Build a mRICH prototype in 2024 summer





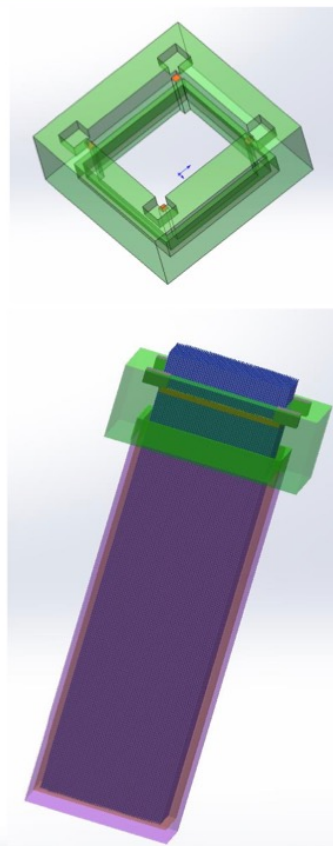
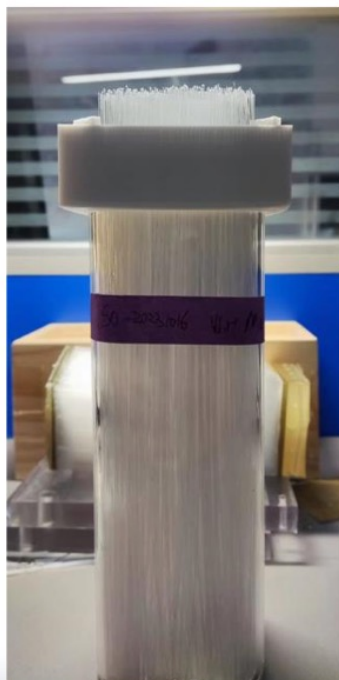
From Wei-Hu



ePIC-fECal block: Fiber filling



- Tools for fiber filling are ready.
- It works well both for meshes and filling.
- 30 min. filling time.



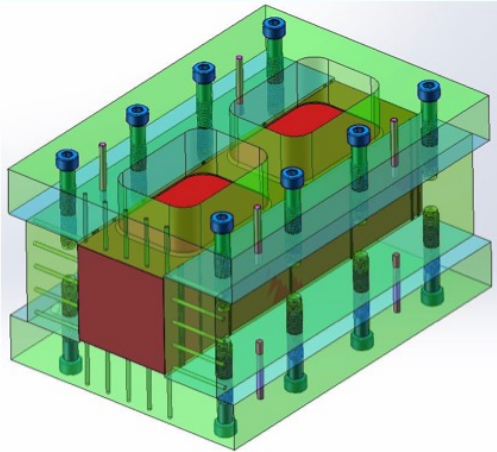
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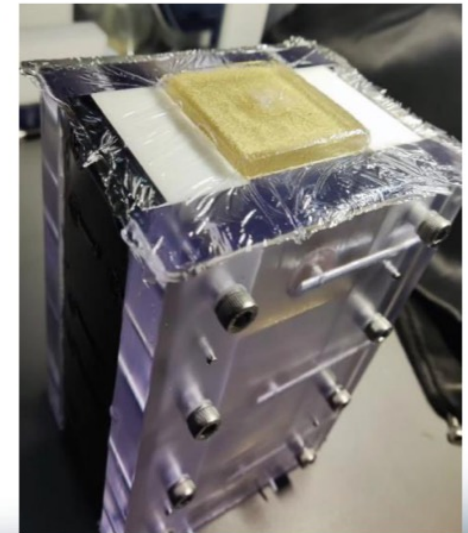
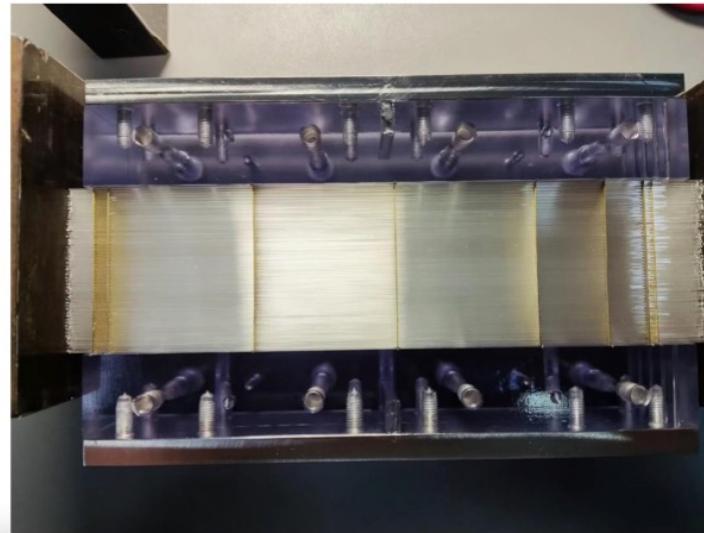
Electron-Ion Collider

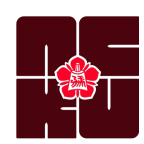


ePIC-fECal block: Mold



- Tools (screws, dowels, capillary tube, etc) for mold assembly are ready at Fudan.
- It works well for putting the fiber set in the mold.
- New molds are ready.



