

# APCTP activities in nuclear and hadronic physics

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**Chang-Hwan Lee**

*Pusan National University &*

*APCTP (General Council Member & Program Coordinator)*

ECT\*-APCTP joint workshop:  
exploring resonance structure  
with transition GPDS

# In memory of Yongseok Oh *Program Coordinator of APCTP (2013-2023)*



**2015** Director: W. Weise

**ECT\*-APCTP Joint Workshop:**

**From Rare Isotopes to Neutron Stars**

Francesca Gulminelli (LPC and University of Caen, France)

Chang-Hwan Lee (Pusan National University, Busan, Korea)

Yongseok Oh (Kyungpook National University, Daegu, Korea)

Jürgen Schaffner-Bielich (Goethe University Frankfurt, Germany)

PHYSICAL REVIEW D **97**, 023010 (2018)

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**Effective interactions of hyperons and mass-radius relation of neutron stars**

Yeunhwan Lim,<sup>1,\*</sup> Chang-Hwan Lee,<sup>2,†</sup> and Yongseok Oh<sup>3,4,‡</sup>

<sup>1</sup>*Cyclotron Institute and Department of Physics and Astronomy, Texas A&M University,  
College Station, Texas 77843, USA*

<sup>2</sup>*Department of Physics, Pusan National University, Busan 46241, Korea*

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(Received 9 August 2017; published 18 January 2018)

ECT\*-APCTP joint workshop:  
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- **ECT\* for us**
- **Introduction of APCTP**
- **EIC related activities in APCTP**

# ECT\* for us

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# Astro-Hadron Physics *my main interests in Neutron Star related problems*

## *Hadron Physics*

## *Astrophysics*

NS EoS with **Effective Field Theories**  
(with **D.P.Min**, **M.Rho** & **G.E.Brown**)

1990s

NS Binary as a source of GW  
(with **G.E.Brown**@Stony Brook)

