Update on Activities for Nuclear Science and Technology in Thailand

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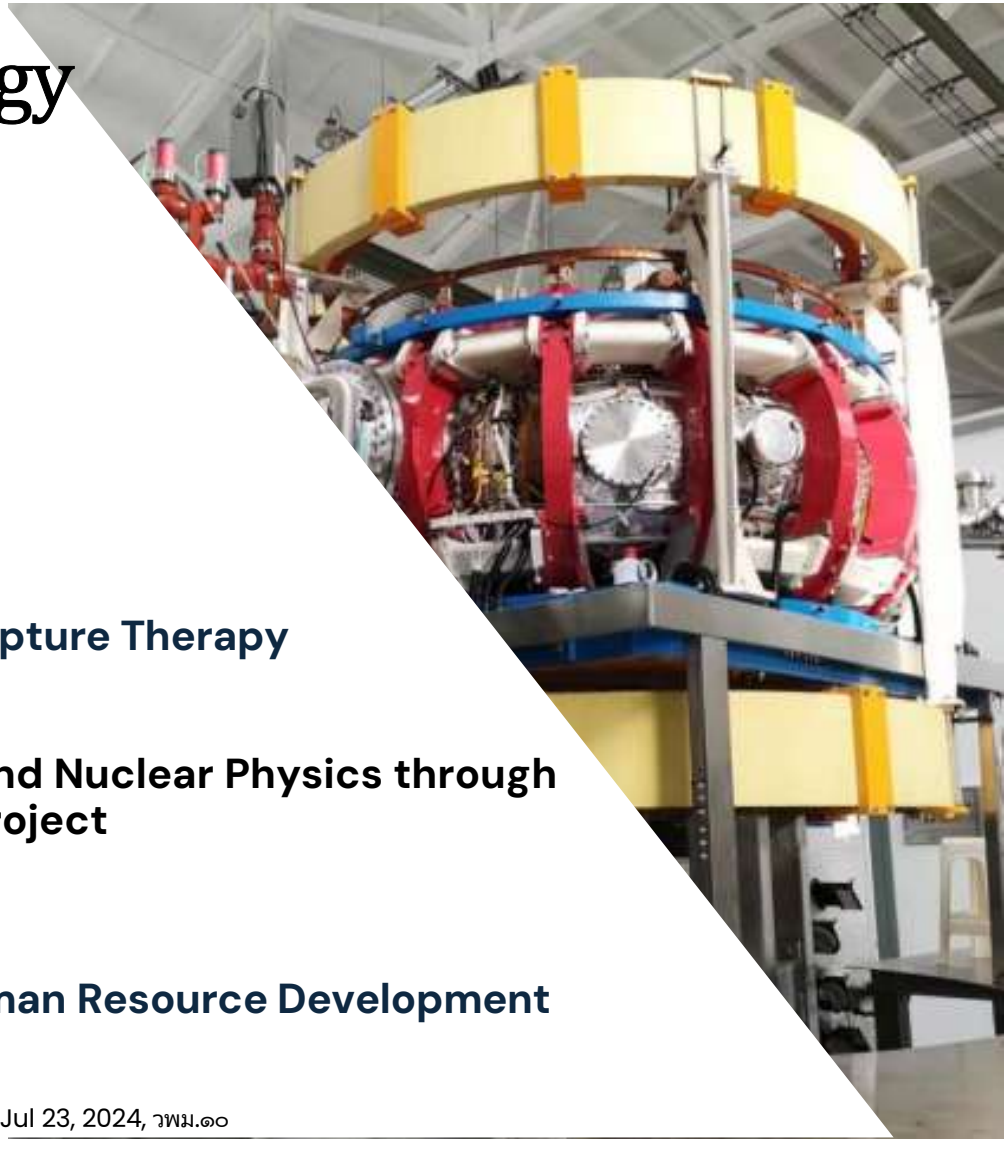
Nuclear Science & Technology in Thailand

