



Astronomy and
Astrophysics from
Antarctica

SCAR AAA WORKSHOP
September 15-19, 2025
PHUKET, THAILAND



Chiang Mai University's Role in Advancing Polar Science

Presented by

Waraporn (FHON) Nuntiyakul

Why Polar Science Matters for Cosmic Rays

- **Polar regions = natural laboratories**

With near-zero geomagnetic cutoff rigidity, they allow direct access to solar energetic particles (SEPs).

- **Unique visibility of solar events**

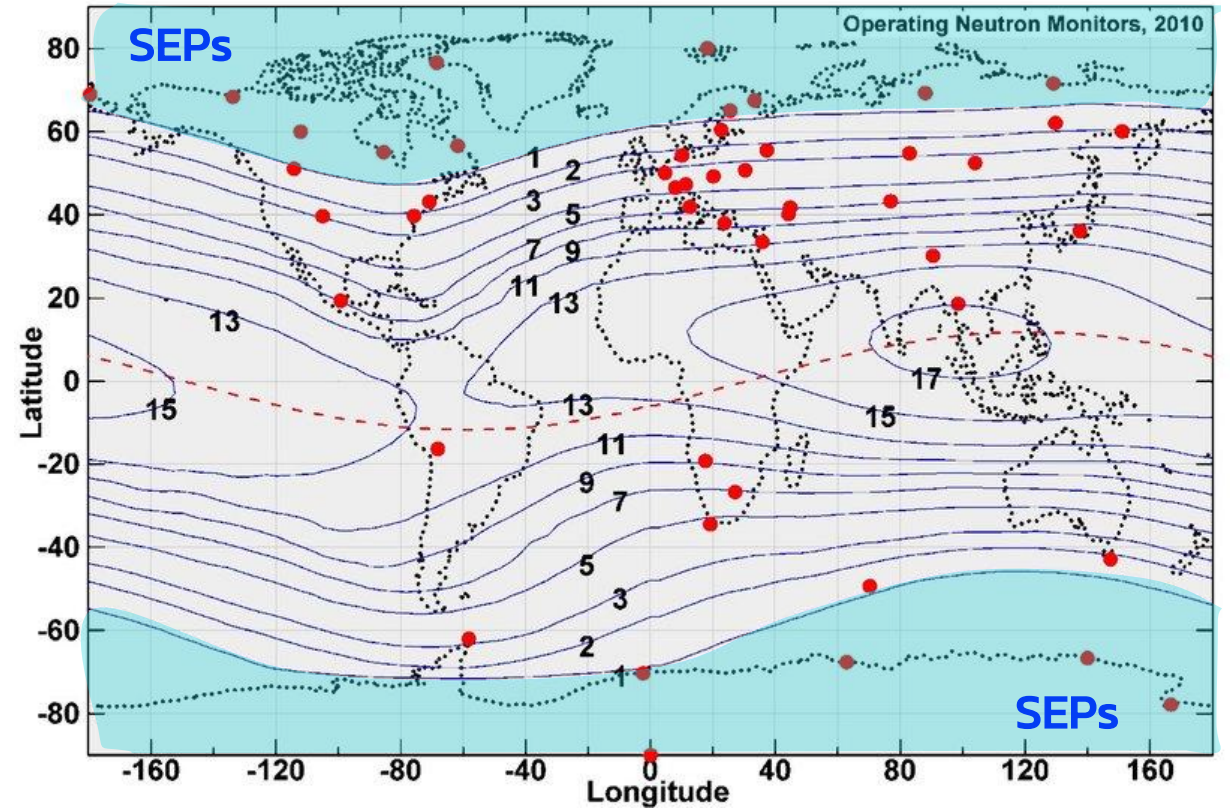
Phenomena such as Forbush decreases (FDs) and ground level enhancements (GLEs) are clearly detected at the poles but often invisible at mid- or low- latitude stations.

- **Critical for space weather research**

Polar observations provide the earliest and clearest signals of solar disturbances that impact satellites, aviation, and power grids.

- **Complementary to equatorial stations**

Polar detectors excel in SEP studies, while high-cutoff regions (e.g., Thailand) are best suited for galactic cosmic ray (GCR) investigations.



Polar regions act as natural windows to solar energetic particles (SEPs), unlike mid- and low-latitude sites. Courtesy of R. Pyle.



