

Thailand-CERN collaborative researches and activities

N. Srimanobhas (Chulalongkorn University, CMS Collaboration)

April 29, 2023

Thai-CERN Collaboration Program under initiative of H.R.H. Princess Maha Chakri Sirindhorn



Physics

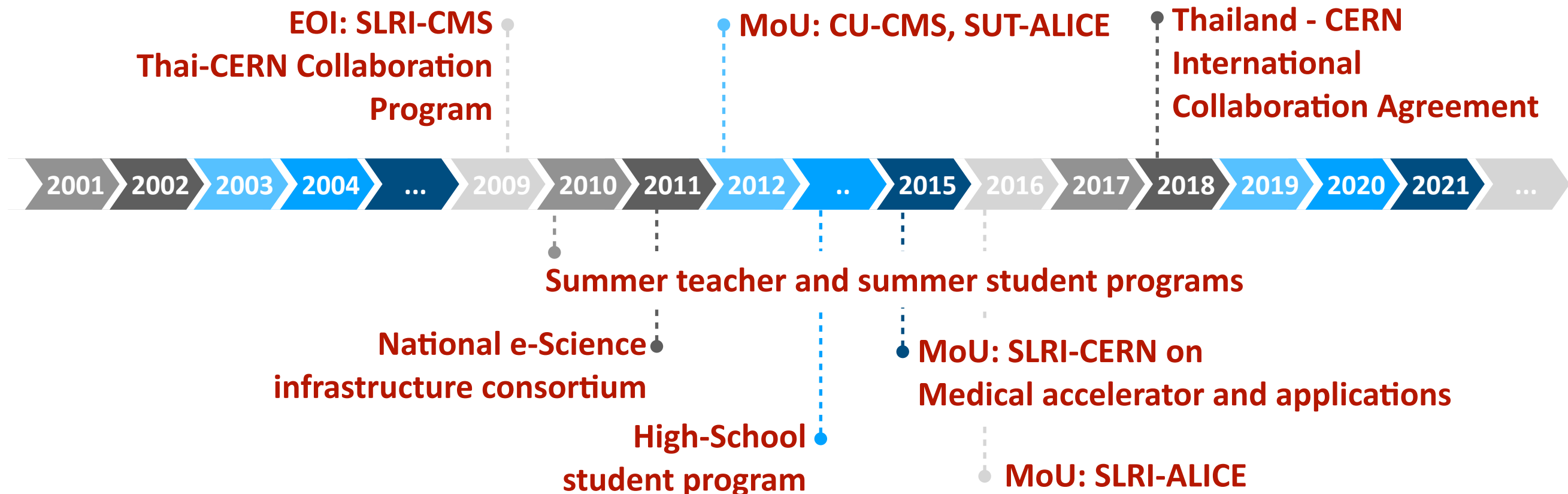
- High Energy Particle Physics
 - Theory,
 - Experiment,
 - Phenomenology

Engineering and infrastructure

- National eScience infrastructure consortium
- Software engineering
- Microelectronics
- Sensor and testing facility

Outreach

- Thai high school students
- CERN summer teacher
- CERN summer students
- National particle physics boot camp
- Thailand school on high-energy and astro-physics



RESEARCH



Thai - CMS Collaboration

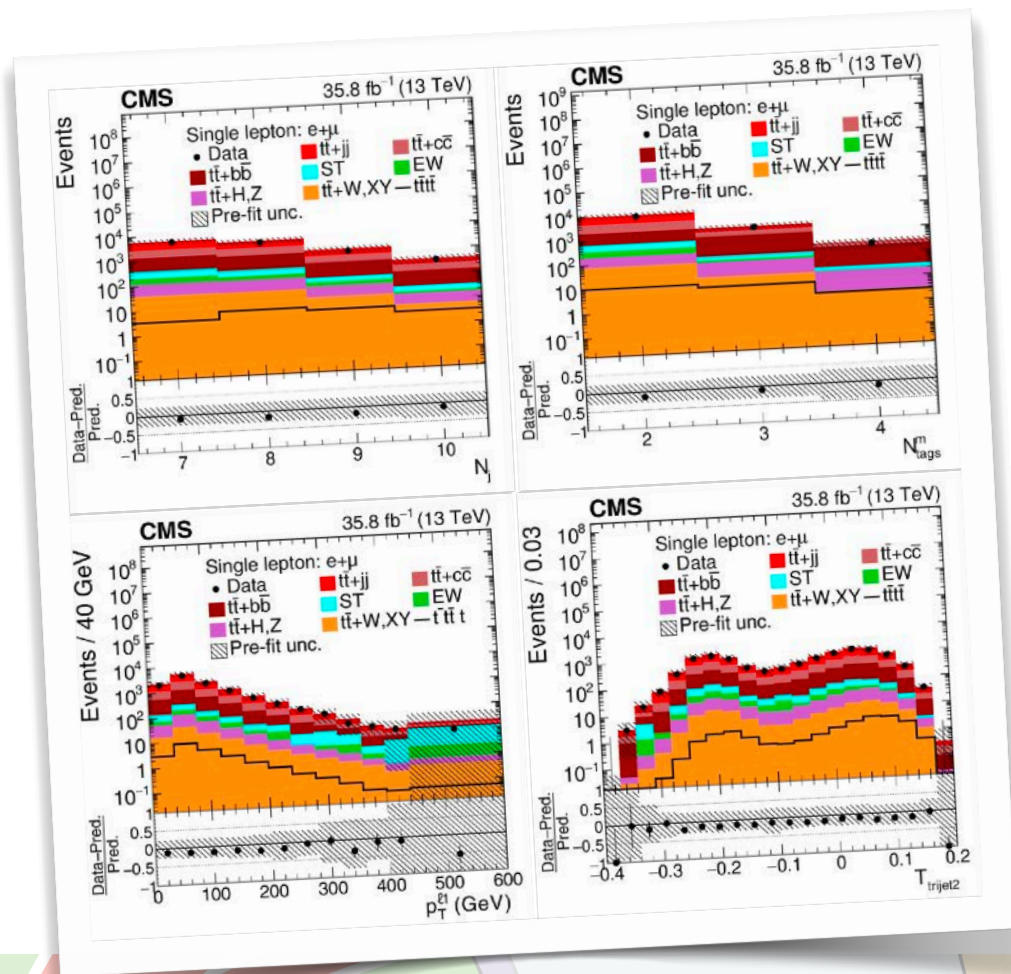
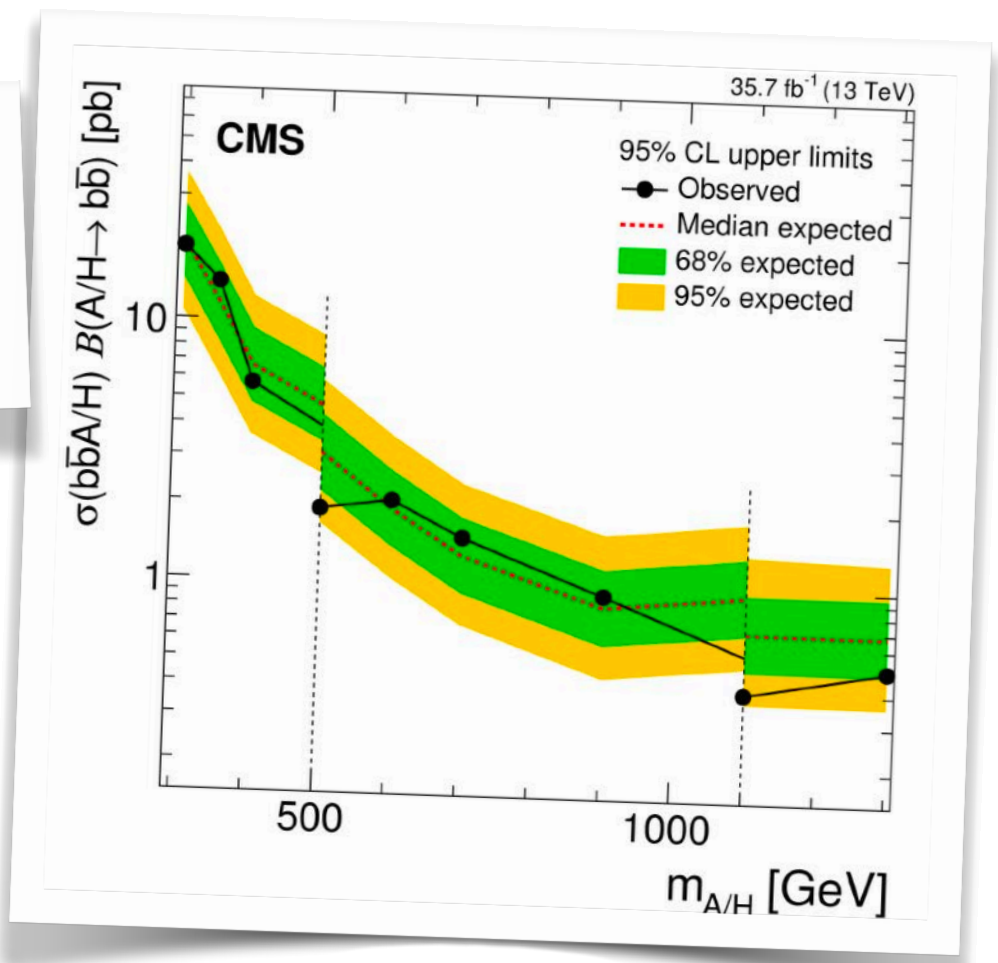
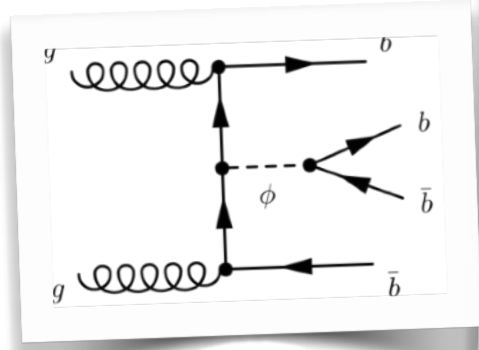
The department of Physics, Chulalongkorn University has joined the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) at CERN since 2012. The focuses are on analysing the colossal amounts of collected data to explain more about the early universe and some unsolved problems, and on CMS data operation. Together with the Department of Computer Engineering, we currently expand our topics of interest into the hardware of CMS trigger system and software engineering.