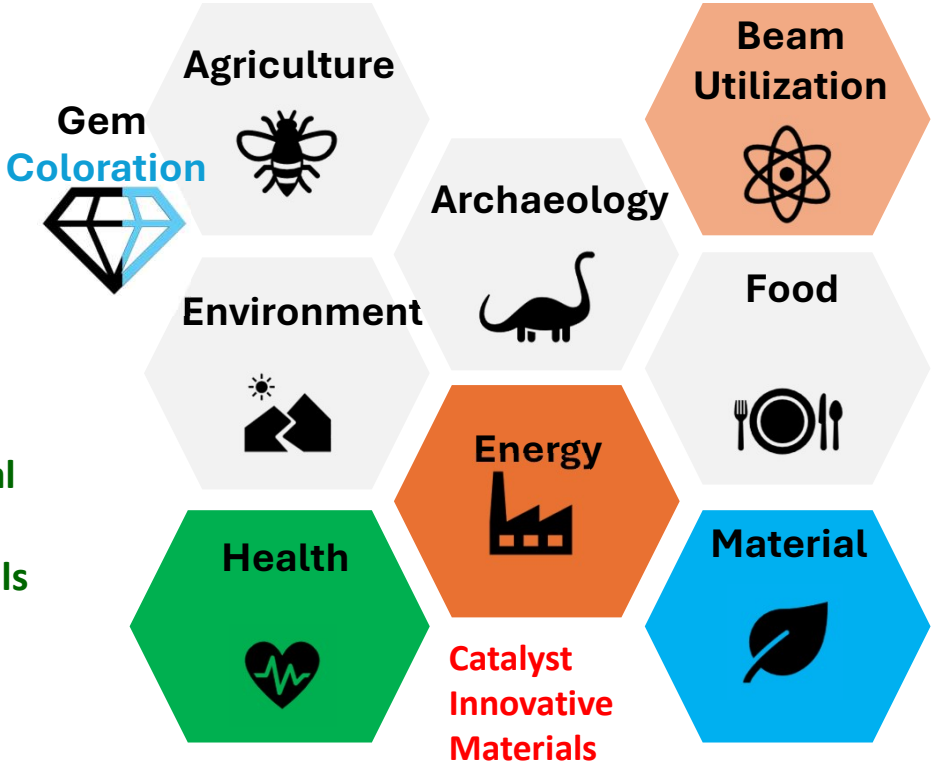


01 TINT perspective and Joint Laboratory for SMR

02 Boron Neutron Capture Therapy

03 Neutrino and Nuclear Physics through IceCube project

04 Human Resource Development



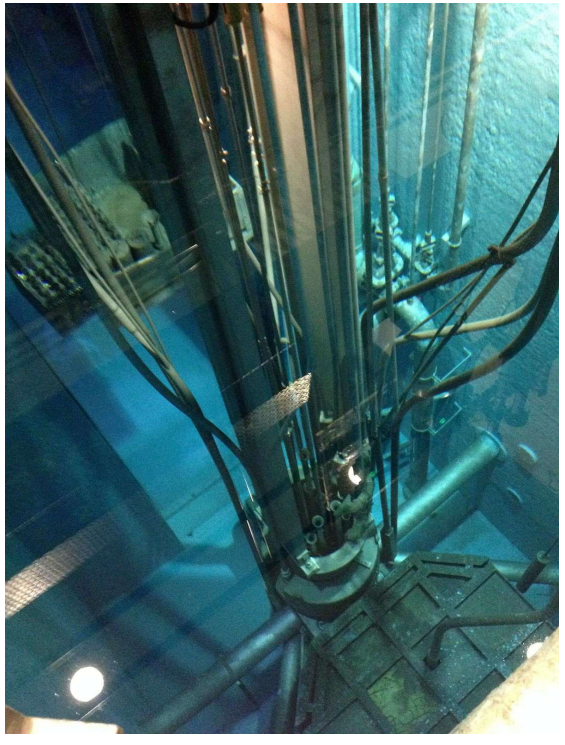
Neutron imaging
Ion beam analysis

Materials for Medical applications
Radiopharmaceuticals

Natural Polymers [Super water absorbent (SWA), Chitosan (plant growth promoter)], Nanomaterials, Biomaterials

Nuclear Infrastructure : **Research Reactor Facility**

TRR-1/M1 Research Reactor, with a maximum steady state power of 1.3 MW, has been operated since 1977 for services and R&D purposes as follows.



- **Neutron Activation Analysis (NAA)** is performed to analyze composition of samples.
- **Radioisotope production** such as I-131and Sm-153 which are employed in medical utilization for diagnosis and therapy, and P-32 for agricultural application
- **Gemstone coloration** is carried out to increase value of gemstone. For example, the color change of topaz or tourmaline could increase its value by 5-30 times.
- **Non-Destructive Techniques (NDT):** neutron experiments, nuclear physics, reactor engineering studies and neutron radiography
- **Reactor operator training** is carried out to enhance the competency of reactor operator.
- **Operation Hours:** Monday to Wednesday 26 hr/week and Thursday to Friday reserve for research and experiments, total 78 hr/month

Nuclear Infrastructure : **Tokamak Facility**

HT-6M tokamak Donation ceremony from ASIPP to TINT with H.R.H Sirindhorn presided the ceremony.

TT-1 Building : Foundation Stone Laying ceremony

Thailand Team Onsite @ ASIPP

Grand Opening

15 Jul 2018

24 Apr 2019

23 Nov 2020

7 Jun 2021

Jun -Sep 2022

17 Jan 2023

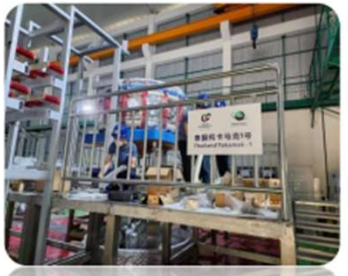
Feb-Jun 2023

25 July 2023

Plasma Technology and Fusion Collaboration MOU signing ceremony between TINT and EGAT

TINT-ASIPP TT-1 Reconstruction of Supporting Ceremony Contract Signing Ceremony

TT-1 arrived TINT Ongkharak



TT-1 Installation @ TINT Ongkharak

Thailand Institute of Nuclear Technology (Public Organization), Ministry of Higher Education, Science, Research and Innovation

Infrastructure: Infrastructure Development Plan

2019

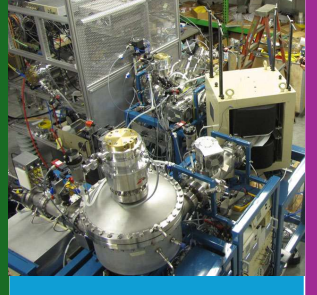
Electron Irradiation Facility

2023

Thailand Tokamak I (TT-1)

2026

Cyclotron Facility

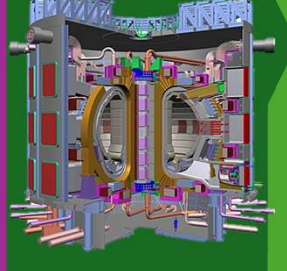


2027

Positive Ion Mass Spectrometry (PIMS)