Thai (co-)operated Neutron Monitors - Real-time data

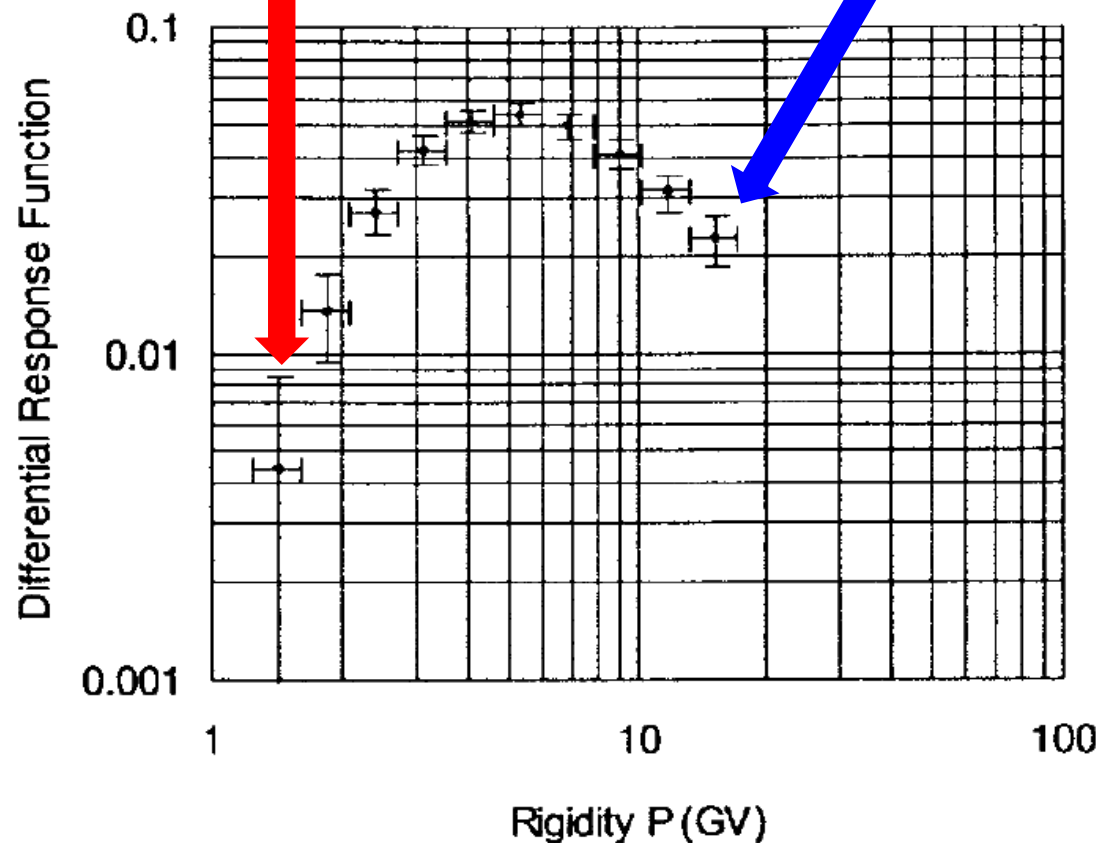