**Science-Business-Belt Project**  
initiated by **D.P. Min**

2003

**Korean Gravitational Wave Group**

Nuclear physics + Astrophysics +  
Mathematics + Artificial Intelligence

**RAON project** was approved

2006

2009

**KGWG** joined LIGO Scientific Collab.

**Transport Studies**  
DJBUU (new transport code)  
**BUD<sup>2</sup>-McGill Collaboration**

2017

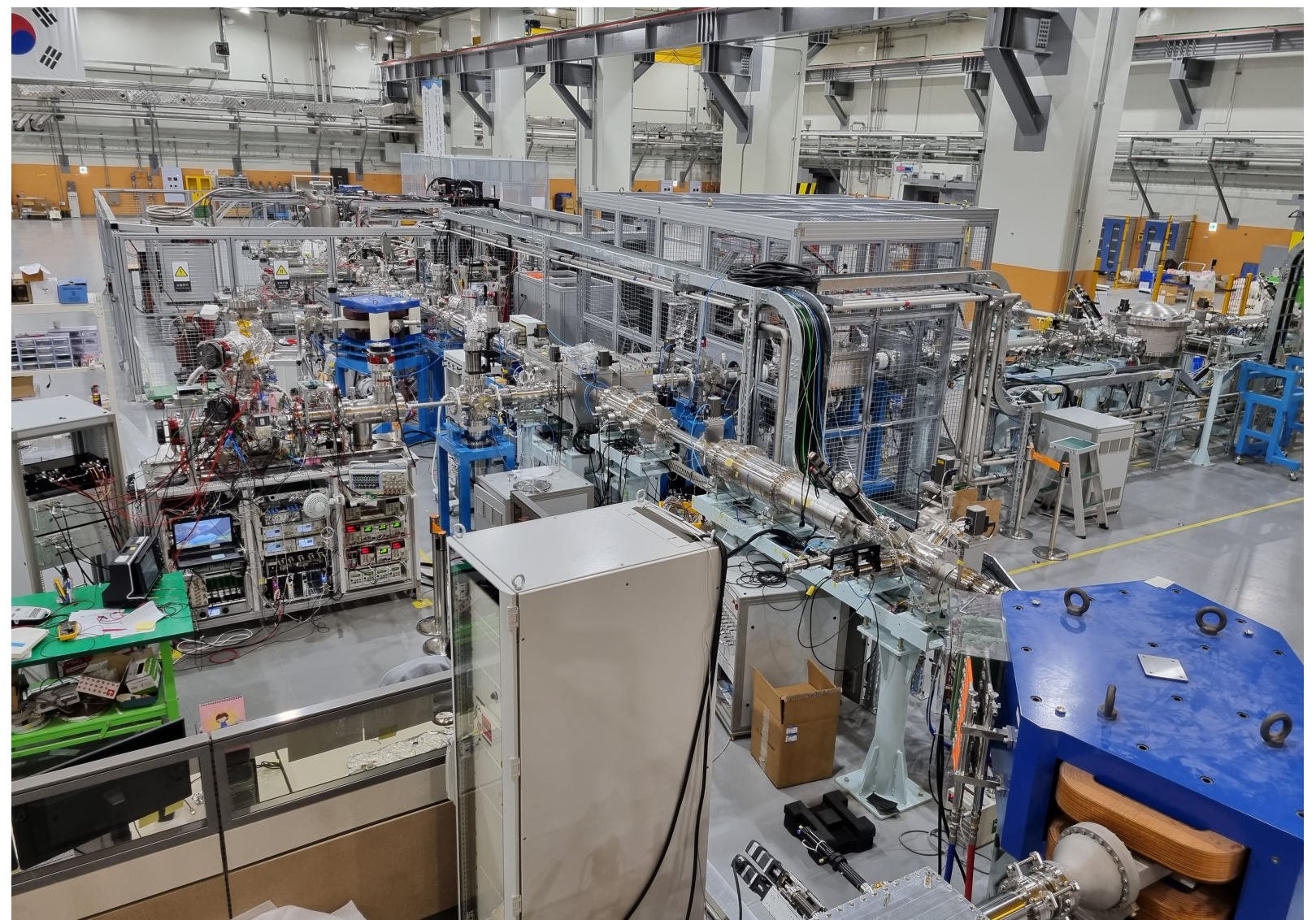
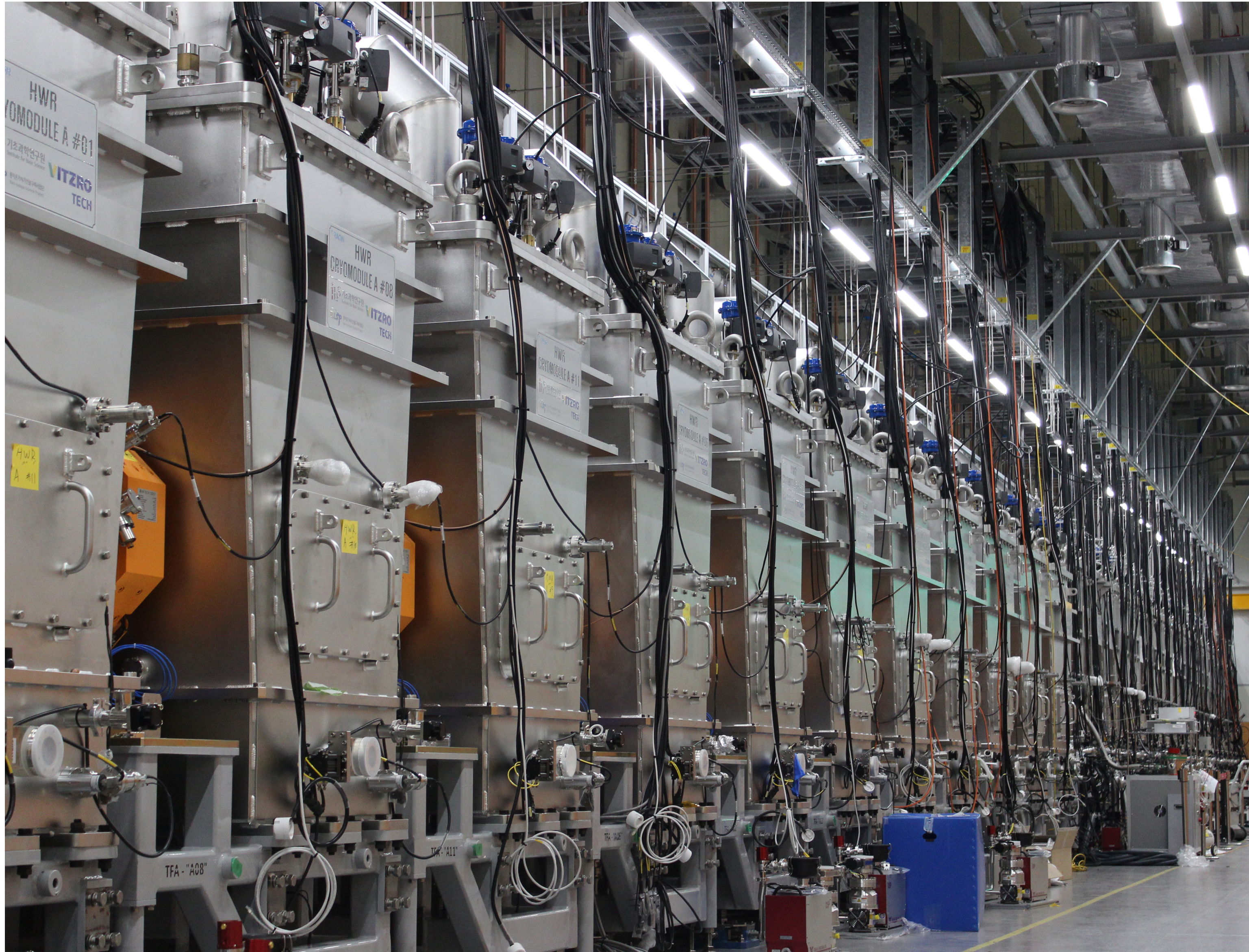
**GW from NS-NS mergers**  
(Multi-messenger Astrophysics)  
Tidal deformability of NS