2030

Regional Irradiation Facilities



2032

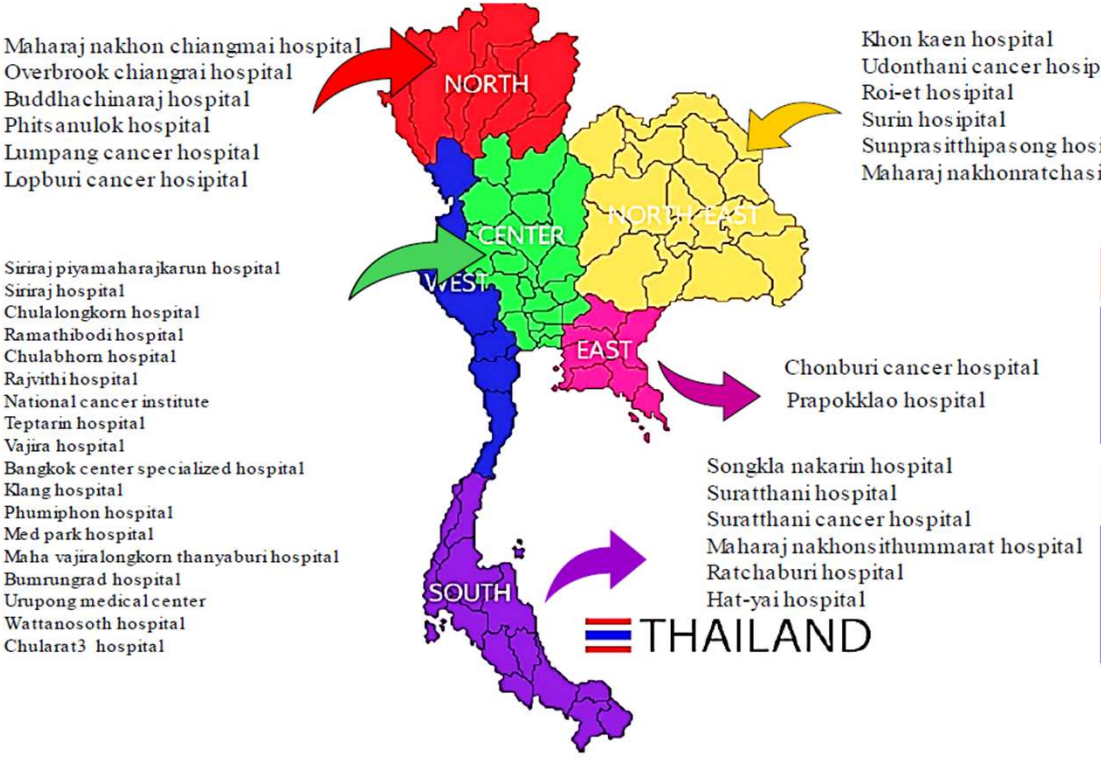
Thailand Tokamak II

2037

Thailand Research Reactor

1. Medical applications:

Nuclear medicine in Thailand has been steadily developing over the years with advancements in technology and techniques for diagnosis and treatment.



- Thailand has **38** hospitals or medical centers which are located throughout the country and equipped with nuclear medicine facilities

Government Hospital

- ❑ General hospitals: 24
- ❑ Cancer hospitals: 7

Private Hospital

- ❑ General hospitals: 4
- ❑ Cancer hospitals: 3

- ^{131}I: Thyroid gland Cancer
- ^{188}Re: Cancer
- ^{153}Sm: Bone Cancer

Radioisotope TINT produce

2. Agricultural applications:

Mutation Breeding

Tulip Siam

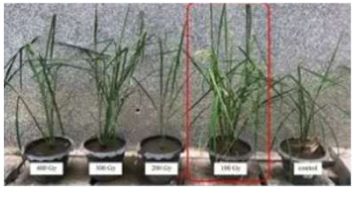
- Thailand imports tulip every year as it cannot be grown in Thailand.
- Mutation breeding on tulip using radiation technology
- New variety of tulip with different color from its parents
- The development of tulip bulb enables this new variety to grow in Thailand
- Enhance tourism

Under the **FNCA project on Mutation Breeding**, Rice Department has developed Glutinous Rice from irradiated Rice and improved Rice varieties to be resilient to climate conditions, acidic soils, and flood-prone areas.

Mulberry blast disease resistant

Papaya ringspot disease resistant

Okra yellow vein mosaic virus disease resistant



Rice acid soil resistant and high nutritional value

chili anthracnose disease resistant

2. Agricultural applications:

Application of SIT to control fruit-fly population and enhance fruit export

Chanthaburi Model for Producing and Exporting Fruit of High Quality is developed by Ministry of Agriculture and Cooperatives

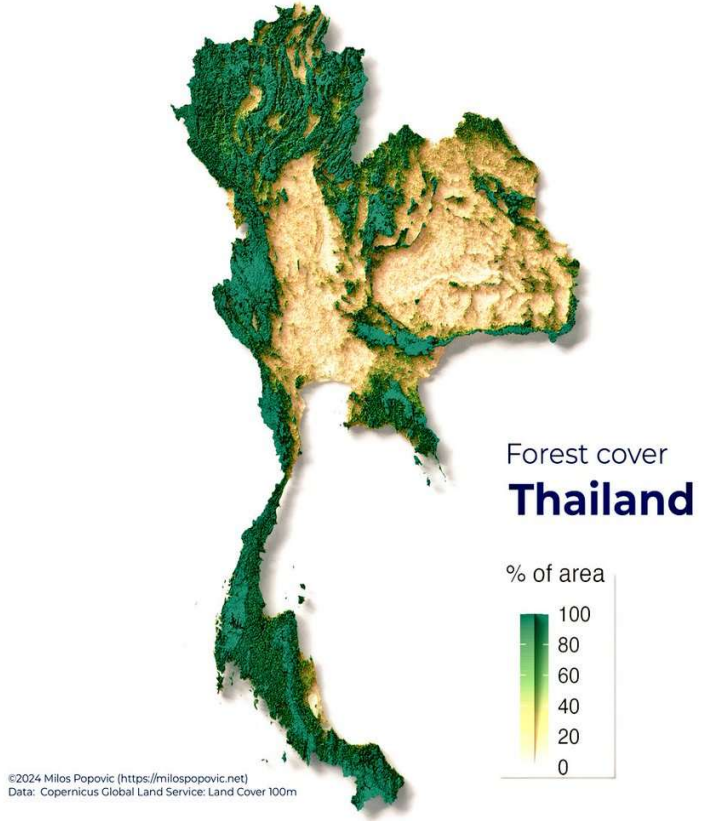
- Trok Nong Model for Low Pest Prevalence for oriental fruit flies is developed by TINT, DOAE, DOA, Trok Nong Municipality
- SIT is applied together with other methodologies to decrease fruit-fly population.
  - 5-10 million sterile male fly released bi-weekly
  - 4 monitor trap per sq. kilometer
  - 1 mass trap per 0.16 hectare
  - Removal of fallen fruits