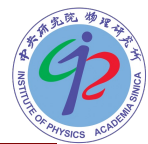


Summary

- Thanks to DAE, DST, and the EIC community for their support.
- EIC India group interests in hardware and software are being defined.
- The funding proposal is in progress.
- The interests are
 - dRICH aerogel characterization
 - SiPM studies for dRICH and Forward EM Calorimeter
 - DAQ/DCS
 - Software and Simulation studies



Prospects of the Korea Group



From Yongsun

Summary

- 15 faculties in 10 institutes in Korea are actively working for ePIC detector R&Ds, in close collaboration with the US and Asian institutes
 - BIC R&D on track
 - ZDC R&D engaged with FoCAL study
- Seeking for further contribution - MPGD, endcap tracker, and LAGD
- began organized activity for theoretical studies
- Funding from Korean government for detector R&D is promising



Summary

- 6 universities from China-mainland are participating ePIC experiments since 2022. 12 institutions in EIC user group.
- Hardware prospects:
 - Forward EMCAL R&D, construction for ePIC
 - R&D of RICH/sMRPC for ePIC
 - Interest with LGAD
- Collaborate and contribute to EIC as much as possible. Organize next EIC-Asia meeting in Shanghai in July 2024.

Prospects of the Japan Group

From Taku

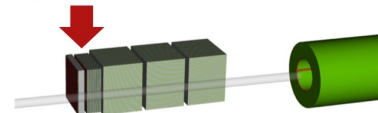
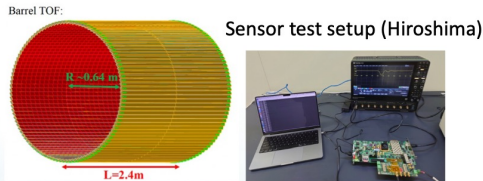
Japanese activities in ePIC

10

▶ AC-LGAD (S. Yano and K. Shigaki)

▶ ZDC (Y. Goto)

W+Si pad Layers as option of the ZDC baseline
Synergies with ALICE-FoCAL



ALICE-FoCAL beam test@CERN

Neutron irradiation at RIKEN RANS



- Japan
- Hiroshima University (AC-LGAD, Frontend ASIC, Sensor-ASIC integration, Simulation)
- Nara Woman's University (Frontend ASIC, Module Assembly, Stave Assembly)
- RIKEN (Module Assembly, Stave Assembly)
- Shinshu University (AC-LGAD, Frontend ASIC)
- University of Tokyo (DAQ, Streaming readout, Online reconstruction)

Japanese activities in ePIC

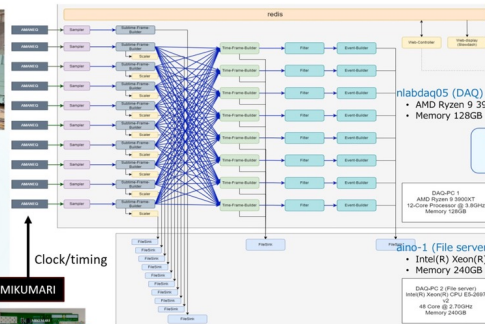
11

▶ Streaming DAQ/Computing

▶ Details at the last collaboration meeting by T. Gunji

▶ SPADI-Alliance in Japan for the standardization of SRO DAQ in many facilities.

Joint workshop and SRO XI WS at Hawaii (2023)



nlbdaq05 (DAQ)
• AMD Ryzen 9 3900XT 12-Core Processor @ 3.8GHz
• Memory 128GB

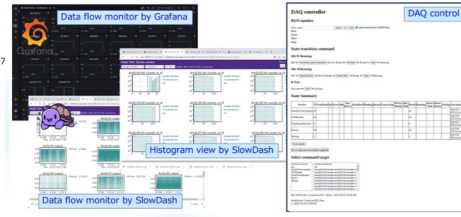
Two server PC configuration
• DAQ
• File server

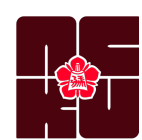
bin0-1 (File server)
• Intel(R) Xeon(R) CPU E5-2697
• Memory 240GB



nestDAQ (network based streaming DAQ)

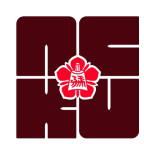
Using nestDAQ at JLab under discussion
Discussion on Echelon2 with RCNP, Osaka





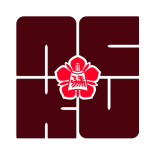
Summary

- The EIC Taiwan group was formed, including experimentalists and theorists
- Kicked off a couple of detector R&D projects for EIC in Taiwan
 - ZDC ECAL prototype with LYSO crystals
 - Mechanical support for TOF
- Started to contribute to detector simulation and performance studies
- Other possibilities: detector assembly with TIDC, more contributions to TOF, computing, and so on



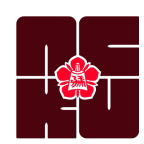
Fun Time in Tainan





3rd EIC-ASIA Workshop





Next (4th) EIC-ASIA Workshop



○ Date: July 1 – 5, 2024

<https://indico.cern.ch/event/1361239/>

○ Location: Fudan University, Shanghai

The 4th EIC-Asia Workshop

Jul 1 – 5, 2024
Asia/Shanghai timezone

Enter your search term



Overview

Timetable

Venu

Visa to China

Hotels

Previous EIC-Asia
workshops

The aim of this workshop is to discuss in depth the opportunities as well as experimental and theoretical activities relevant to the upcoming EIC, in particular on the contribution/collaboration of/among Asian physicists to the EIC relevant physics.

International Advisory Committee

- Elke-Caroline Aschenauer (BNL)
- Jian-Ping Chen (Jefferson Lab)
- Abhay Deshpande (Stony Brook U.)
- Rolf Ent (Jefferson Lab)
- Yuji Goto (RIKEN)
- Yongsun Kim (Sejong U.)
- John Lajoie (Iowa State U.)
- Zuo-Tang Liang (Shandong U.)
- Yu-Gang Ma (Fudan U.)
- Bedanga Mohanty (NISER)
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