**First Beam of RAON**  
2022.10.07

2022

2023

for Astro-Hadron Physics



2022

RAON

*previous ECT\* Workshops co-organized by Koreans & Europeans*

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Contributions of **Mannque Rho** (Saclay, France)

*Approaches based on fundamental symmetries*



**ECT\*** established in 1993

**Director: B. Mottelson**

International Workshop on  
Chiral Symmetry in Hadron and Nuclei (Sep, 1993)  
Organized by M. Rho & G. Ripka

*(my first visit to ECT\* as a Ph.D. student)*

**ECT\* provided a unique experience for young researchers !**



*previous ECT\* Workshops co-organized by Koreans & Europeans*

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**2004 Sep. Director: W. Weise**

**Novel Approaches to the Nuclear Many-Body Problem:  
From Nuclei to Stellar Matter**

Organisers: C-H. Lee (Co-ordinator) (*Pusan National Univ.*),  
N. Kaiser (*TU Munich*),  
A. Schwenk (*Ohio State Univ.*)



**2015 Sep. Director: W. Weise**

**ECT\*-APCTP Joint Workshop:  
From Rare Isotopes to Neutron Stars**

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Jürgen Schaffner-Bielich (Goethe University Frankfurt, Germany)



**We tried to invite more young researchers from Korea !**

# 2019 May & Oct

Director: J. Wambach

**Challenges to Transport Theory for Heavy-Ion Collisions**  
Trento, May 20-24, 2019



**The first compact star merger event- Implications for nuclear and particle physics**  
Trento, October 14-18, 2019



## 2023 ECT\* again

ECT\*-APCTP joint workshop:  
exploring resonance structure  
with transition GPDS

### publications with I. Zahed

- **(1998) Lee**, Yamagishi, **Zahed**, PRC 58, 2899  
*Dilepton and photon emission rates from a hadronic gas. III*
- **(1999) Lee**, Wirstam, **Zahed**, Hansson, PLB 448, 168  
*Thermal dileptons from a nonperturbative quark-gluon phase*
- **(1999) Lee**, Yamagishi, **Zahed**, NPA 653, 185  
*Master formulae approach to photon fusion reactions*
- **(2014) Lee, Zahed**, PRC 90, 025204  
*Electromagnetic radiation in hot QCD matter: Rates, electric conductivity, flavor susceptibility, and diffusion*
- **(2018) Lee**, Ryu, **Zahed**, PRD 98, 056006  
*Diffraction vector photo production using holographic QCD*

# Introduction of APCTP

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## Asia Pacific Center for Theoretical Physics (APCTP)

# APCTP Milestones



- **A hub-institute of theoretical physics in Asia Pacific region**  
to facilitate collaboration & exchange of scientists  
to provide a platform for scientists of less advanced region  
by locating in Pohang (POSTECH), Republic of Korea
- **18 member entities & 33 partner institutes**  
including IUPAP, AAPPS, KPS, ICTP, ECT\*, IOP-CAS, ISSP, IBS, etc.