Mass rearing facility: 80-100 million fly per week

Irradiation facility: Co-60 and x-ray irradiator

3. Environmental applications:

Evaluating Carbon Emission from Forest Soils (FNCA)



- According to an assessment in 2018, Thailand's forests cover 31.68% of the country's land area. Thailand used to have 53.33% forest cover in 1961; however, recent estimates have shown that the forest area had dropped to more than 50 % in 1990s primarily due to rapid social and economic development.
- The forest area has slowly increased since 2000 due to the ban of forest concessions nationwide and embarking on intensive reforestation throughout the country.
- **Main Plan for Forestry in Thailand** is to increase Research and Development to strengthen forest development at all levels and to better understand C cycling and carbon (C) sequestration.
- As outlined in the Thailand's Main Plan for Forestry, TINT, has participated in the FNCA project. Nuclear and related techniques are used to achieve the objectives, including a combined stable isotope (δ18O' δ2H, δ13C) techniques.

TINT Fission Mission on SMR: Go Clean Go Green Together

Thailand Institute of Nuclear Technology (TINT)

Road to SMR Collaboration of Thailand and China

CHINA

THAILAND

Human Resource Development (HRD) Support:
- Special CNNC international Ph.D. program on SMR
- UCAS scholarship in MHESI collaboration
- TINT-Thailand Academy of Sciences (TAS), MHESI

R&D

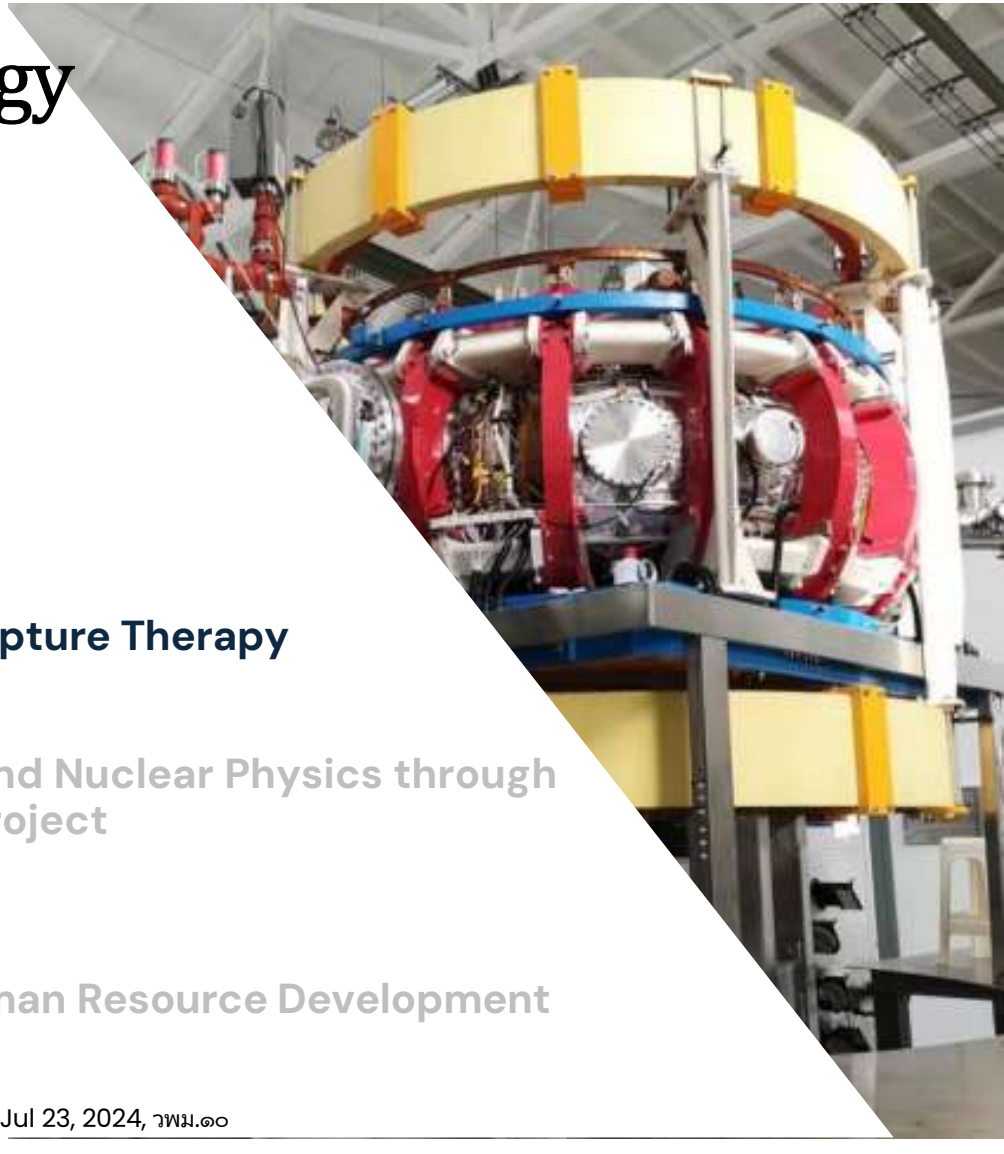
HRD

Public

China-Thailand Belt and Road Joint Laboratory on SMR Technology:
- Safety and risk analysis research
- SMR technology assessment
- Carbon and economic analysis
- Approach for waste and spent fuel management