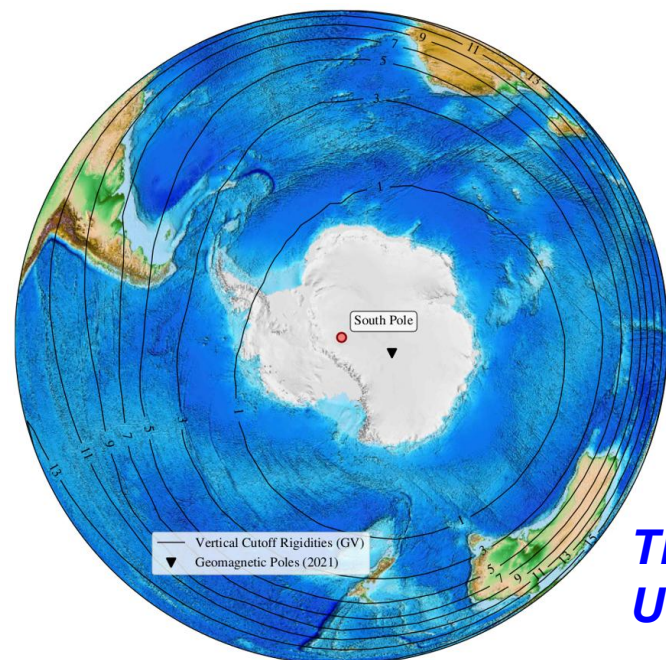
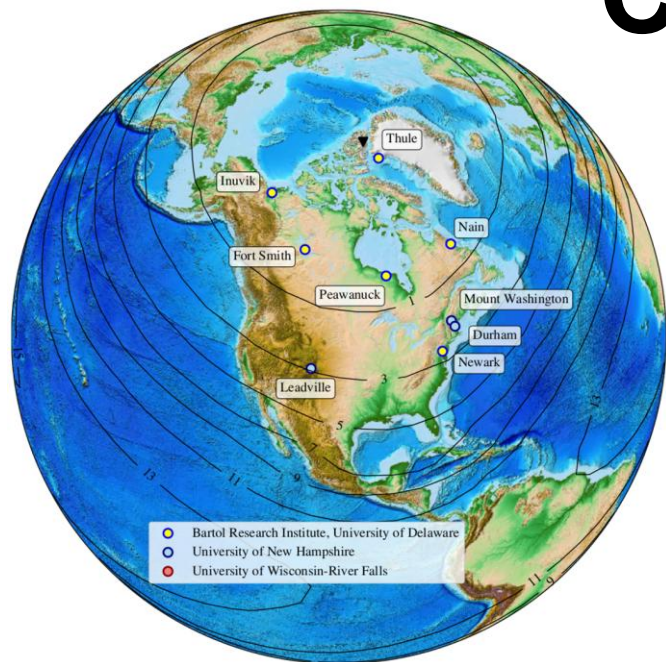