CU contributions to CMS physics analyses

Search for beyond the standard model

Higgs bosons decaying into a $b\bar{b}$ pair

- Search for additional neutral Higgs bosons in the bottom quarks final state
- Sensitivity enhanced with b-associated production
- No evidence for a signal yet to be found
 - Interpretation in the context of MSSM and 2HDM



Search for the production of four top quarks in the single-lepton and opposite-sign dilepton final states

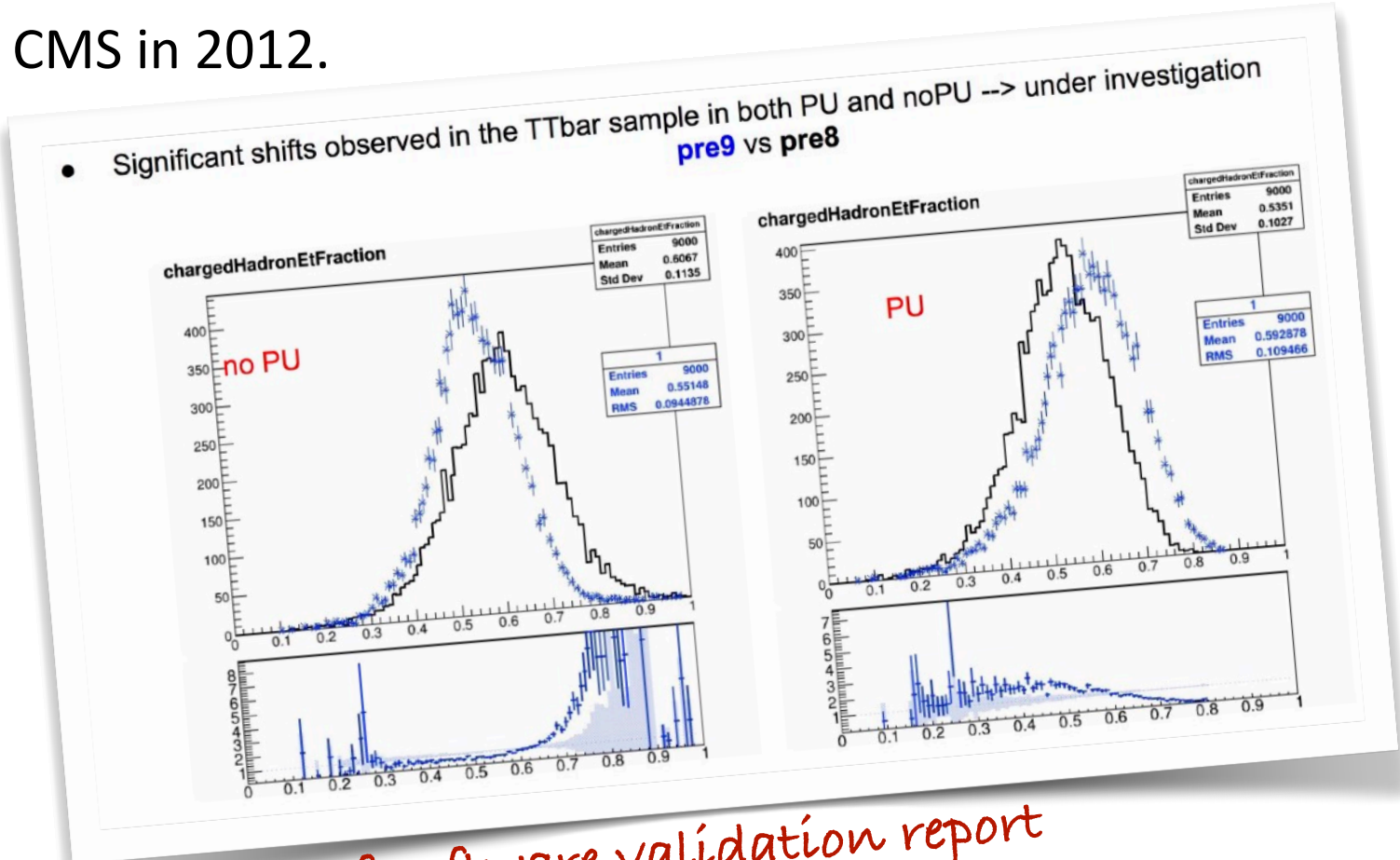
- Probing the very rare Standard Model process
- Results can be used for phenomenological reinterpretation of a wide range of new physics models.

CU contributions to CMS physics performance

- Long-term contribution since CU joined CMS in 2012.

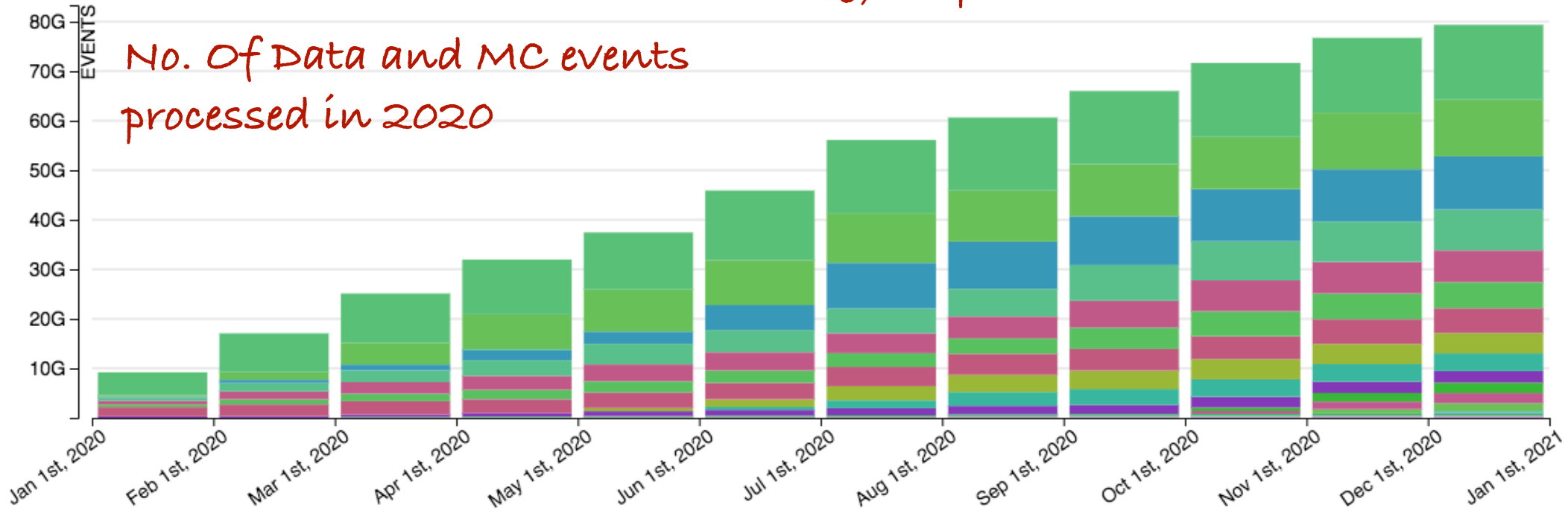
Currently, CU participates in

- Software (CMSSW) validation
- Data processing and Monte-Carlo production
- Data Quality Monitoring: Apply machine learning to online/offline monitoring