Public Engagement Strategy Lesson Learned :
- Government-Led Initiatives to promote safety, transparency, and trust-building
- Policy of communication to support education campaigns and stakeholder consultations

Nuclear Science & Technology in Thailand



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SUT-BNCT Integrated Action Plan (IAP)

PHASE 1 Pre-project

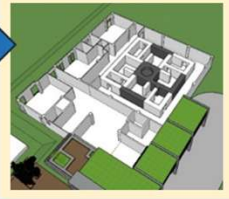
2014

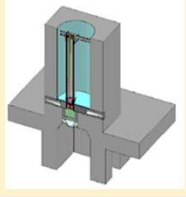
- Justification of the research reactor and considerations
- Inception of the project.
- Site survey

PHASE 2 Project Formulation

2015 – 2025

- Design of Research reactor
- Design of Building And Utility
- Research reactor construction.
- Reactor building construction.

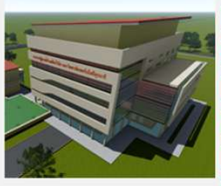




✔ Site License - Construction license (In progress)*

PHASE 3 Implementation

2026 - 2030



- Install the research reactor and prepare for testing.
- Research reactor cold commissioning test.
- Research reactor hot commissioning test.

- Fuel license

Operations

2031 - 2051

- Operation
- Decommissioning

- BNCT
- Neutron radiography
- PGNAA / NAA
- Neutron Shielding Rubber

- Operational license

PARTICIPATION

BNCT SUTH

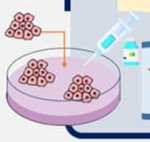
SUTH โรงพยาบาลมหาวิทยาลัยเทคโนโลยีสุรนารี

Research, development, and testing of medical products and advanced materials for medical equipment.

Neutron Radiography , PGNAA / NAA , Neutron Shielding Rubber

Design → System & Instrument Installation → Operation test

Treatment Planning Using Boron Compounds

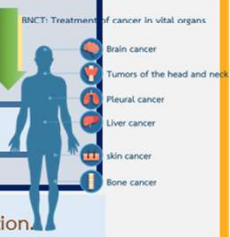


- Boron delivery technique
- In-vitro exp. (Cell)

→ In-vivo exp. (Animal)

→ In-vivo exp. (Man)

SUTH CRC



Radiotherapists (radiation oncologists)
BNCT technic training

Recruitment for operation

- Pharmacist (Researcher)

Submission to Clinical and Laboratory Standardization/ Medical Devices

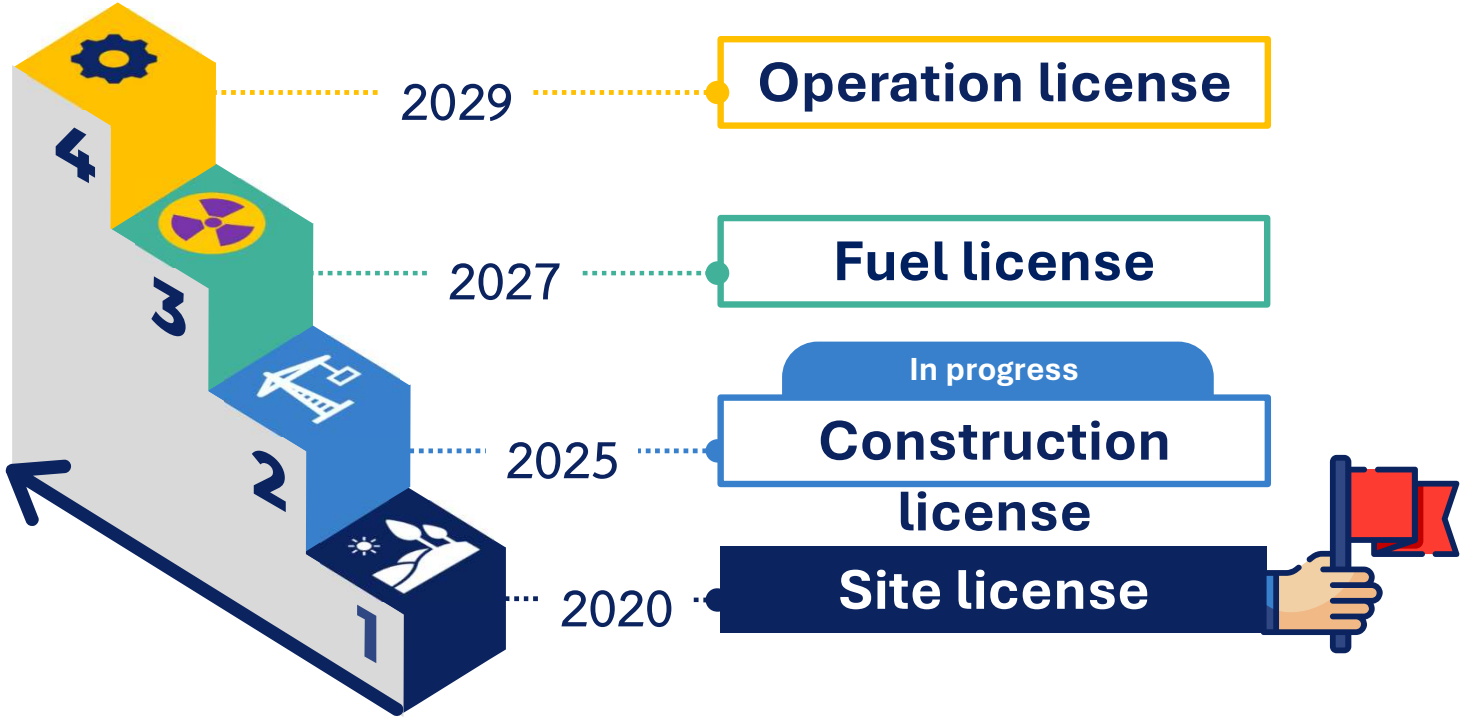
Nurse (Researcher)