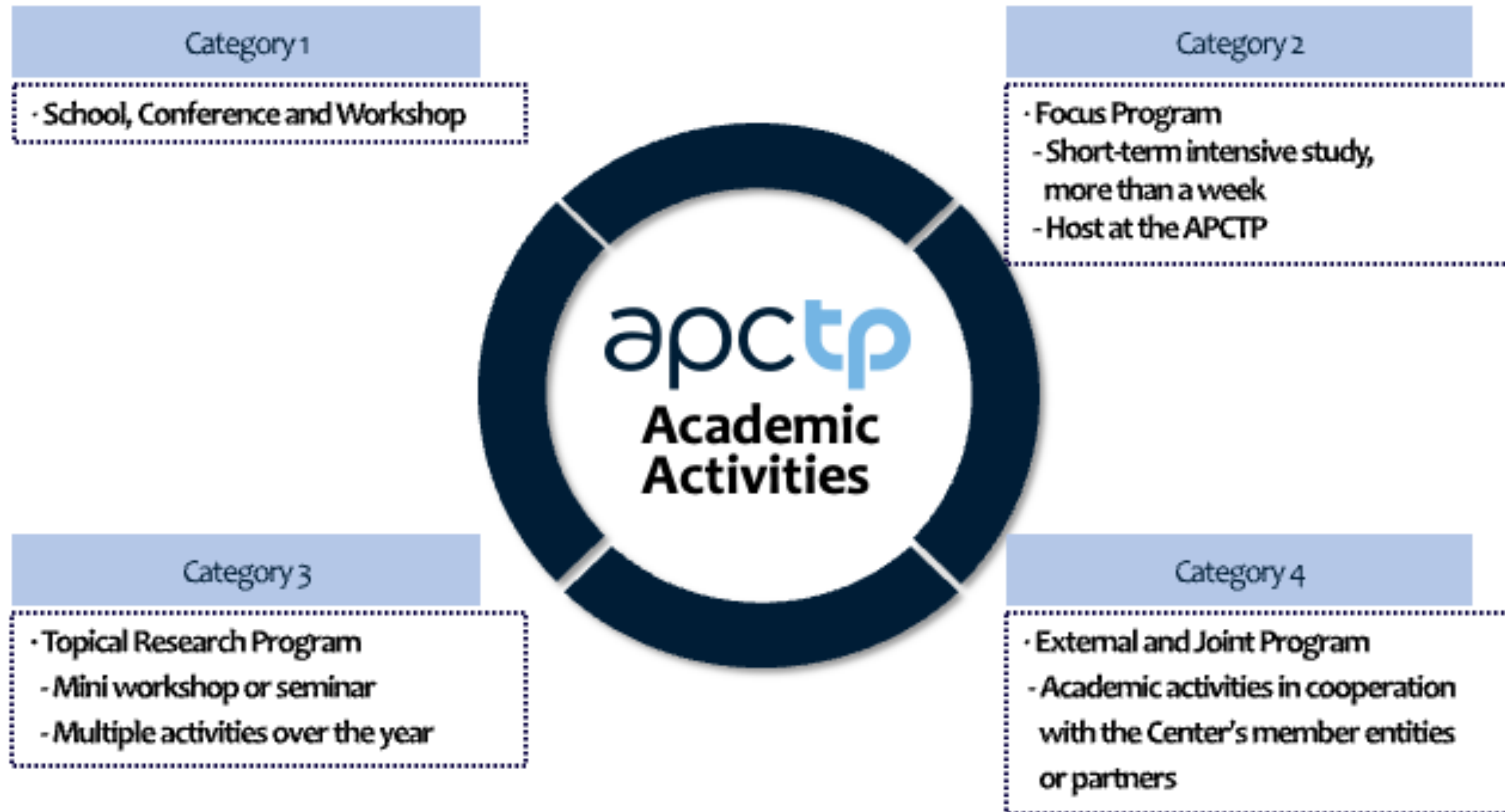
# APCTP Activities



- **Academic Activity Hub**
  - ✓ School, Int'l/Domestic Conference/Workshop
  - ✓ Focus Program, Topical Research Program (TRP)
  - ✓ School, Int'l/Domestic Conference/Workshop
  
- **In-house Research**
  - ✓ Junior Research Group (JRG)
  - ✓ Young Scientist Training Program (YST)
  - ✓ Senior Advisory Group (SAG)
  - ✓ APCTP Fellow Program
  
- **International Cooperation**
  - ✓ Publication of the AAPPS Bulletin
  - ✓ Cooperation with AAPPS, APEC, IUPAP and AAAS
  - ✓ Benjamin Lee Professorship



# Academic Activity Hub





# In-house Research



- **Young Scientist Training Program (YST):** With the stimulating and active scientific environment, a variety of scientific activities and in-house researchers, the Center gives an opportunity to young promising physicists (scientists) from the Asia Pacific region to increase their research capability.
- **Junior Research Group (JRG):** The Center collectively supports and funds outstanding mid-career physicists' inspirational ideas and their research projects. Each group leader can organize a research group and run it independently. All JRGs have successfully achieved their best results with noticeable contributions to physics community and beyond.
- **Senior Advisory Group (SAG):** Groups of established senior researchers provide active support for the young scientists of the Center through collaborative research activities such as mentoring, consulting, advisory sessions and lectures for innovative research outcomes.
- **APCTP Fellow Program:** To lay the foundation for synergistic effects of joint research amongst institutes by letting APCTP alumni scientists freely visit center and participate in cooperative research and research guidance.

# International Cooperation



Participates in the APEC PPSTI Meetings and reports our progress of endorsed programs



As a Headquarters of the Association of Asia Pacific Physics Societies (AAPPS), supports its Physics Conference, APCC