Example of software validation report

No. of Data and MC events processed in 2020





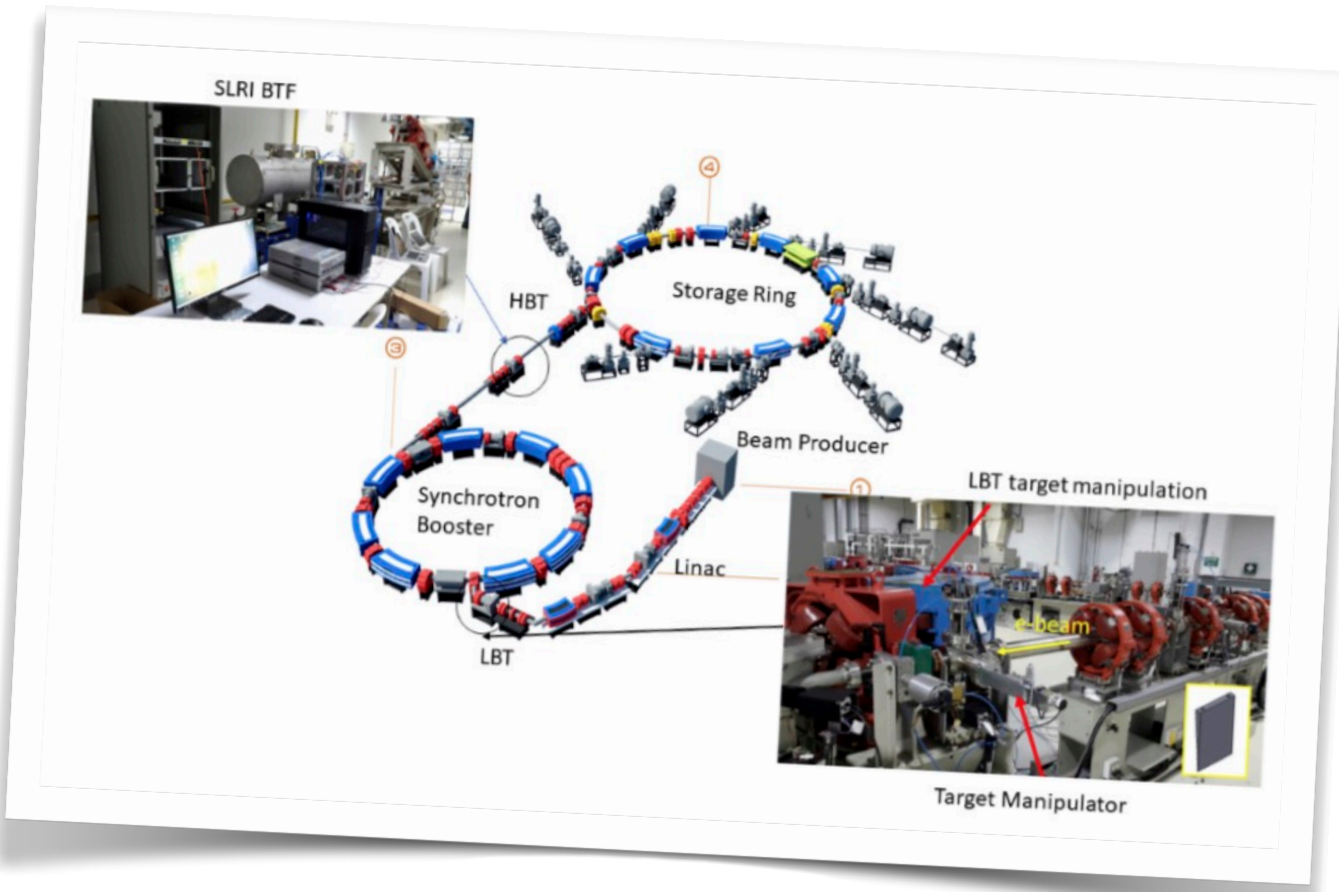
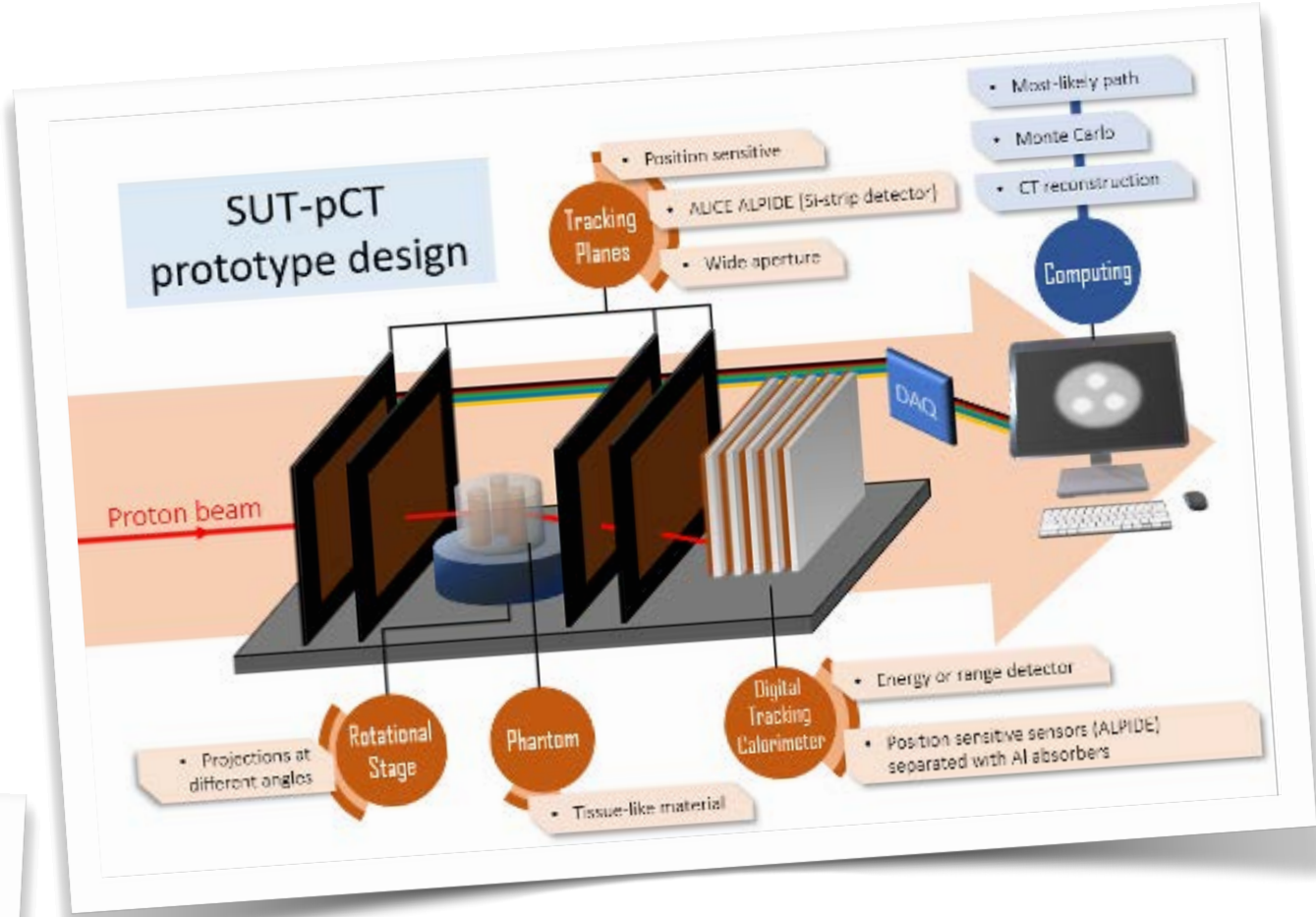
Thai - ALICE Collaboration

The joint effort between Suranaree University of Technology (SUT), King Mongkut's University of Technology Thonburi (KMUTT), Synchrotron Light Research Institute (SLRI), and Thai Microelectronics Center (TMEC) to join ALICE collaboration. The work first focuses on the simulation the upgrade of the ALICE Inner Tracking System (ITS). Then research is expanding into the area of sensor development and testing, and ALICE online-offline computing system.