Example of FD Observation

- **Clear contrast between polar and equatorial regions**
Polar stations (e.g., Mawson, South Pole) show a sharp FD signature. High-cutoff stations (e.g., Thimon, Doi Inthanon, Chiang Mai) show little to no signal.
- **Why it matters**
→ Polar regions are ideal for studying Solar Energetic Particles (SEPs) and solar transients.
→ Low-latitude regions are better suited for long-term Galactic Cosmic Ray (GCR) modulation studies.
- **Takeaway**
This contrast highlights the complementary roles of polar and equatorial neutron monitors.

Complementary Science

Polar vs. Thailand



Thimon neutron monitor: built by Chiang Mai University, currently installed in Maui, Hawaii (12.9 GV)



PSNM (Chiang Mai, TH)

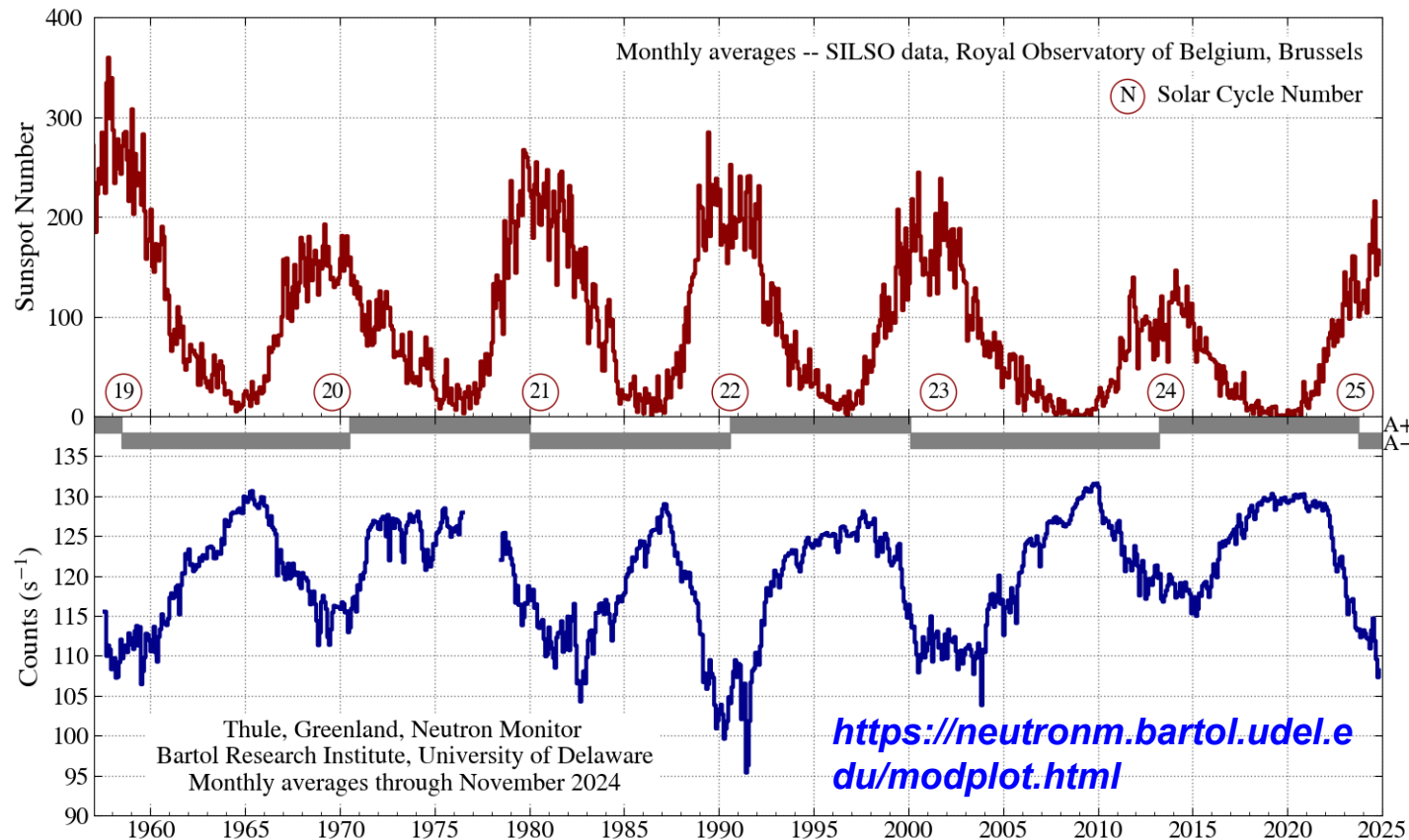


Changvan (Chiang Mai, TH)