Publication of AAPPS Bulletin in cooperation with the AAPPS and Springer Nature

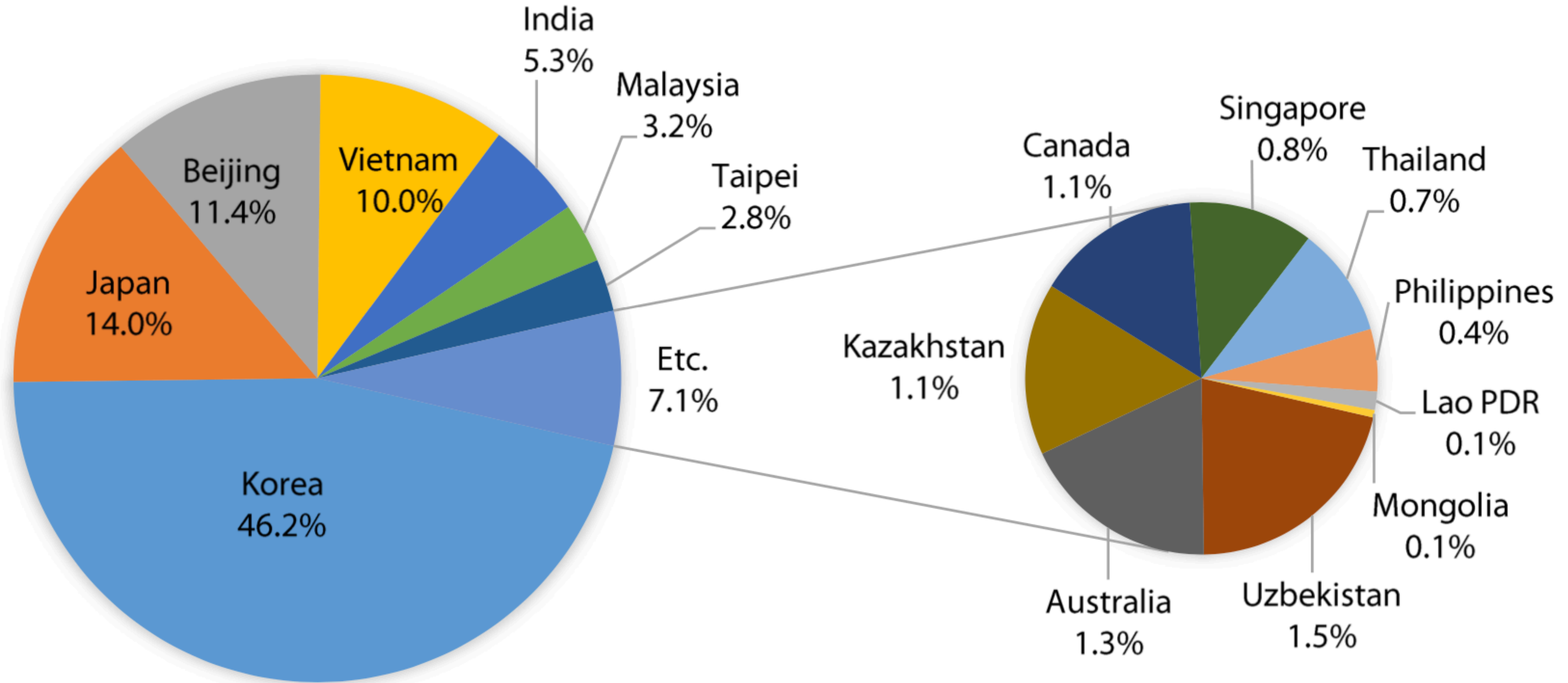


Benjamin Lee distinguished professorship, created in honor of Korea's foremost theoretical physicist, late Benjamin Lee, who had a distinguished career in particle physics theory

