

## Current Research Activities on Nuclear Physics in Myanmar



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## **Overview of Nuclear Physics Education and Research Activities**

**Background on Nuclear Physics Education in Myanmar** 

 ✓ In Basic Education, Implemented the KG +12 system in 2016-17 (key Reform) Redesigned the basic education curriculum in line with the new KG+12 structure with a focus on 21st century skills (JICA, EU)

- ✓ Added more background on basic nuclear physics and its application
- 2 pathways: award the completion certificate --- Join the industry/job OR join vocational education
  Passed G12 ----Join University degree programs

In Higher Education, developed a new curriculum for the degree programs at Universities in Myanmar, in line with KG+12 system

- ✓ Attempted to achieve an international-standard bachelor degree programs
- ✓ Physics: Revised curriculum of BSc degree, set up the syllabi of the new curriculum, upgrade the course contents of 1<sup>st</sup> -4<sup>th</sup> year Nuclear Physics subjects
- Conduct Final year project (FYP) (including Nuclear physics) in new Bachelor degree program (from 2024) aiming to have research experience
- Conduct Nuclear Physics projects for Master degree in Physics in all Universities in Myanmar (depending on the resources available)
- ✓ Conduct Nuclear Physics projects for Doctoral degree program in 2 Universities in Myanmar (Yangon and Mandalay)

#### **Implementation Units for Nuclear Physics Research**



#### **Research Focus at Yangon University**



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$\langle$	Materials research is more
	popular at YU

## **Environmental Monitoring using Nuclear Radiation Technology**



"Studies on the Effect of Radiation on Manawthukha Rice", PhD Thesis (2005) University of Yangon, Myanmar

"Radon Measurements In And Around Some Gold Mines In Shwe Kyin"

J. Myanmar Acad. Arts Sci. (2020) Vol. XVIII.No.2B

"Study on the Effect of Neutron And Gamma Irradiation on Rice Samples"

Whar Whar Nyein, *et al.*, Myanmar-Korea Conference, (Neutron Activation Analysis (NAA) with SLOWPOKE-2 reactor

Collaborate with Dalhousie University, Canada)

.... and similar works

#### **Research Focus at Mandalay University**

- Theoretical Nuclear Physics Research
- Environmental Monitoring using Nuclear Radiation Technology





## **Theoretical Nuclear Physics (TNP) Research**

- Strangeness Nuclear Physics (hypernuclear physics and kaonic nuclear physics) Prof. Khin Swe Myint
- > Ab Initio Calculation of Light Hypernuclei
- Triple Alpha Process in Thermal Plasma
- Mean Field Study on Nuclear Structure
- Heavy-Ion Fusion Reactions
- > Analysis of J-PARC E07 experimental data for double strangeness nuclei

#### **Strangeness Nuclear Physics**

Prof. Khin Swe Myint (Retired Rector, former professor of Physics Dept. UM) Dr. Tun Tun Oo, Dr. Aye Thandar Htay, Dr Htike Nandar kyaw

Recent talk: Application of Linearized AMY T-Matrix Method to CLAS-Data Analysis (2023, JPARC)

- 1. Study on  ${}_{\Sigma}^{4}He$  hypernucleus within full coupled channel framework
- 2. Study on coupled channel hyperon-nucleon and hyperon-hyperon interaction
- 3. FADDEEV calculations of the  ${}^{12}C$  nucleus within three alpha model framework
- 4. Structure calculation of double Lambda hypernucleus  $^{11}_{\Lambda\Lambda}Be$  system
- 5. Differential cross section of  $(\pi^+, K^+) {}^{20}_{\Lambda} Ne$ ,  ${}^{19}_{\Lambda} F$  reaction with green function method



#### Dr. Aye Thandar Htay

- 6. Relativistic effect on kaonic nuclei  $K^- {}^{12}C$  and  $K^- {}^{208}Pb$
- 7. Coherent  $\Lambda$ - $\Sigma$  coupling in Lithum drip-line region
- 8. Analysis of  $\Lambda(1405)$  photoproduction by  $\gamma p \rightarrow K^+ (\pi \Sigma)^0$  reaction
- 9. Mesonic weak decay of Hypertriton  ${}^{3}_{\Lambda}H$
- 10. Comparative study between single pole and double pole nature of  $\Lambda(1405)$





## **Research Highlights**







Triple-alpha reaction: a key reaction to produce 12C: expected to occur in weakly coupled thermal plasmas.