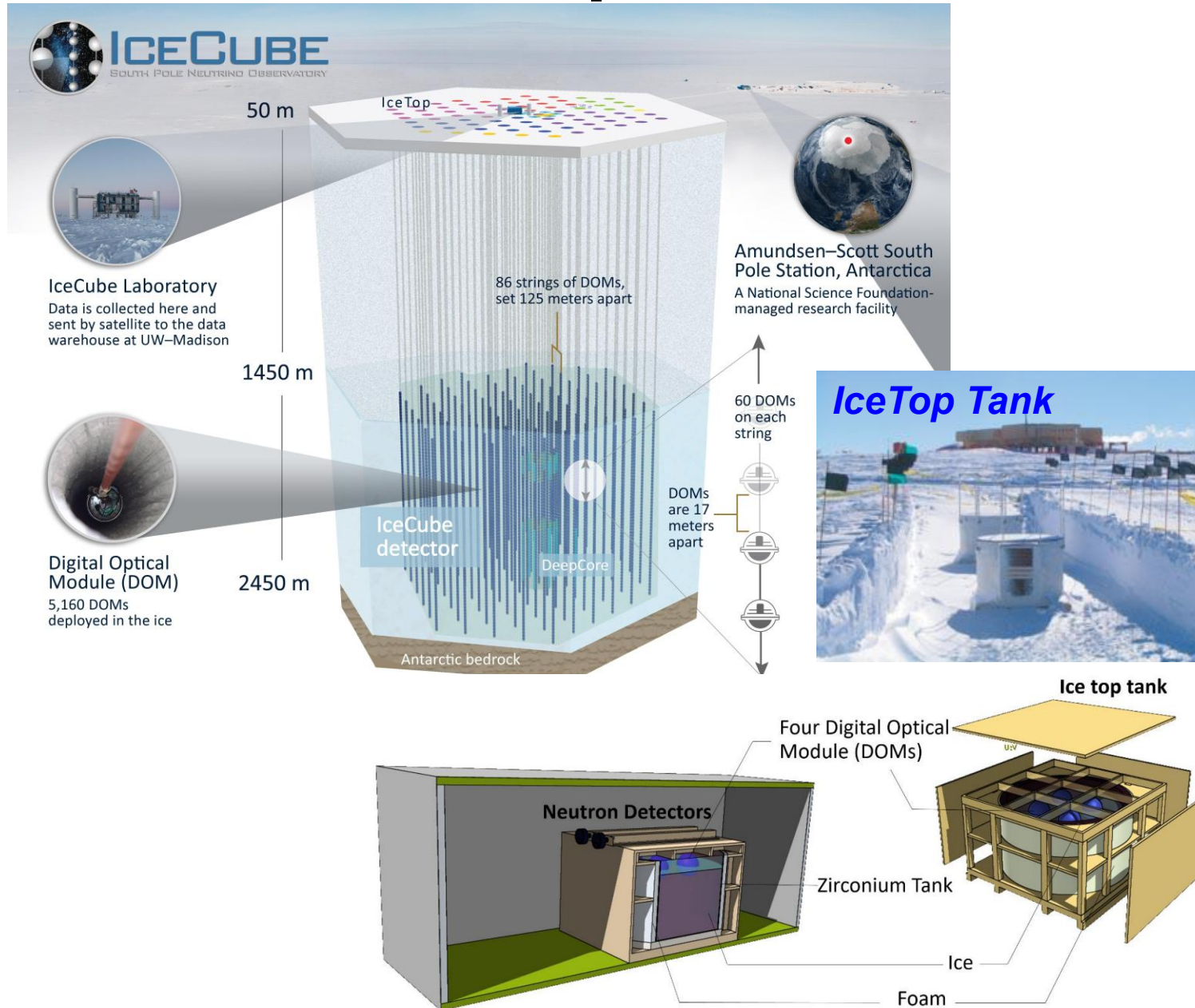


Thimon (Hawaii, USA)

- Expertise in low-energy cosmic rays
(long-term modulation, latitude surveys)
- Collaboration with strong groups in high-energy
cosmic rays + neutrino



IceCube + IceTop Connection



Status: Associated Member since 2021

Researches:

- Analyzing IceTop data & simulations
- Studying IceTop yield functions (South Pole)
- Conducting simulations of scintillators & radio antennas (IceCube Gen2)

Engineering:

- Drilling operations at the South Pole
- DOM/LOM production in Thailand (Schedule subject to NSF budget approval)

Outreach and Education:

- IceCube Summer Student Program
- Thai-IceCube VR on Tour
- ThaisCube Workshop Series
- Rosie & Gibbs Comic Translation
- IceCube Master Class

Latitude Survey & Yield Function Determination



South Korea (KOPRI):

- **Antarctic Voyage:**
28-Dec-2023 to 1-May-2024
- **Arctic Voyages:**
1-Jul to 1 Oct 2024



GCR spectrum

Solar
Modulation

Yield function

Integral Response Function

$$N(P_c, h, t) = \int_{P_c}^{P_L} G_i(P) M_i(P, t) Y_i(P, h) dP$$

Differential Response Function

$$DRF(P) = - \left[\frac{dN}{dP} \right]_p = \sum_i G_i(P) M_i(P, t) Y_i(P, h)$$



Role of Monte Carlo Simulations

Primary (p, α)