Otolaryngologist

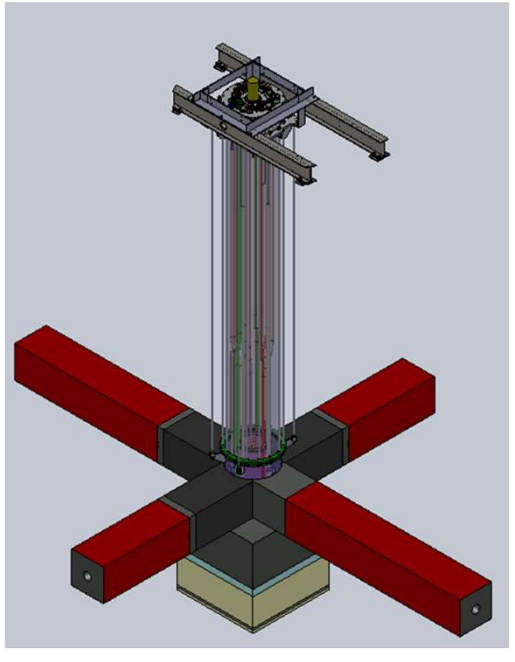
Plastic Surgeon

Neurosurgeon

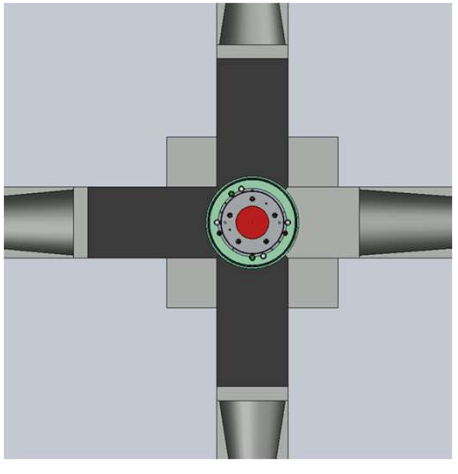
licenses in accordance with the specifications of the regulatory body.



Suranaree University of Technology Research Reactor (SUT-RR)



Top view of SUT-RR



- ❑ **Reactor type: Tank in pool**
- ❑ **Fuel meat: UO_2 (Low enriched Uranium)**
- ❑ **Reactor power:**
- ❑ **~ 45 kW for usage of Epithermal neutron**
- ❑ **~ 30 kW for normal usage**
- ❑ **Operating: 2.5 hours a day, 4 days a week**
- ❑ **One vertical neutron beam port**
- ❑ **Four horizon neutron beam ports**

Transportation of the Suranaree University of Technology Research Reactor (SUT-RR) to Suraphat Building 3