SLRI-SUT sensor testing

Characterization of the new ALICE Pixel Detector (ALPIDE) sensor with a pixel sensor telescope using the 1 and 1.2 GeV electron beam at the Synchrotron Light Research Institute Beam Test Facility (SLRI-BTF).

- To measure detection efficiency in all sections of the ALPIDE sensor.



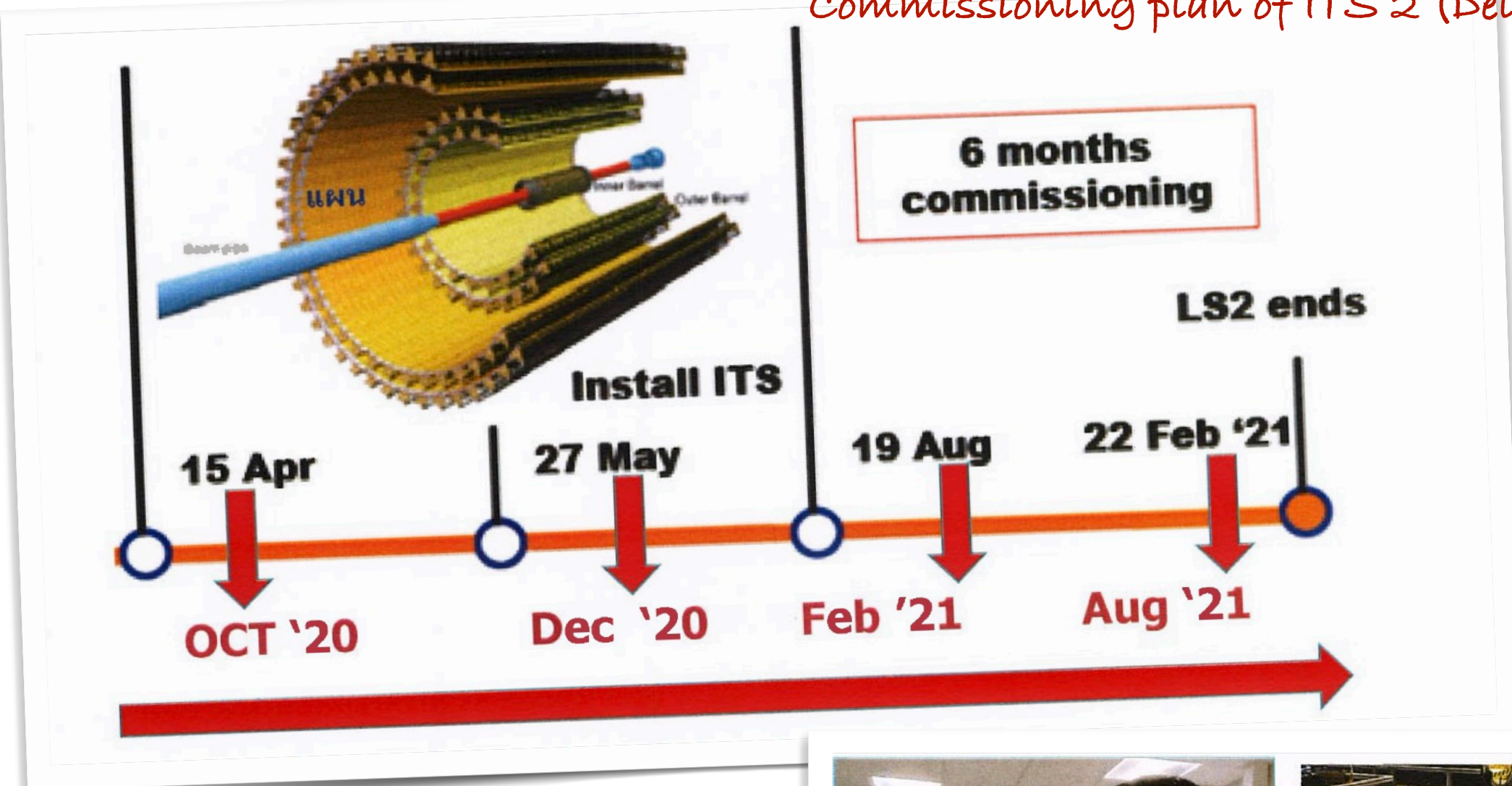
SUT-Proton Computed Tomography

Using ALPIDE for proton's position/trajectory and energy before and after traversing an object, then reconstruct an cross-section image of tumours.

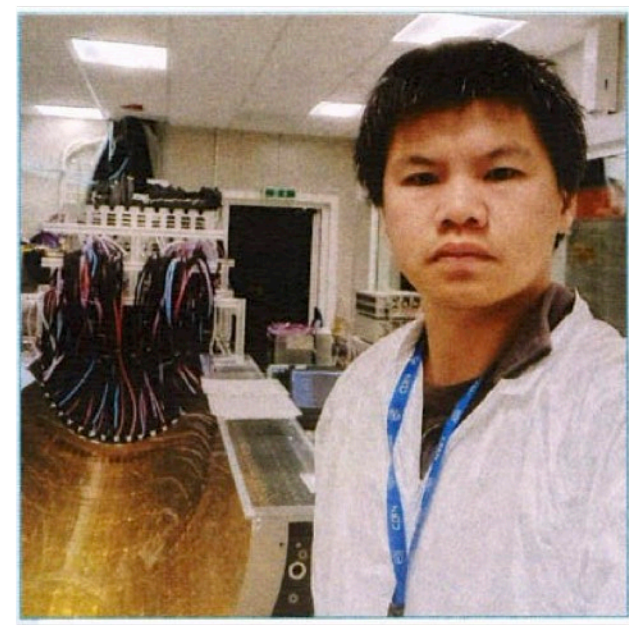
Beam test facility at SLRI

Commissioning of the Inner Tracking System (ITS) 2 ^{Highlight}

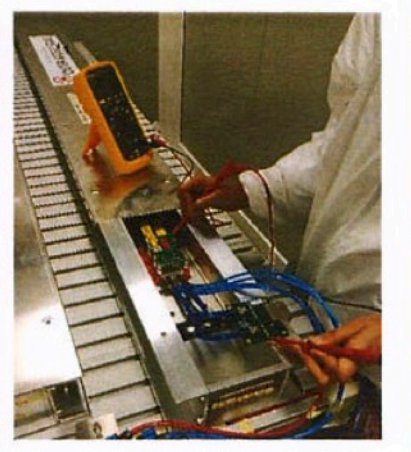
Commissioning plan of ITS 2 (Delay due to COVID-19)



SLRI expert @ ALICE for ITS 2 commissioning



การตรวจสอบทางกายภาพของเซ็นเซอร์บนโครงสร้างยึดจับ (Stave)



การตรวจสอบทางอิเล็กทรอนิกส์ก่อนติดตั้ง stave บน Outer barrel

TRAINING

Training: High school student program

- Started in 2013 (together with Singapore)
- 5 days program for high school students
- 12 students from Thailand (joining with 12-24 students from Singapore)
- Lectures include intro. to CERN, intro. to particle accelerator, intro. to particle physics (both theory and experiment), and applications
- Visit several CERN sites including SC, CMS, ATLAS, SM18, AD, CCC, Data Centre
- **GOAL:** Students to get ideas on inter-disciplinary to solve complex problems (Science, Engineering, Medicine, ..., Public communication)