Atmospheric Simulations

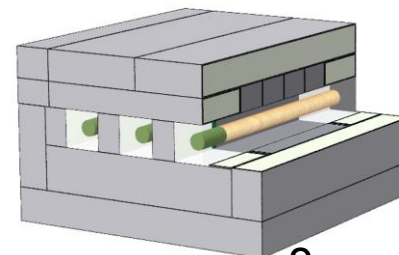
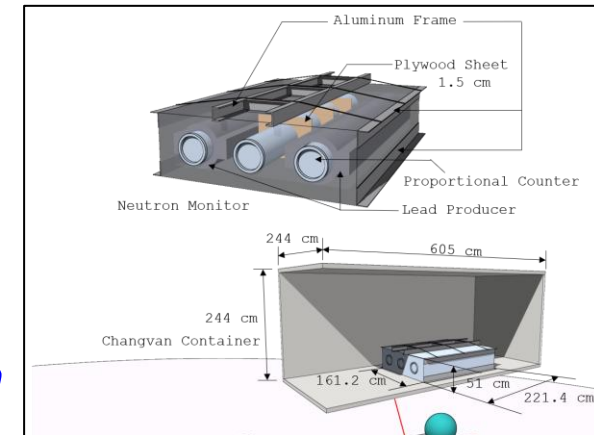
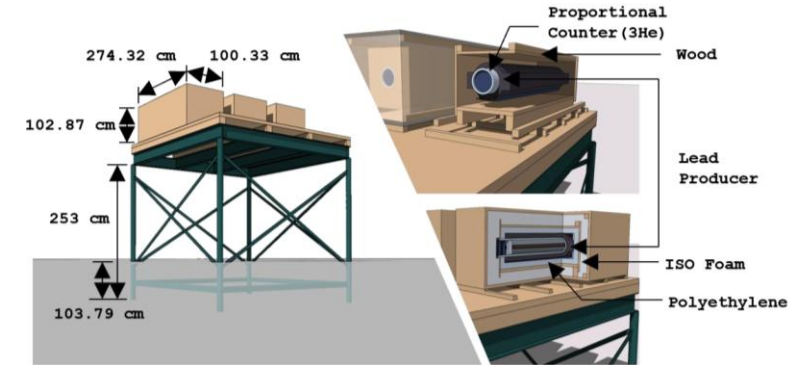
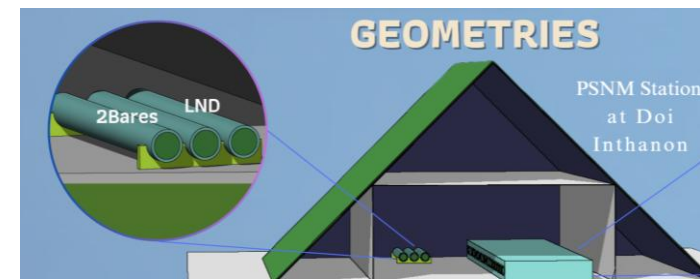
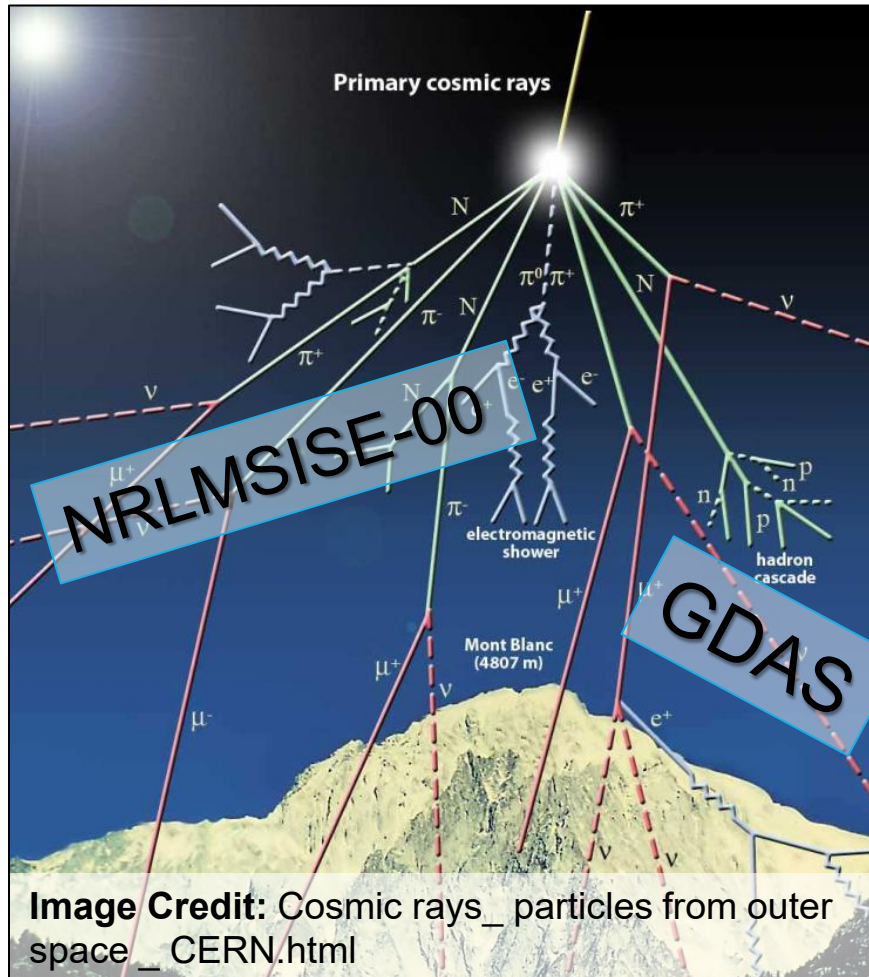