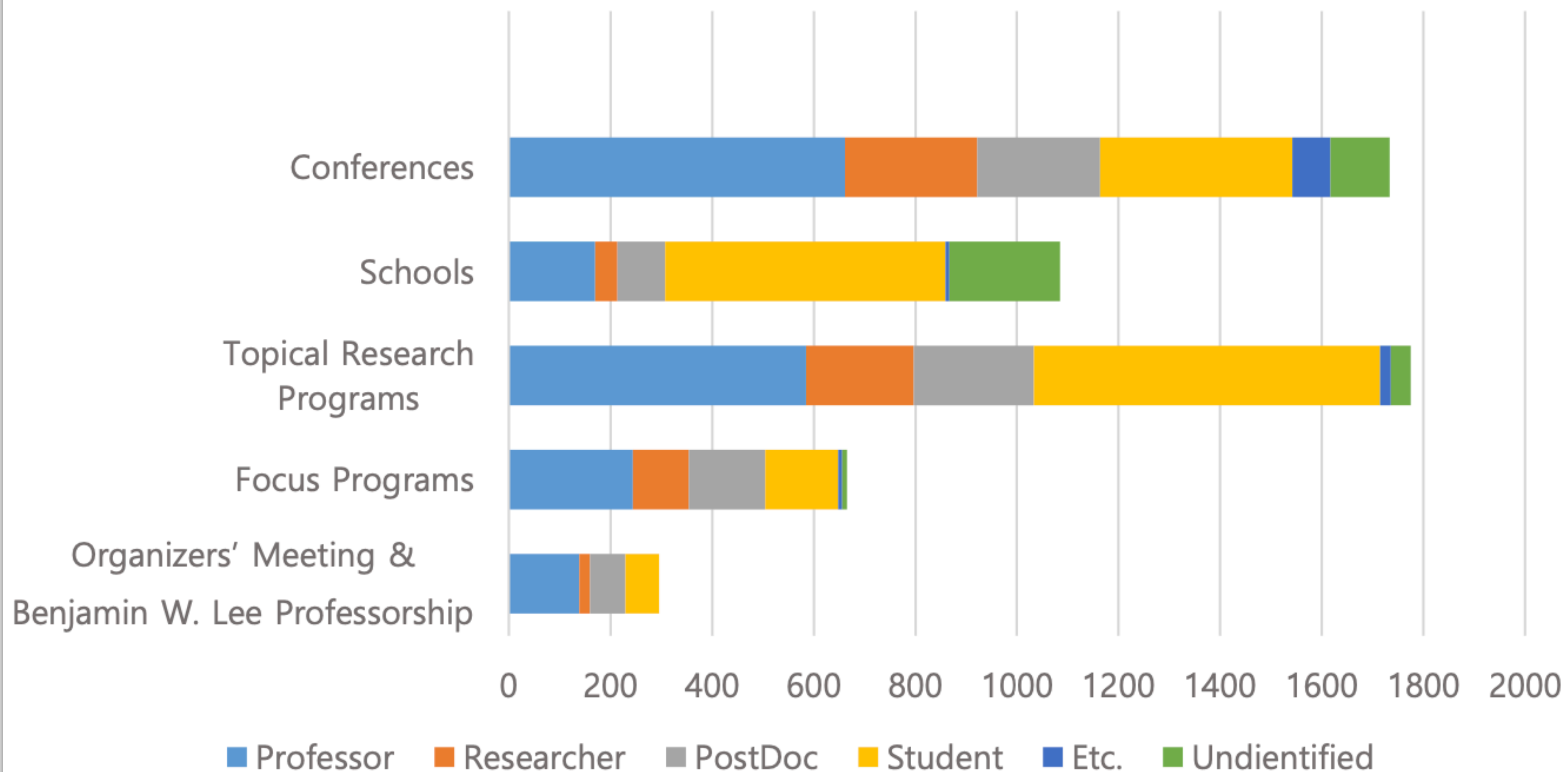
2017

### Participant Ratios by Member Country

(total 5,181 persons)