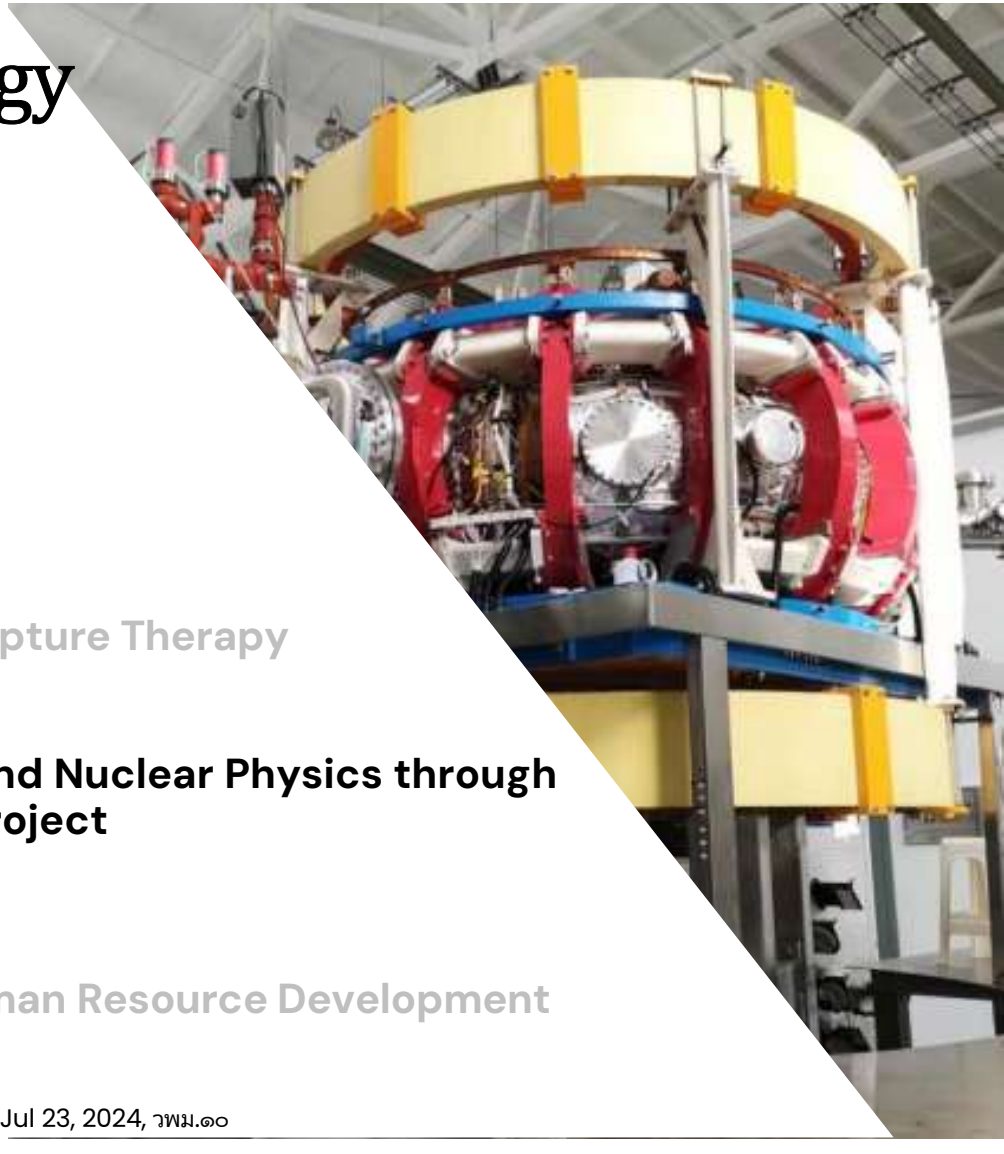
November 11-16, 2024

Containers are inspected before transport by the executives.

January 13, 2025

The container was officially opened by the Rector.

Nuclear Science & Technology in Thailand



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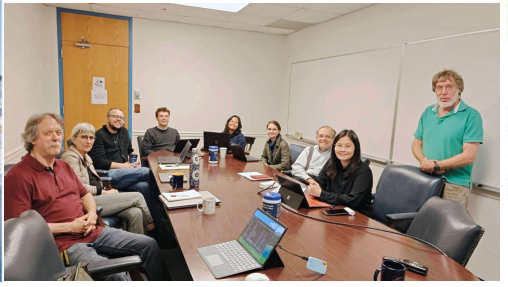
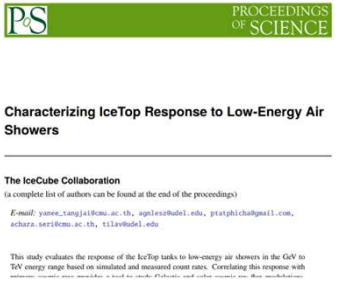
Probing the Universe through Neutrino and Nuclear Physics with IceCube

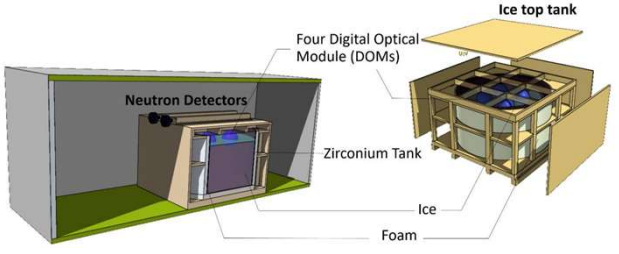
- IceCube detects high-energy neutrinos interacting with nuclei in Antarctic ice → direct connection to nuclear interaction modeling
- Studies of hadronic interactions in air showers (via IceTop) bridge cosmic-ray physics and nuclear reaction cross-sections at extreme energies
- Nuclear physics plays a key role in:
  - Modeling neutrino–nucleon cross-sections
  - Interpreting secondary particle production in cascades
  - Validating hadronic models used in CORSIKA and GENIE
- Thailand's IceCube team contributes via surface detector studies and simulations enhancing understanding of these nuclear-scale processes

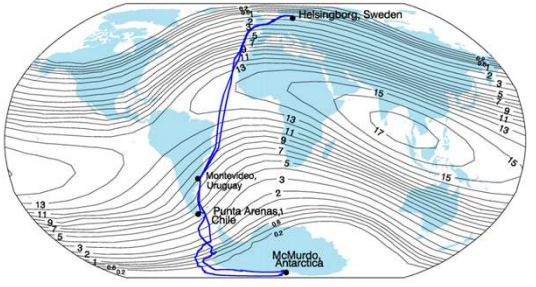
CMU Contributions in 2024–2025

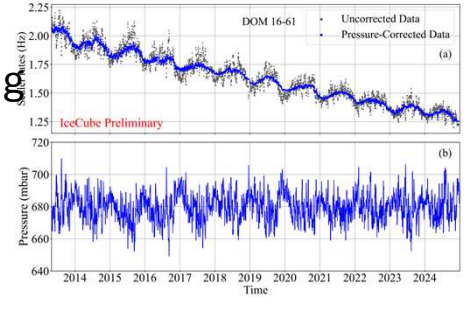
- IceTop analyses on cosmic-ray spectrum, latitude survey, and real-time monitoring — foundations for IceCube Gen2 surface array
- Publications:
  - Yanee Tangjai (Ph.D.): Spectral variations from IceTop tanks → published in PoS (ICRC2025)
  - Ongoing: Yield-function study of semi-leaded neutron monitors (2023–24 latitude survey)
- Collaboration with UDelaware, UW–Madison, and IceCube members
- South Pole field participation (Asst. Prof. Chana Sinsabvarodom – drilling season 3)
- Annual ThaisCube Workshops on multimessenger + neutrino physics