- □ 12C is created in the fusion of three  $\alpha$  particles. Be +  $\alpha \longrightarrow C^*$ (Hoyle state)
- □ The Efimov states for the three-alpha system are investigated.





Lai Hnin Phyu, H. Moriya, W. Horiuchi, *et al.*, Prog. Theor. Exp. Phys., 2020, 093D01 (2020)

#### **Ab Initio Calculation of Light Hypernuclei:**Compute

the energies of the s-shell hypernuclei  ${}^{3}_{\Lambda}H$ ,  ${}^{4}_{\Lambda}H$  and  ${}^{5}_{\Lambda}He$  within the No-core shell Model framework.

Study the effect of NN interaction's uncertainties on the hypernuclei with a fixed leading order chiral hyperon-nucleon interaction. Yupeng Yan,





Yupeng Yan, Thiri Yadana Tun, *et al.*,

Few-Body Syst. **62**, 94 (2021) PRC **106**, 054001 (2022), PRC **105**, 064001 (2022).

## **Research Highlights (contd.)**



#### **Prof. Khin Than Tint**

- □ J-PARC E07 experiment: to search for double strangeness nuclei.
- ❑ Analyze the events in nuclear emulsion plates (type of hypernucleus, binding energy, etc.) by using the ranges and angles data of tracks measured with microscope system.







**A hyperon** 

Neutron

Proton



ng of Microscope system in Gifu University

# Nyein Wint Lwin

- Mean Field Study on Nuclear Structure: using relativistic and nonrelativistic mean field models
- □ Heavy-Ion Fusion Reactions

Collaborate with Prof. K. Hagino, Kyoto Univ.

## **Environmental Monitoring using Nuclear Radiation Technology**



#### **Prof. Khin Than Tint**

- Investigation of Radionuclides and Heavy Metals in Sediment of Ancient Lakes in Upper Myanmar
- Health Risk Assessment of Toxic Metals and Radioactive Materials in water and sediment in Mandalay region
- Radon Measurements in Water and Sand Samples Collected from wells and hot springs
- Study On Pollution Monitoring Parameters Of The Water Quality From Mandalay Area
- A Dual Source of Phosphorus to Lake Sediments Indicated by Distribution, Content, and Speciation: Inle Lake (Southern Shan State, Myanmar)
- Investigation of the Environmental and Human Health Impact of Industrial Pollution

## **Environmental Monitoring using Nuclear Radiation Technology: Research Highlights**

Usage of nuclear radiation for environmental monitoring at Inle lake, Shan State Examples: Soil, water analysis, radiation levels for agriculture and ecosystem health.





Elisa Sacchi, Sergio Comizzoli, Eloisa Di Sipio, Myat Mon Thin, Viviana Re, et al.,

- ✓ Water, 13(17):2434, Sept 2021
- ✓ Water, 12(7):1993, July 2020
- ✓ Environmental Earth Science, 79(8), April 2020
- ✓ E3S Web of Conferences 98, June 2019
- ✓ Applied Geochemistry, March 2018
- Procedia Earth and Planetary Science\_ 17:750-753, December 2017
- ✓ Isotopes in Environmental and Health Studies 2016, http://dx.doi.org/10.1080/10256016.2015.1130038







#### Sample collection for investigation of radionuclides

Collaboration with Pavia University, Italy



## Research Facilities at Yangon/Mandalay University



## Integrated multidisciplinary research labs

## **Research Facilities for Environmental Sampling**



High Purity Germanium (HPGe) detector system



Atomic Absorption Spectrometer (AAS) (YURC)



Energy Dispersive X-Ray Fluorescence (EDXRF) Spectrometer (YURC)



**RAD7** Radon

detector



## X-ray Diffractometer (XRD)



Nal (TI) Scintillation Detector

## International collaborations and trainings/lectures (MOE)

- ✓ Prof. Y. Akaishi, (KEK, Japan) (1995-2019)
- ✓ Prof. Nakazawa, (Gifu Univ., Japan) (2005-2020)
- ✓ Prof. Y. Fujita (Osaka Univ. Japan) 26<sup>th</sup> May-6<sup>th</sup> June, 2018
- ✓ Dr. T. Sato, PHITS (JAEA, Japan), Dec., 2019
- ✓ Prof. Khin Swe Myint, Lectures on Theoretical Nuclear Physics
- ✓ Prof. K. Hagino (Kyoto Univ., Japan), Dec., 2017
- ✓ Prof. Lorenzo Maccone (Pavia Univ., Italy, ), Feb., 2023
- ✓ Prof. Liu Weiping, China Institute of Atomic Energy, Feb., 2023 (online)
- ✓ Dr. Yusuke Tanimura (Nuclear Theory Group, Tohoku University, Japan), Feb., 2023 (online)