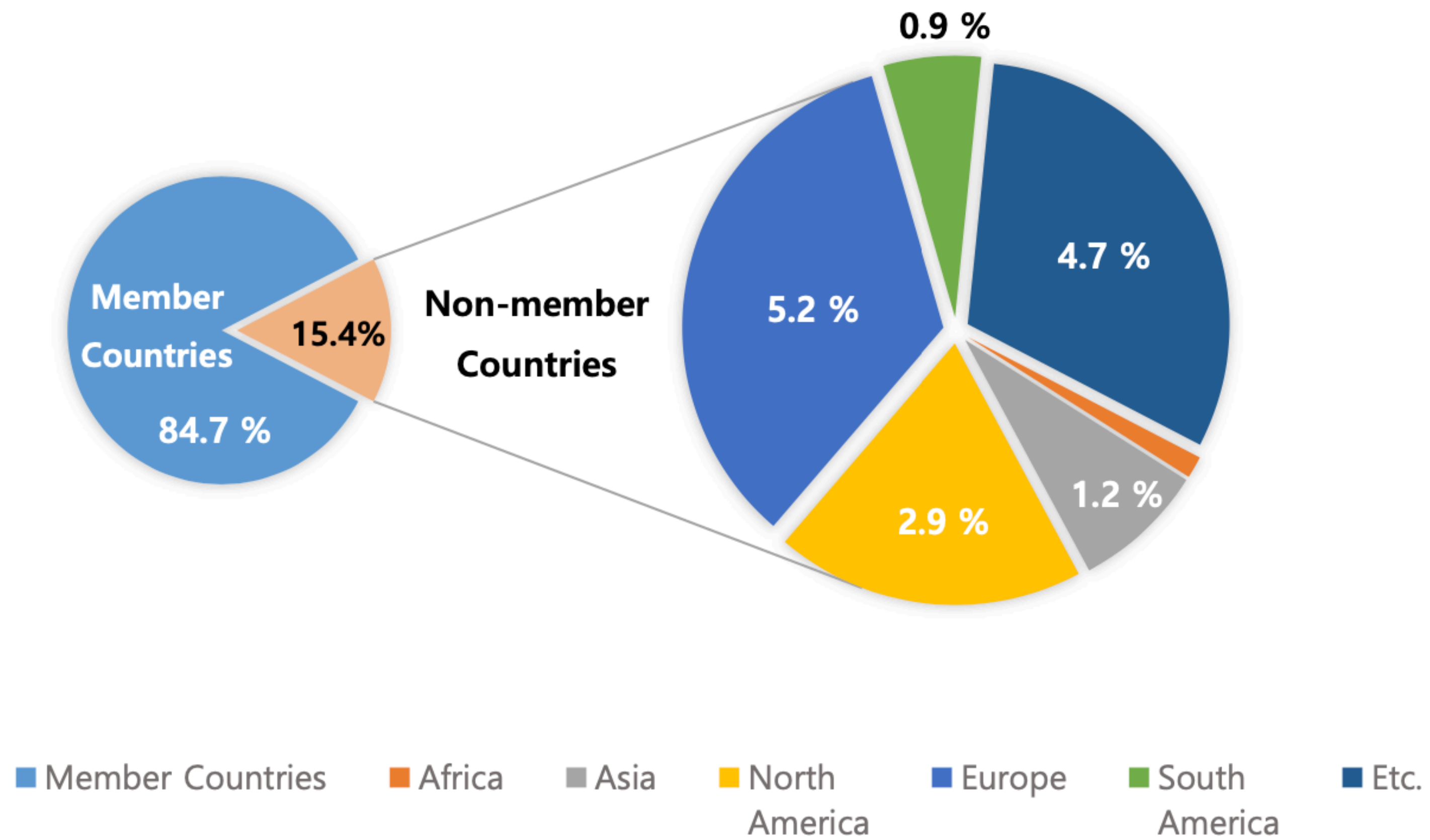


# 2022 Number of Participants by Academic Position



2022

## Ratios of Participants by Region



# **EIC related activities in APCTP**

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*based on materials available online*

# Major group activities in nuclear/hadronic physics

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- **HIM** (Heavy Ion Meeting)

*RHIC@Brookhaven (STAR, PHENIX), USA*

*LHC@CERN (CMS, ALICE), Europe*

- **LENS** (Low Energy Nuclear Studies)

*RIKEN, Japan*

*RAON (Rare isotope Accelerator complex for ON-line experiments), Korea*

- **HaPhy** (Hadronic Physics)

(organizers: J.K. Ahn, M.K. Cheoun, H.S. Jo, K.J. Kwak, H.-Ch. Kim, Y. Kim, S.i. Nam, G.-S. Yang)

***J-PARC, EIC, ...***

**2020** online

## Nuclear and Hadron Physics in EIC

September 25 (Fri), 2020

**2021** hybrid

## APCTP Focus Program in Nuclear Physics 2021 Part II: Science Opportunities with EIC

Jul 19 – 24, 2021  
Hilton Gyeongju

Enter your search term



*in parallel*

## 2nd PSQ@EIC Meeting: Precision Studies on QCD at EIC

Jul 19 – 23, 2021  
Online

Enter your search term



## Joint Workshop on Hadron-Nuclear Physics and Astrophysics (HaPhy 2021-2)

Nov 19 – 20, 2021  
Online (ZOOM)

Enter your search term





# 2022 EIC@HaPhy

# 2022 HaPhy

November 11(Fri.)-12(Sat.), 2022  
Room #302, Science Building III,  
POSTECH, Pohang



## APCTP Workshop on the Physics of Electron Ion Collider

asia pacific center for  
theoretical physics

Nov 2 – 4, 2022  
Howard Johnson Incheon Airport Hotel

Enter your search term



## *New perspectives on nuclear and hadron physics with EICs*

### OVERVIEW

The Hadron Physics (HaPhy) meeting is a hadron-nuclear physics workshop which has been held in Korea on a regular basis for many years. It aims to bring together theorists and experimentalists to increase our understanding of various aspects of QCD. This meeting will provide an exciting opportunity to discuss hot topics with EICs (Electron-Ion Colliders) programs.

### SPEAKERS

Sungtae Cho (Kangwon Natl. U.),  
Yongwoo Choi (Inha U.)  
Yongsun Kim (Sejong U.)  
SangHoon Lim (Pusan Natl. U.),

Kirill Semenov (Kyungpook Natl. U.)  
Sangin Shim (Pukyong Natl. U.)  
Hyeon-Dong Son (Inha U.),

### ORGANIZERS

J.K. Ahn (Korea U.)  
M.K. Cheoun (Soongsil U.)  
H.-S. Cho (KNU)  
K.J. Kwak (UNIST)

H.-Ch. Kim (Inha U.)  
Y. Kim (RISP/IBS)  
S.i. Nam (PKNU)  
G.-S. Yang (Hoseo U.)

### Homepage

[https://apctp.org/theme/d/html/activities/activities01\\_read-pop.php?id=1748](https://apctp.org/theme/d/html/activities/activities01_read-pop.php?id=1748)



asia pacific center for  
theoretical physics

Inquiries: [sec@apctp.org](mailto:sec@apctp.org)/054-279-3613 | Homepage: [www.apctp.org](http://www.apctp.org)  
The APCTP is supported by the Korean Government through the Science and Technology Promotion Fund and Lottery Fund and strives to maximise social value through its various activities.

# 2023 penta-quarks@HaPhy



# 2023-1st HaPhy

Recent progress  
on Nuclear and Hadron Physics  
*\*special issue: penta-quarks revival*