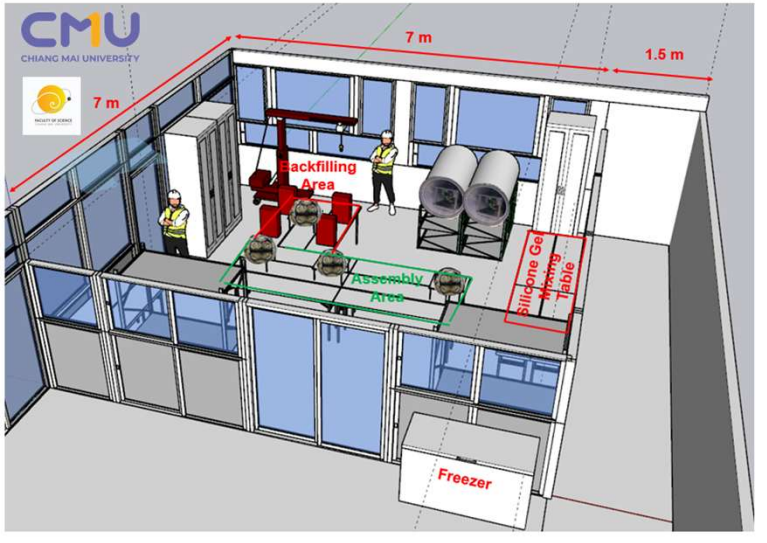






Detector R&D and Nuclear Physics Applications

- Long Optical Module (LOM) assembly facilities initiated in Thailand with Hana Microelectronics partnership
- Electronics + PMT integration and testing — enabling local fabrication and calibration
- Monte Carlo–based response modeling for photon and charged-particle interactions in optical modules
- Cross-validation of MIP response from scintillator calibration with nuclear energy deposition simulations
- Strengthening Thailand's role in nuclear detector development for IceCube Gen and SND@LHC CERN



Outlook and Impact (2025–2028)

- Continue IceTop + Gen2 surface-array analyses → advance nuclear interaction modeling of air showers
- Develop scintillator and radio hybrid systems to distinguish proton vs. iron primaries
- Produce calibrated LOM prototypes for photon detection → nuclear-level calibration for neutrino detection systems
- Integrate nuclear-physics training into Thai student programs (e.g., Wassachon Kammeemoon, Ph.D.)
- **Vision:** Strengthen Southeast Asia's contribution to IceCube Gen2 through research, detector physics, and engineering capacity
- **Goal:** Establish CMU as a regional hub connecting nuclear physics and neutrino astrophysics

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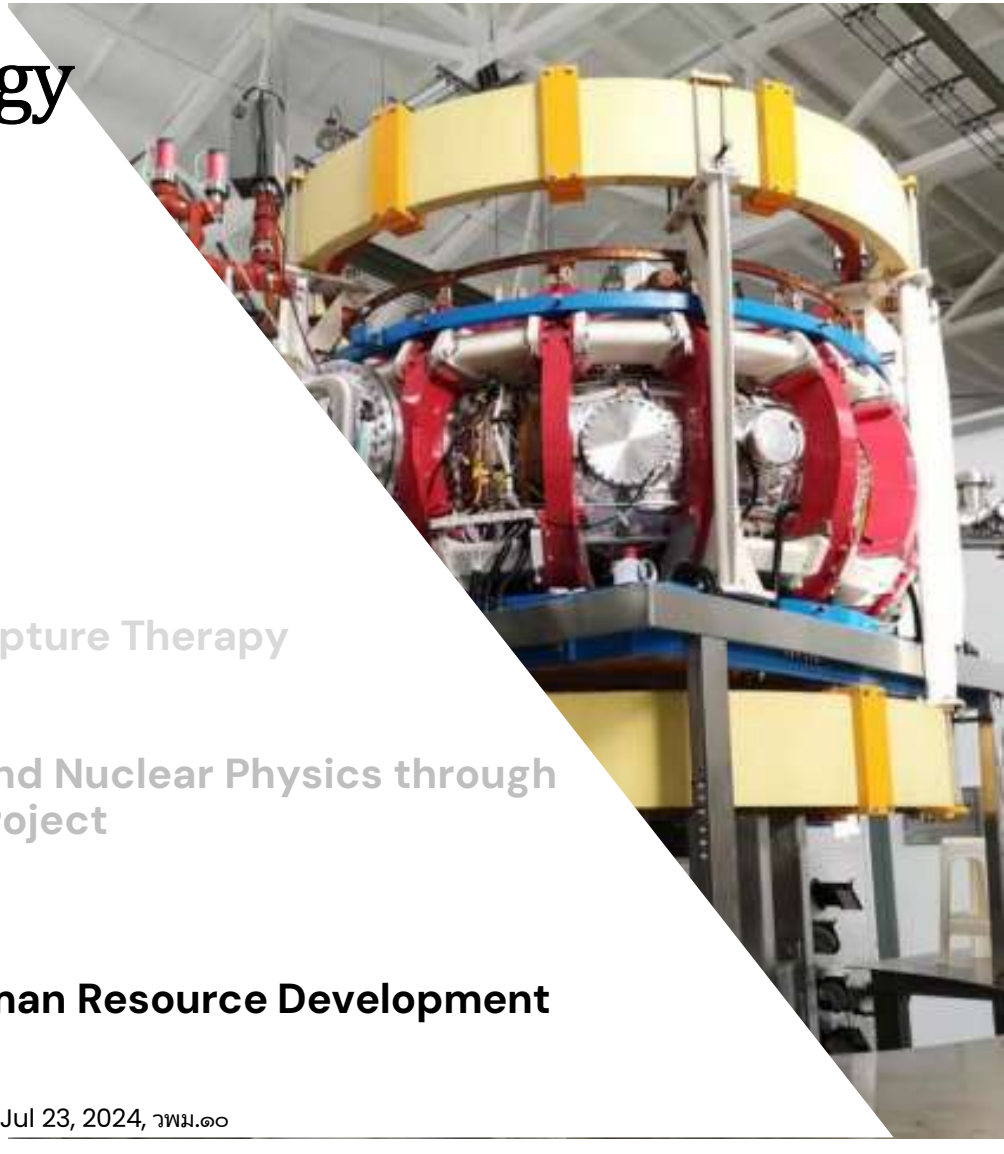

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CERN summer student programme

โครงการจัดส่งนักเรียนระดับมัธยมศึกษาตอนปลายไปศึกษาดูงานที่เซิร์น

โครงการครูวิทยาศาสตร์ภาคฤดูร้อนเซิร์น

THANK YOU

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