Training: CERN summer teacher program

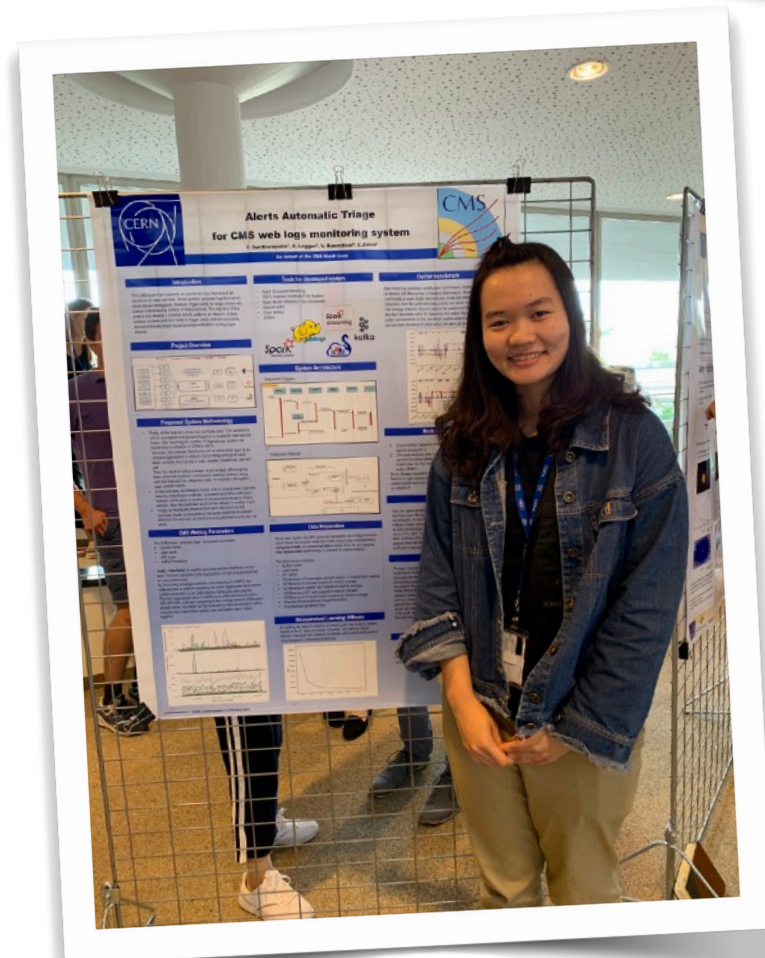
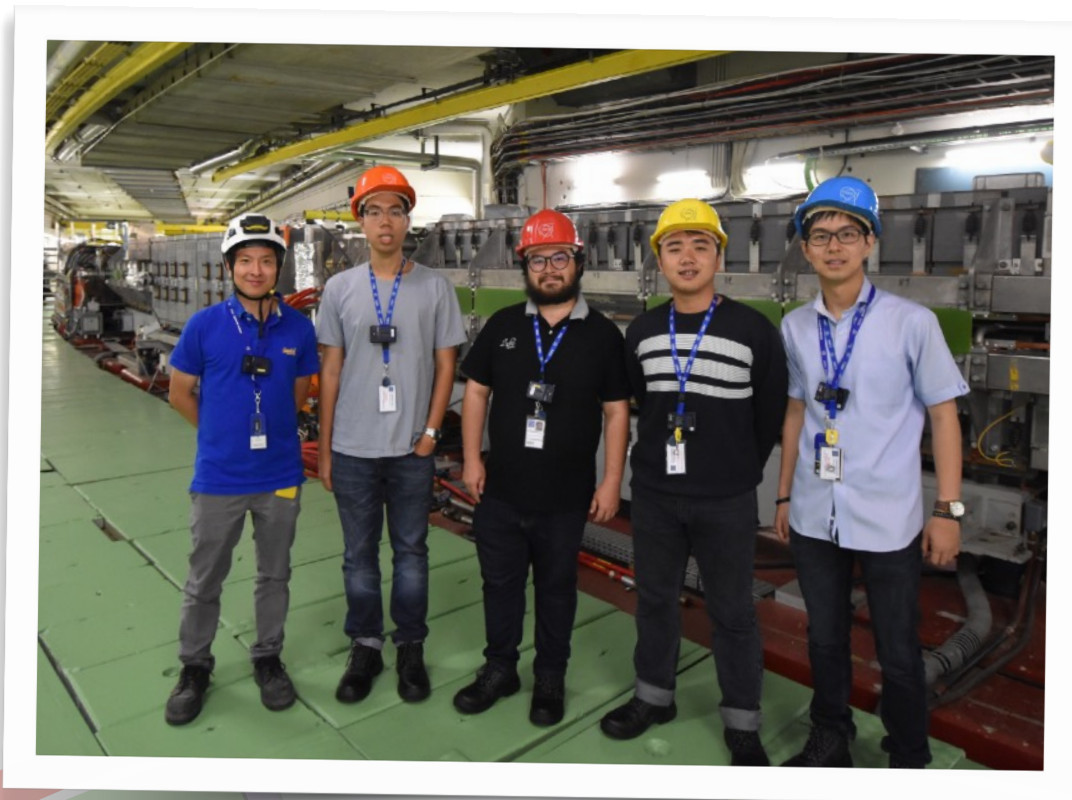
- **GOALS:**

- To support teachers' professional development in the field of particle physics (and Science in general).
 - To promote the teaching of particle physics in high schools.
 - To facilitate the exchange of knowledge and experience among teachers of different nationalities.
 - To stimulate activities related to the popularisation of physics within and beyond the classroom.
- Officially joined the program in 2010
 - Two 2-week international teacher programmes: The International High School Teacher (HST) Programme and the International Teacher Weeks (ITW) Programme
 - 2 Thai teachers
 - 1 teacher fully supported by CERN
 - 1 teacher fully supported by Thailand
 - Lectures + workshops



Training: CERN summer student program

- Officially joined the program in 2010
- 8-12 weeks
- From 2017, 4 students each year
 - 2 Physics, 2 Engineering
 - 2 students fully supported by CERN (max. 8 weeks per student)
 - For extension period (max. 4 weeks) supported by Thailand
 - 2 students fully supported by Thailand (max. 12 weeks per student)
- Lectures + site visits + summer research project in various fields
 - Possible for credit transfer, i.e. Engineering Practice





Chiang Mai University
Physics: 10



Khon Kaen University
Physics: 3



Chulalongkorn University
Physics: 1, Engineering: 6



Mahidol University
Physics: 3



**King Mongkut's University
of Technology Thonburi**
Engineering: 3



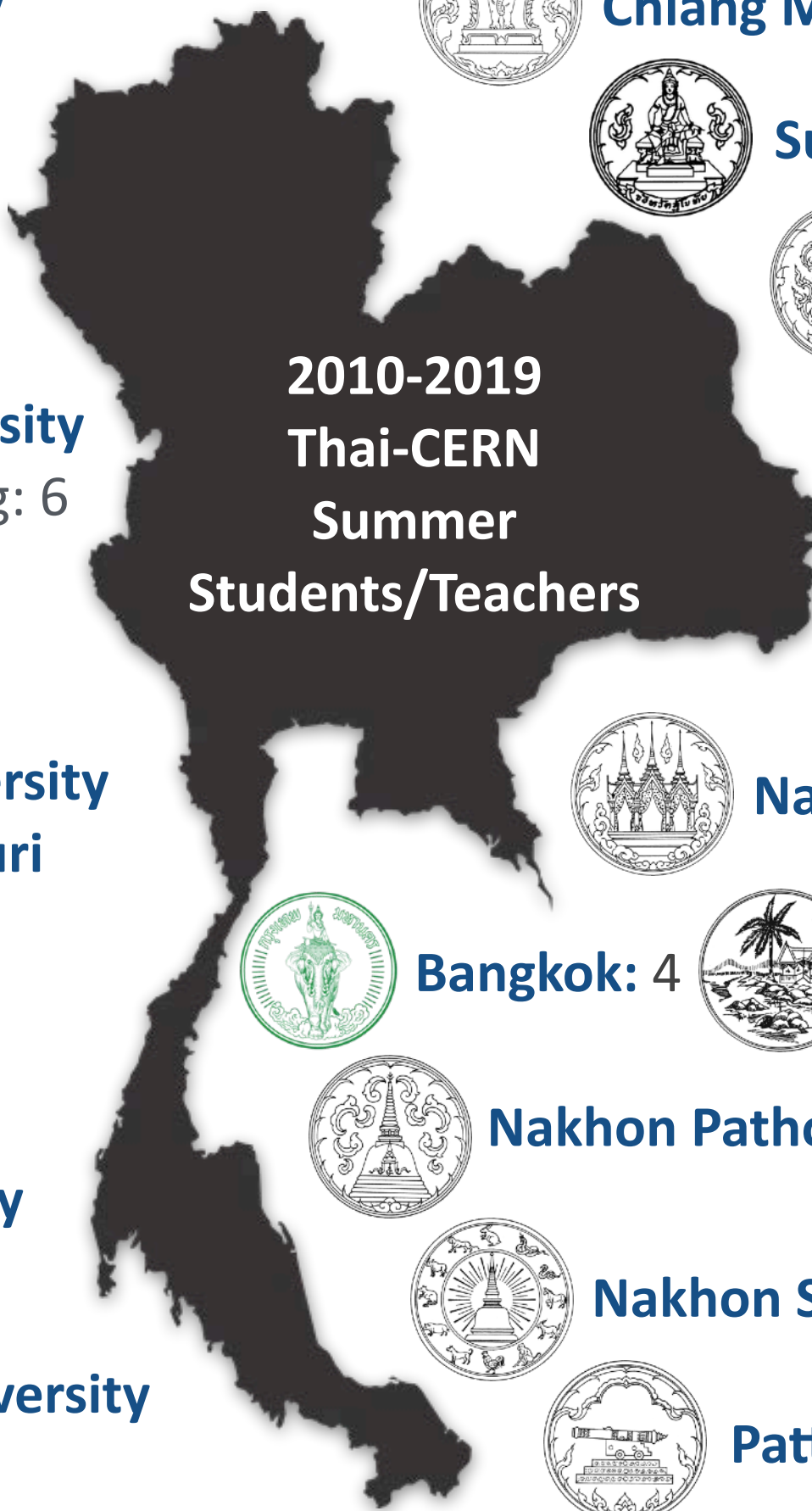
Kasetsart University
Physics: 1



Thammasat University
Engineering: 1



Prince of Songkla University
Physics: 1



Chiang Mai: 2



Phayao: 1



Sukhothai: 1



Udon Thani: 1



Sakon Nakhon: 1



Kalasin: 1



Nakhon Sawan: 1



Bangkok: 4



Rayong: 1



Trat: 1



Nakhon Pathom: 2



Surat Thani: 1



Nakhon Si Thammarat: 2



Pattani: 1

29 students

20 teachers

EDUCATION

Education programs

NOW!
Host by OBEC (March)