Dr. Y. Akaishi



Dr. Y. Fujita



Dr. Liu Weiping



on experimental physics education



Dr. T. Sato

## International collaborations and trainings(MOST)

Department of Atomic Energy

- NI Lab (Nuclear Instrumentation Lab): carrying out research work for the development of nuclear technology and experimental projects for nuclear application fields
- Radioisotope Techniques Lab: conduct researches using Radiotracer and Sealed Source techniques in industrial applications
- NDT Lab: Non-destructive testing (NDT) using nuclear techniques involves the use of ionizing radiation to test the quality of materials and products

MOST actively participates in the IAEA training courses, workshops and meetings under TC project on Nuclear Safety, Nuclear Security and Nuclear Safeguards and other IAEA/RCA projects on Radiation Application.

 ✓ Gamma chamber: Installed in July 2000 under IAEA TC project MYA 7-005-090 (Ministry of Science and Technology)

#### Gamma Chamber

Located at the site of Department of Atomic Energy, Hawbi, Yangon. Installed in July 2000 under IAEA TC project MYA 7-005-090



#### **Radiation Source** Co-60 0.46 Dose Rate kGy/hr (May 2024) Exposure Volume Sample Holder : 17.2 cm Diameter Height 20.5 cm

Gamma Irradiation

#### Research

- Food Irradiation for value addition
- Industrial product for value addition
- Environmental Application
- Polymer waste recycling
- Gemstone Irradiation
- Preservation for Cultural Heritage purpose
- Dosimetry Research



**Food Irradiation** (Sprout Inhabitation)



Polymer waste recycling research





Info: from MOST

(Shelf life extension)

(high quality Wire, cable insulation)



Cultural Heritage research



Agricultural Soil and Waste Water treatment by gamma irradiation for environmental application

#### **Gamma Irradiation Service**

Sterilization of Bone Graft from Ministry of Health Mutation Breeding from **Biotechnology Research** Department and Department of Agricultural Research) University Research



Sterilization of Bone Graft



**Mutation** Breeding of Sugar cane



Color Enhancement of Gemstone

MOST also cooperates with the following **international organizations** 

- ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM)
- US-DOE and ANSTRO National Nuclear Security Administration
- Comprehensive Nuclear-Test- Ban Treaty Organization (CTBTO)
- EU-CBRN, EU-JRC
- Asia Pacific Safeguards Network (APSN)
- Korea Institute of Nuclear Non-proliferation and Control (KINAC)
- Bilateral cooperation (MOU) with MOSTI Malaysia in Nuclear Security.
- Myanmar coordinates with ROSATOM in the field of Nuclear Infrastructure (the use of nuclear energy for peaceful purposes)

## Information Centre for growing regional interest in peaceful nuclear technologies

- Nuclear Technology Information Centre (NTIC) opened in Yangon, Myanmar in 2023
- The Information Center created at the initiative of Rosatom implemented together with the Ministry of Science and Technology (MOST) of Myanmar.
- Russia and Myanmar have signed an agreement instituting cooperation in the peaceful use of atomic energy
- To raise awareness of nuclear technology, develop sustainable solutions, and promote technical education.
- The ultimate result is an educational space for senior school and college students.





NTIC, Yangon

#### Global Atomic Quiz 2024

#### **Remarks & Future Prospects for Nuclear Research in Myanmar**

ANPhA objective – to strengthen cooperation among nuclear physicists in Asia

- Limitation: lesser numbers of researchers in nuclear Physics areas at present
- Requisites: overseas trainings, short-term programs, degree programs for students and staff
- Expectation: Increase number of scholars in theoretical/experimental nuclear Physics areas
- expand in basic and applied nuclear sciences strengthen research cooperation
- Some facilities for environmental monitoring (increase collaboration in Asia/ etc.)

#### **Upmost importance: International support and collaboration!**