Detector Simulations

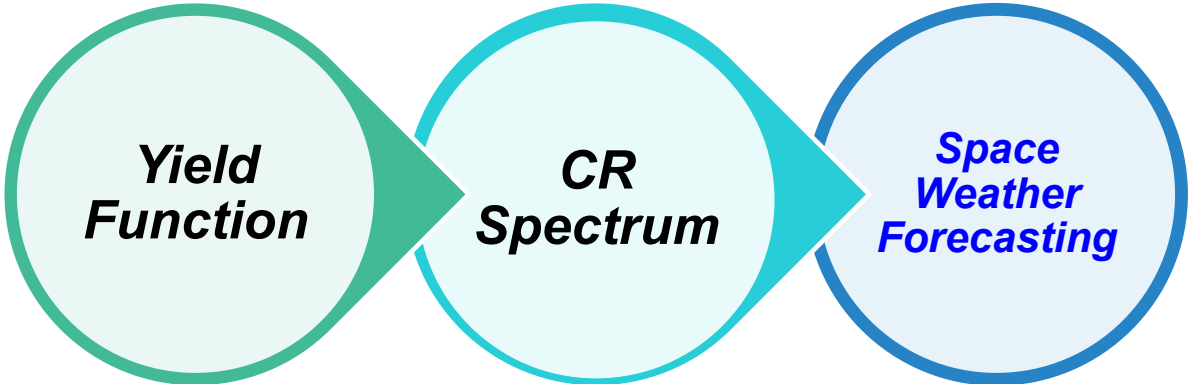


Post FLUKA Analysis

- Applied deadtime corrections*
- Used monthly solar modulation parameter (ϕ , in MV) and GCR model*
- Calculated count rates and yield functions*



From Yield Function to Cosmic-Ray Spectrum + Space Weather



Space Weather War Room



ZiCURE



Cosmic Ray Research Team

Group Leader



Assoc. Prof. Dr. Waraporn Nuntiyakul

Proactive Researcher (Fellowship)



Dr. Achara Seripienlert

Postdoctoral Researcher



Dr. Tatphicha Promfu

Administrative & Technical Staff



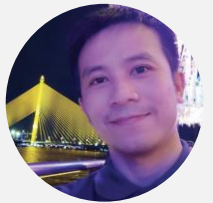
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Kotchanipa Chainoi

Finance & Secretariat



Ekkarach Somboon

IT

RA



Audcharapon Pagwhan



Jetsada Maburee



Sidarat Khamphakdee

PhD



Kledsai Poopakun

Graduated



Aekawit Kittiya

Graduated



Montree Phetra

Graduated



Panutda Yakum



Yanee Tangjai



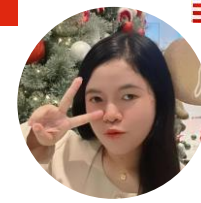
Pittaya Apiwattanakul



Wassachon Kammeemoon



Surya Suresh



Budsayarat Duangjai




Thitikorn Sae-lin

Expansion of Research Scope at CMU


- **Aurora & ionosphere studies** as indicators of space–Earth coupling
- **Multi-source observations:** satellite + ground-based data
- **Key datasets:** THEMIS (NASA), TIMED/GUVI, Thai GNSS network
- **Research themes:** geomagnetic storms, ionospheric electron density, plasma variations
- **Goal:** understanding atmospheric responses to space weather



Prof. Suwicha Wannawichian



CHANG MAI UNIVERSITY



Welcome to

Chiang Mai University Space Weather Data Center

Earth-Space Ecology Research Group
Chiang Mai, University

Data Center

TEC data analyzed from the GNSS observations at Chiang Mai University

In collaboration with the National Institute of Information and Communications Technology (NICT) and Nagoya University from Japan, we aim to Provide the complete archive of TEC data observed at Chiang Mai University. This will encourage global and regional researchers, as well as students from Chiang Mai University, to collaborate their research studies with our data.

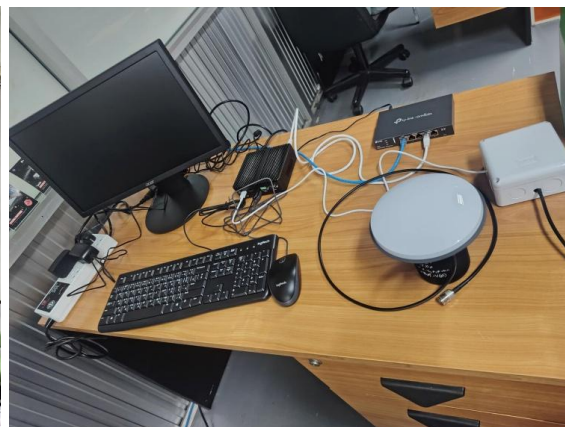
Total Electron Content (TEC) from Mae Hea Campus under collaboration with NICT

DOWNLOAD

Total Electron Content (TEC) from Sirindhorn Observatory under collaboration with Nagoya University

DOWNLOAD

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2024-25 Outputs

- 1 publication in ISI Q1 Tier 1 (Top 10%)
- 8 publications in Scopus Q1-Q2
- 7.25 million THB in external research funding
- 9 international and/or national research collaboration
- 22 highly skilled personnel developed