โครงการอบรม
ฟิสิกส์อนุภาคพื้นฐาน

Planned
Quantum Field Theory & Dark Matter
Host by KKU (June)

School in
High-Energy and
Astro-Physics

Advanced schools
organized by CU,
NU, NARIT, SLRI, ...

General Audience	High School Student/Teacher	Undergraduate Student	Graduate Student	Researcher/Lecturer/Professor
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- Organised by Thai-CERN
Plan for 2021
- Organised by Thai-CERN
No plan (yet) for 2021
- Not organise by Thai-CERN
No plan (yet) for 2021

Thailand
Experimental Particle
Physics Novice Workshop
(อนุภาคน้อย)

CERN School
Thailand

Education

Several schools and workshops have been organised in Thailand, covering all levels of audiences including general audiences, high school students, undergrad, graduate students, and researchers. Lectures and workshop materials always open for public.

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Thai-CERN

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Events

Create event

Title	Start date	
3rd Thailand School on High-Energy and Astro-Physic...	18 May 2021, 03:30	
Friendly Frontier 2019 (Particle Physics and Cosmolo...	7 Sep 2019, 03:00	
โครงการอบรมฟิสิกส์อนุภาคพื้นฐาน (ภูมิภาค) 2562	3 Jul 2019, 03:00	
2nd Thailand School on High-Energy and Astro-Physi...	16 Jun 2019, 19:00	
โครงการอบรมฟิสิกส์อนุภาคพื้นฐาน 2562	24 Apr 2019, 12:00	
Thai - CERN: International Collaboration Agreement	13 Sep 2018, 04:00	
Thailand School on High-Energy and Astro-Physics (S...	23 Jul 2018, 03:00	
โครงการอบรมฟิสิกส์อนุภาคพื้นฐาน 2561	22 Apr 2018, 03:00	
โครงการอบรมฟิสิกส์อนุภาคพื้นฐาน 2560	19 Apr 2017, 03:00	
The 3rd Thailand Experimental Particle Physics Novic...	23 Jul 2015, 03:00	
โครงการอบรมความรู้พื้นฐานทางฟิสิกส์อนุภาค 2559	24 Apr 2015, 03:00	
CERN School Thailand 2010	4 Oct 2010, 03:00	

Education

โครงการอบรมฟิสิกส์อนุภาคพื้นฐาน

- General audience / High school students
 - Also pre-school for Thai-CERN teachers and students
- Host by universities, research institutes
 - Office of the Basic Education Commission (2021)
 - Joint efforts from experts in various fields
- Topics include
 - Introduction to particle physics
 - Accelerators and particle detectors
 - Applications
 - Special topics (depends on host)
 - Visit (SLRI, Chulabhon Hospital, ... etc)



Visit SLRI



Lectures from experts in various fields in Thailand



Hand-on

Education



2019 school at IF, NU



Challenge exercises are provided to students to work together, with supervision from experts

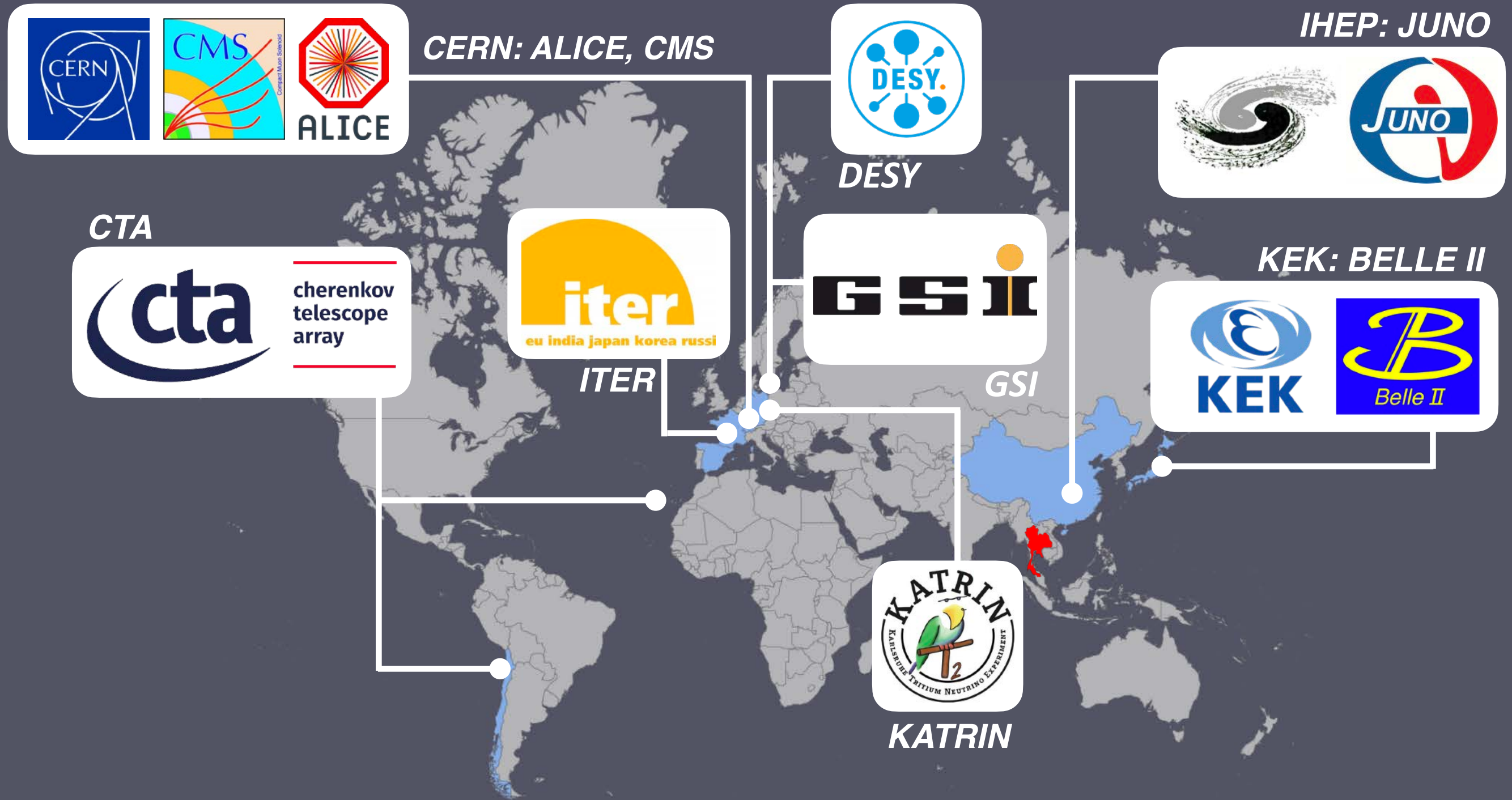
School in High-Energy and Astro-Physics (SHEAP)

- A series of schools being held around Thailand every year. The school will devote to a specific topic, including
 - 2018: Quantum field theory (@CU)
 - 2019: Gravitation and black hole (@IF, NU)
 - 2021: Quantum field theory and dark matter (@KKU)
- **CHALLENGE:** Small no. of students who are interested in these topics in each university
 - Put them together during summer, to develop the concepts, and do exercises
- **GOAL:** To provide young physicists with an opportunity to learn about basics in elementary-particle physics, quantum field theory, and cosmology from Thai researchers.
 - Courses are designed to fit advanced undergraduate students and master's students
- **GOAL:** To encourage collaborations among researchers.

2018 school at CU



Thai - High Energy Physics Global Partnerships





Brain Power Strategy

The time is ripe to catapult Thai universities towards world-class institutions for fundamental study!