2023.5.12(Fri)~5.13(Sat.), 제1공학관 502호  
호서대학교 아산캠퍼스

## Program

5.12(Fri.)		
14:30-15:20 (50')	김현철 인하대 물리학과	Killing or Saving Pentaquarks. (펜타쿼크의 죽음과 부활)
15:30-16:00 (30')	안정근 고려대 물리학과	A New Era of Multiquark States and the Hunt for Antidecuplet Members
16:00-16:20 (20') BREAK		
16:20-16:50 (30')	김신형 일본원자력연구개발기구(JAEA)	Search for $\Theta^+$ pentaquark in $K+p \rightarrow K0pp$ reaction at J-PARC
16:50-17:20 (30')	김용선 세종대 물리천문학과	Opportunity for exotic particle studies in heavy ion collisions at the LHC
17:20-17:50 (30')	남승일 부경대 물리학과	Do pentaquark-like states exist in the light-flavor sector?: Yes!!
18:30- BANQUET		
5.13(Sat)		
09:30-10:00 (30')	김희진 인하대 물리학과	Molecular nature of the $D_{s0}^*(2317)$
10:00-10:30 (30')	Samson Clymton 인하대 물리학과	The axial vector meson in the coupled channel approach
10:30-10:50 (20') BREAK		
10:50-11:20 (30')	심상인 극한핵물질연구센터(고려대)	Photo- and electroproduction of phi-meson with $P_s$
11:20-11:50 (30')	김상호 우주물질연구소(송실대)	Possible existence of $N(1685, 1/2^+)$ in the $\eta n$ and $K^0 \Lambda$ and photoproduction
11:50-12:20 (30')	손현동 인하대 물리학과	Exotic and excited baryons from s-quark excitation in the large $N_c$ mean field

## Homepage

<https://www.apctp.org/wb.php?id=2023-1haphy>

## Infomation

양길석 (ghsyang@hoseo.edu)



# Korean Prospective for EIC

[Yongsun Kim \(Sejong Univ.\)](#)

[Yongseok Oh \(Kyungpook Natl. Univ.\)](#)

EIC-ASIA workshop  
2023.03.16



## Institutes interested in ePIC

### Calorimeter (barrel)

Yonsei U, SKK U, KNU, PNU  
*(Dual readout + Si teams)*

### Calorimeter (ZDC)

Sejong U, Korea U  
*ALICE Focal + LAMPS\**

### Si pixel

Yonsei U, PNU  
*ALICE ITS3 group*

### $\mu$ RWELL

SNU, U of Seoul  
*Korean CMS group*

### LGAD

KNU, Korea U  
*Korean CMS group*



\* LAMPS: A detector for rare isotope collision experiment in Korea

# DOE Perspectives on the EIC *EIC User Group Meeting July 24, 2023 by T.J. Hallman*

## Current EIC Resource Review Board To Discuss International Contributions

Name (Members)	Affiliation	Country	Funding Agency/PI
Samson, Claire	Canada Foundation for Innovation (CFI)	Canada	Funding Agency
Vyšíňka, Marek	Ministry of Education, Youth and Sports	Czech Republic	Funding Agency
Sabatie, Franck	Institut de Recherche sur les Lois Fondamentales de l'Univers (Irfu-SPhN), CEA-Saclay	France	Funding Agency
Grasso, Marcella	IN2P3/CNRS	France	Funding Agency
Lucotte, Arnaud	IN2P3/CNRS	France	Funding Agency
Bettoni, Diego	Instituto Nazionale de Fisica Nucleare (INFN)	Italy	Funding Agency
Nania, Rosario	Instituto Nazionale de Fisica Nucleare (INFN)	Italy	Funding Agency
Moon, Young Kun	Research Promotion Division at the Ministry of Science and ICT	Korea	Funding Agency
Gaczyński, Mateusz	Department of Innovation and Development, Ministry of Science and Higher Education	Poland	Funding Agency
Blaire, Grahme	UK Science and Technology Facilities Council (STFC)	United Kingdom	Funding Agency
Hiscock, Jenny	UK Science and Technology Facilities Council (STFC)	United Kingdom	Funding Agency
Hallman, Timothy	DOE Office of Nuclear Physics	United States	Funding Agency
Name (Observers)	Affiliation	Country	Funding Agency/PI
Hayotsyan, Sargis	State Science Committee of Armenia	Armenia	Funding Agency
Mohanty, Bedanga	NISER	India	Funding Agency
Nxomani, Clifford	National Research Foundation	South Africa	Funding Agency

# DOE Perspectives on the EIC *EIC User Group Meeting July 24, 2023 by T.J. Hallman*

## PIs participating in the Resource Review Board To Discuss International Contributions

Name (PI)	Affiliation	Country
Machado, Ana Amelia	UNICAMP	Brazil
Huber, Garth	University of Regina	Canada
Bielčík, Jaroslav	Czech Technical University, Prague	Czech Republic
Munoz Camacho, Carlos	IJCLab	France
Antonioli, Pietro	INFN Bologna	Italy
Goto, Yuji	RIKEN	Japan
Gunji, Taku	Center for Nuclear Study, University of Tokyo	Japan
Ka, Oumar	Cheikh Anta Diop University	Senegal
Jones, Pete	iThemba Labs	South Africa
Joo, Kyungseon	University of Connecticut	South Korea
Oh, Yongseok	Kyungpook National University	South Korea
Yang, Yi	National Cheng Kung University	Taiwan
Jones, Peter	University of Birmingham	UK



# Lago di Carezza

Dolomites@2023.08.20