Science

Education

Engineering

Astronomy Program

Department of Physics and Material Science

Department of
Biology

Department of
Curriculum,
Instruction, and
Learning

Department of
Civil Engineering

**Siramas
Komonjinda**

**Suwicha
Wannawichian**

**Waraporn
Nuntiyakul**

**Jeeraporn
Pekkoh**

**Kreetha
Kaewkhong**

**Chana
Sinsabvarodom**



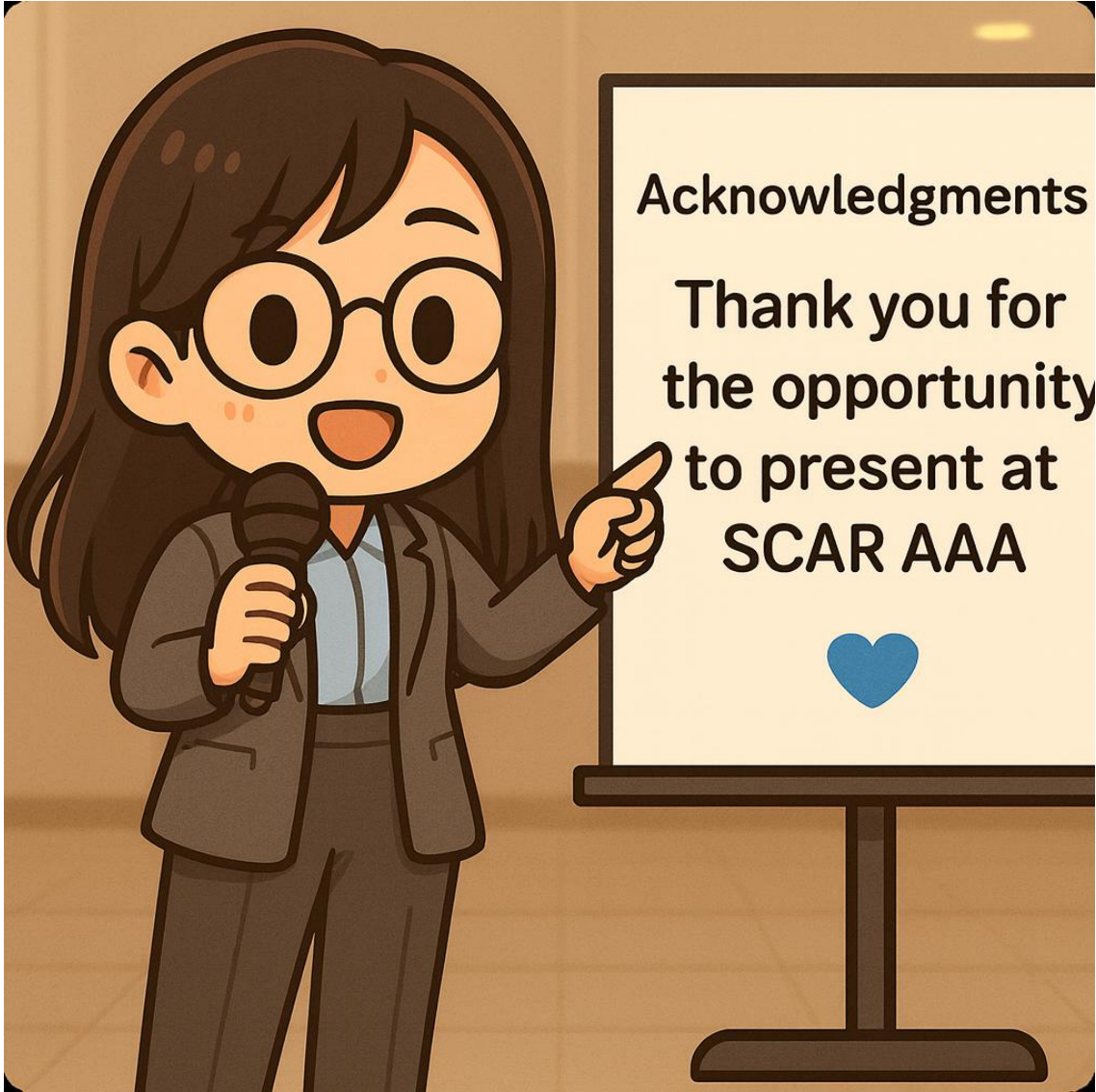
**Kittiya
Phinyo**



**Achara
Seripienlert**



**Chaneanath
Sriaporn**



ACKNOWLEDGMENTS

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- **SCAR, Chiang Mai University (CMU), and PMU-B** for sponsoring SCAR AAA 2025
- **Thailand Center of Excellence in Physics (ThEP)** for supporting the staff team in organizing the SCAR AAA 2025 conference

***From the Poles to the Tropics, Together We
Advance Polar Science***