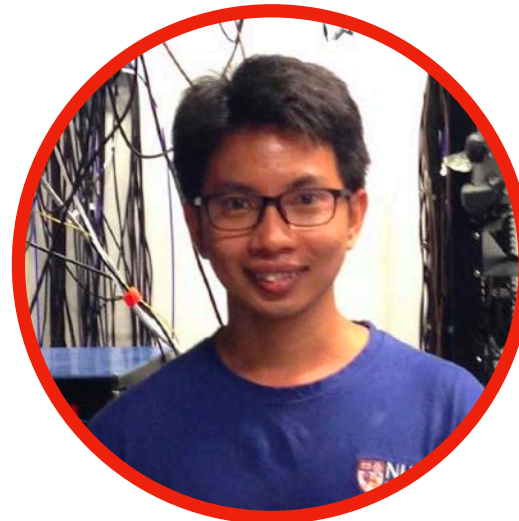
Additional manpower is key to exploit the existing resources to its fullest extent.

77 students

Thai summer students at DESY since 2003 and at CERN since 2010

Chakrit Pongkitivanichkul
(Physics, KKU; HEP consortium)

Supachai Awiphan (NARIT)



Rattakorn Kaewuam
(NIMT, Quantum consortium)

Narongrit Ritjoho
(Physics, SUT; HEP consortium)

Pinit Kidkhunthod (SLRI)



Navadecho Chankhunthod
(Physics, KKU)



Thapakorn Pulampong (SLRI)

Ideas from the next generation

Applications

Looking for possibly for CERN technology transfer

- Medical, Agriculture,...etc.



Knowledge Transfer
Accelerating Innovation

Possibilities to support Thai frontier research programs

- Quantum
- Space



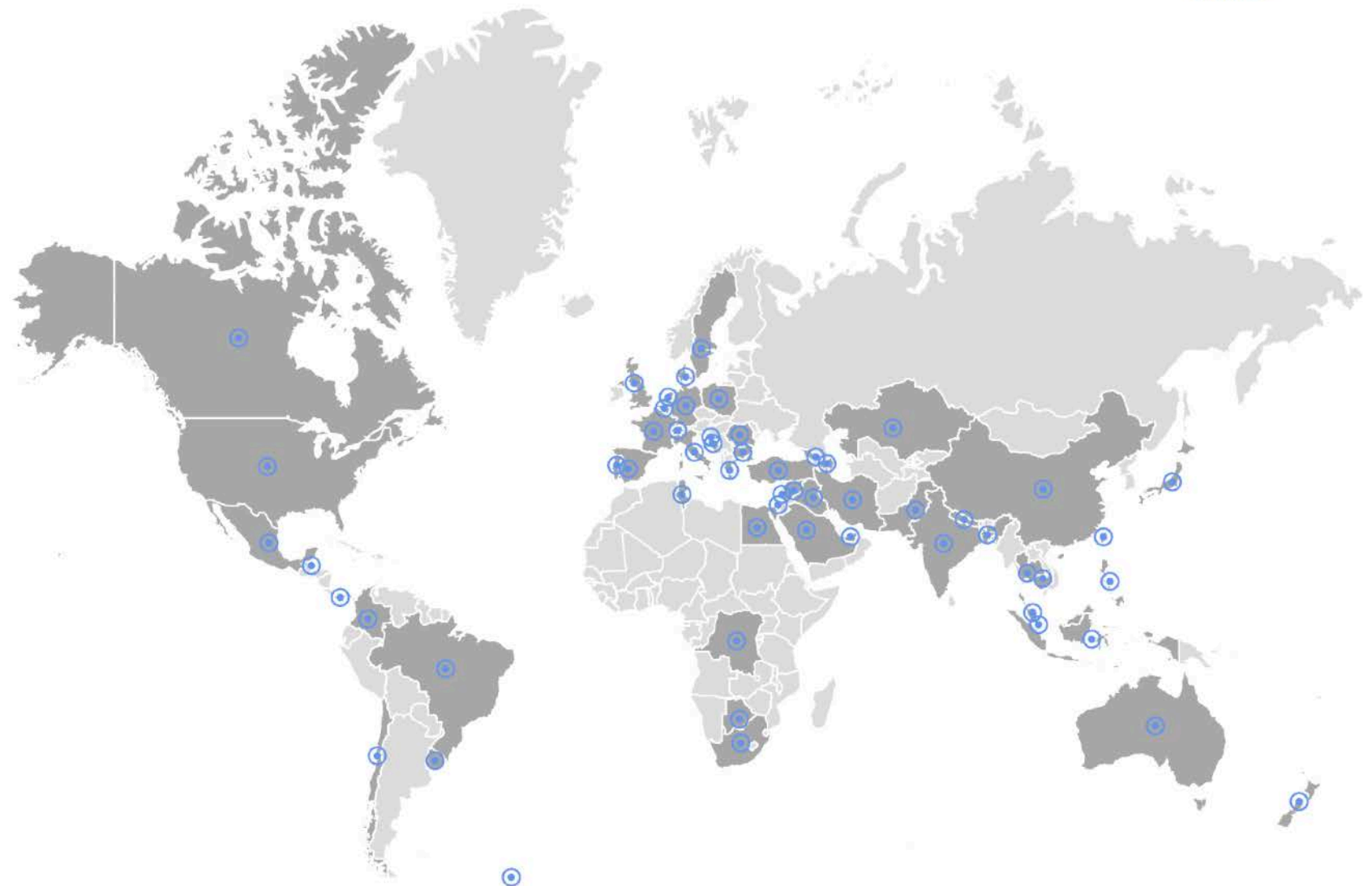
Key to improve Thai SDG index



What students will do with proton beam at CERN

This competition offers high-school students from around the world the chance to create and perform a scientific experiment at an accelerator beamline.

A team from Thailand participated in BL4S competition in 2022



Knowledge Transfer: How to boost up in Thailand?

Applications

Looking for possibly for CERN technology transfer

- Medical, Agriculture,...etc.



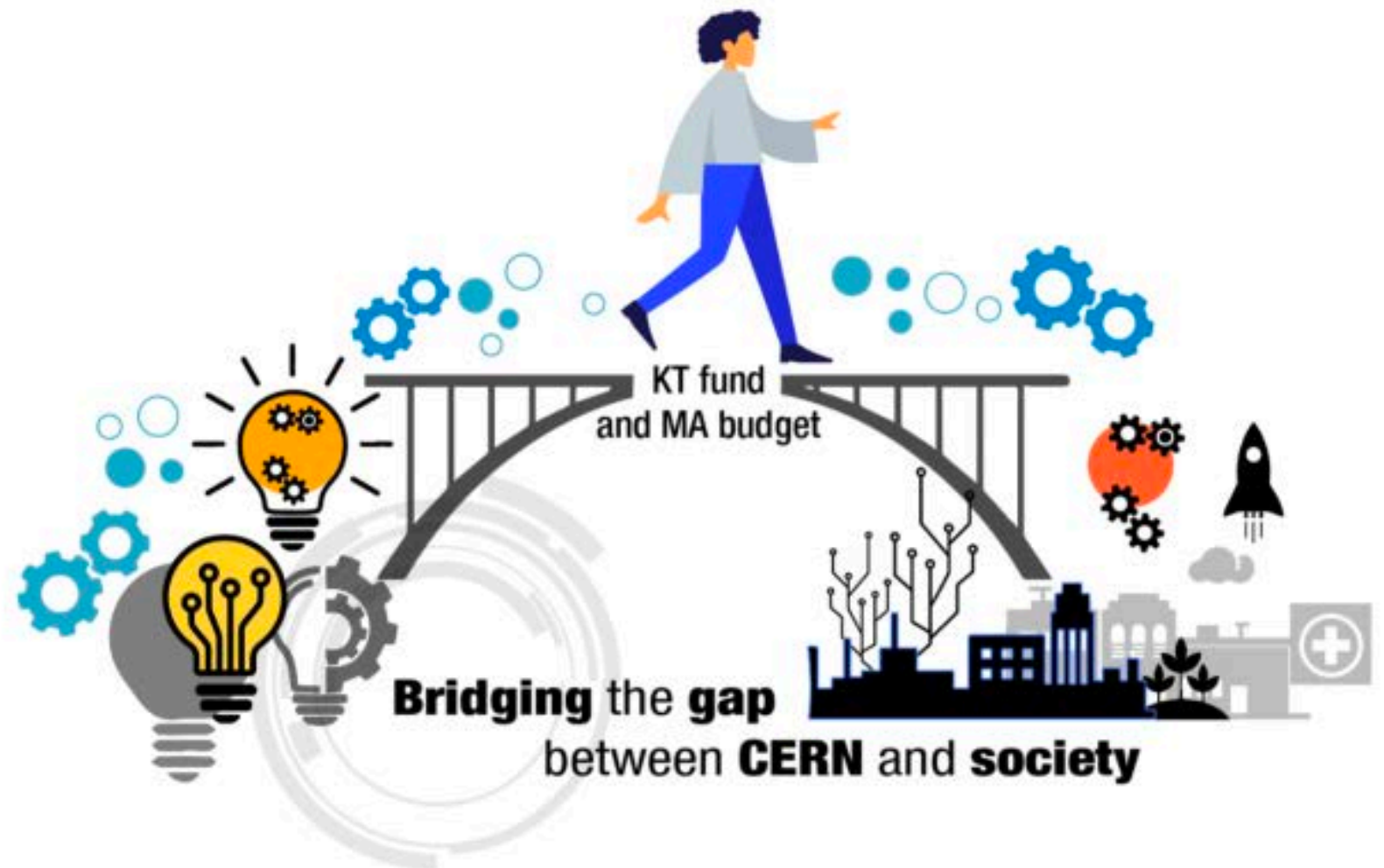
Knowledge Transfer
Accelerating Innovation

Possibilities to support Thai frontier research programs

- Quantum
- Space



Key to improve Thai SDG index



CERN offers its personnel two funding schemes: the CERN Knowledge Transfer (KT) fund and the CERN Medical Applications budget. These mechanisms provide resources to help take early-stage, innovative projects from the Laboratory to society, bridging the gap between research and industry.

In 2022, KT funding opportunities for CERN personnel is 8 August 2022. CERN especially looks forward to welcoming project proposals which support the environment.

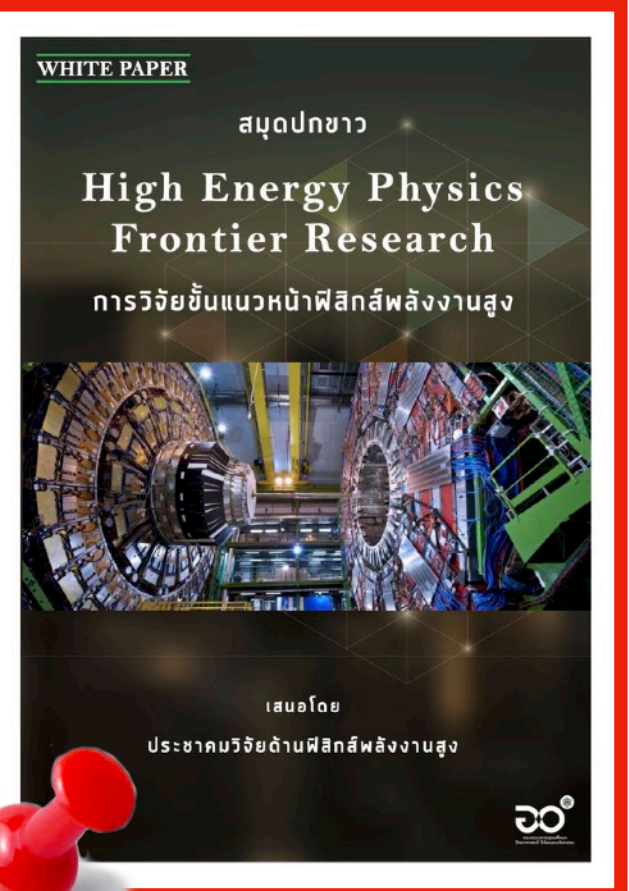
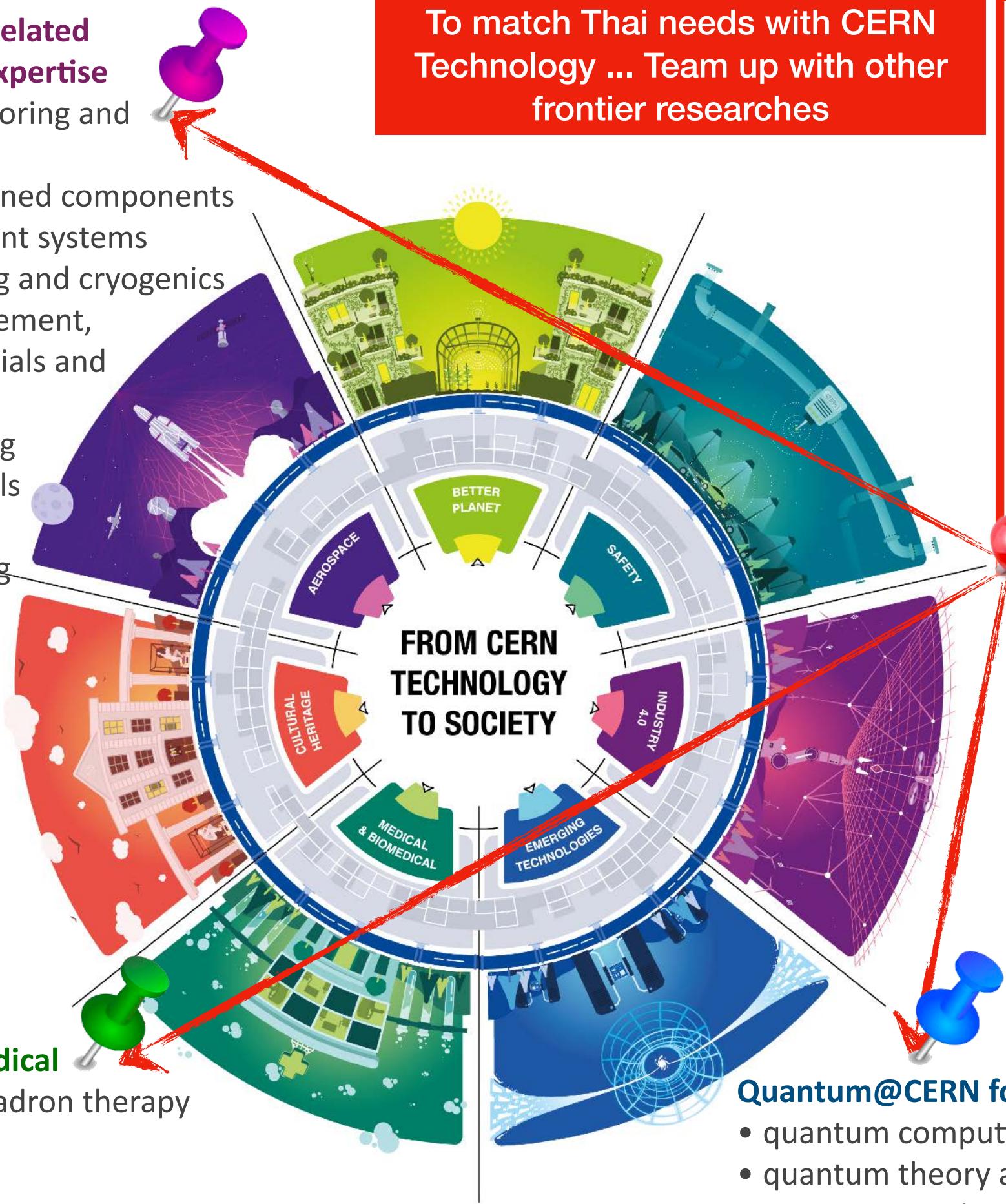


CERN Innovation Programme
on Environmental Applications

To match Thai needs with CERN Technology ... Team up with other frontier researches

CERN aerospace-related competences & expertise

- Radiation monitoring and dosimetry
- Radiation-hardened components
- Radiation-tolerant systems
- Superconducting and cryogenics
- Thermal management, advanced materials and processes
- Big data handling and analysis tools
- Irradiation and cryogenic testing facilities



Medical & Biomedical

- Radiation and hadron therapy
- Radioisotopes
- Imaging
- Dosimetry
- Simulation and computing

Quantum@CERN for Thai research program

- quantum computing and algorithms,
- quantum theory and simulation,
- quantum sensing, metrology and materials,
- quantum communication and networks.

Talk more beyond physics communities



Applications

Looking for possibly for CERN technology transfer

- Medical, Agriculture,...etc.



Possibilities to support Thai frontier research programs

- Quantum
- Space



Key to improve Thai SDG index



Bring together *university students (not just physics, but engineer, business, design,...)* to address societal challenges in the spirit of open science and open innovation, inspired by CERN and its experts, to create solutions that contribute towards the United Nations Sustainable Development Goals.

Different way to organize courses at CBI:

- 1-2 weeks workshop
 - intensive 3-month project course
- ... (see [this link](#))

