

Mukobara Yuta

Institute of Science Tokyo / School of Environment and Society / Transdisciplinary Science and Engineering
Nuclear Engineering Course / Doctoral Program, 2nd Year / Katabuchi Lab.

🏠 yuta-mukobara.com 🔄 [yuta-mukobara](https://github.com/yuta-mukobara) ✉️ mukobara.y.636f@m.isct.ac.jp

I am a doctoral student at the Institute of Science Tokyo, specializing in theoretical calculations in nuclear physics. My research focuses on nuclear data evaluation and improving the accuracy of heavy ion therapy simulations. I employ methods such as Antisymmetrized Molecular Dynamics (AMD) and machine learning, aiming to contribute to applications of nuclear physics, including radiation medicine and nuclear reactors. Building on my undergraduate background in information engineering, I have implemented J-PARC detector systems for use with the Pelletron accelerator at my university and contributed to managing our laboratory's computing cluster. Additionally, I engage in external activities such as managing Discord Bots.

Education

Doctoral Program, Graduate School of Institute of Science Tokyo

Since Oct. 2024

School of Environment and Society / Transdisciplinary Science and Engineering / Nuclear Engineering Course / Katabuchi Lab.

- Research Topic: Enhancing the Accuracy of Theoretical Cross-Section Calculations for Heavy Ion Therapy Reactions
- Paper: **Y. Mukobara**, T. Sanami, A. Ono, T. Inakura, T. Katabuchi, S. Chiba, and C. Ishizuka, J. Nucl. Sci. Technol. 61, 206 (2024).

Doctoral Program, Graduate School of Tokyo Institute of Technology

Apr. 2023 – Sept. 2024

School of Environment and Society / Transdisciplinary Science and Engineering / Nuclear Engineering Course / Katabuchi Lab.

Master's Program, Graduate School of Tokyo Institute of Technology

Apr. 2021 – Mar. 2023

School of Environment and Society / Transdisciplinary Science and Engineering / Nuclear Engineering Course / Chiba Lab.

- Master's Thesis: Dependence of heavy-ion reaction cross sections on mean-field models calculated by Antisymmetrized Molecular Dynamics

Chiba Institute of Technology

Apr. 2017 – Mar. 2021

Computer Science / Computer Science / Yasutake Lab.

- Bachelor's Thesis: Expression of Δ Δ di-Baryon by Color Molecular Dynamics

Research Assistant

Institute of Science Tokyo ZC Lab.

Since Oct. 2024

- Development of Machine Learning Programs for Analyzing Nuclear Fission Trajectories

Tokyo Institute of Technology ZC Lab.

Dec. 2021 – Sep. 2024

- Annotation of Nuclear Fission Yield Data
- Development of Machine Learning Programs
- J. Chen, **Y. Mukobara**, C. Ishizuka, T. Katabuchi and S. Chiba, J. Nucl. Sci. Technol. 61, 12 (2024).

Chiba Institute of Technology STAIR Lab

Sep. 2019 – May 2023

- Data Annotation
- Research on Improving the Accuracy of Natural Language Processing Classifiers
- **Y. Mukobara**, Y. Shigeto, and M. Shimbo, in Proceedings of EACL, pp. 432–442 (2024).

Research Keywords

Nuclear Physics, Nuclear Data, Antisymmetrized Molecular Dynamics, Machine Learning

Skills

Programming

Proficient:

C, Python, Fortran

Experienced:

ShellScript, C++, Julia, Rust, JavaScript

Libraries / Frameworks

OpenMPI, Pytorch, Numpy, Jax, Pandas, Scikit-learn, Numpyro, TensorFlow2

Tools / Platforms / etc.

Linux, Git, Docker, Tmux, Bash, Makefile, LaTeX, Markdown, HTML, CSS

Languages

Japanese (Native)

English (Conversational level)

Awards

Sep. 2023:

Encouragement Award,
2023 Autumn Meeting,
Atomic Energy Society of Japan

Mar. 2023:

Outstanding Student Award,
Master's Thesis Presentation,
Tokyo Institute of Technology

Nov. 2022:

Best Poster Award,
Nuclear Data Research Meeting,
Japan Atomic Energy Society

Projects & Publications

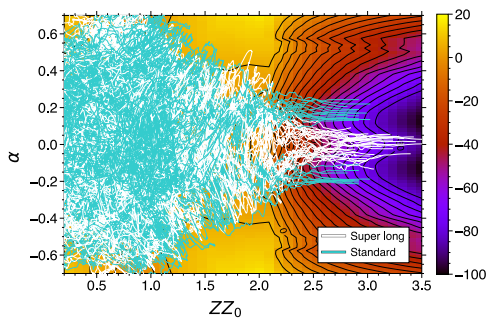
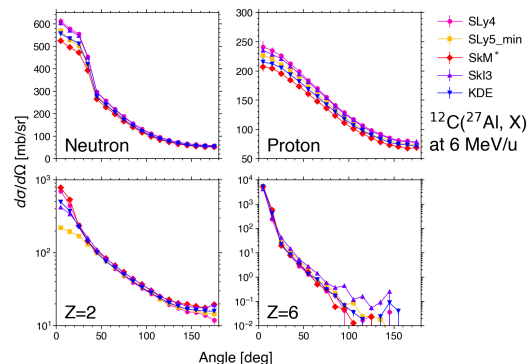
Nuclear Physics, Theoretical Calculations

Paper Title: Mean-field dependence of fragment-production cross sections in heavy-ion induced reactions calculated by antisymmetrized molecular dynamics

[[PDF](#) | [DOI](#)]

Y. Mukobara, T. Sanami, A. Ono, T. Inakura, T. Katabuchi, S. Chiba, and C. Ishizuka, J. Nucl. Sci. Technol. 61, 206 (2024).

- Investigated the mean-field dependence of the fragment production cross-sections in heavy-ion induced reactions using Antisymmetrized Molecular Dynamics (AMD).
- Comparison was made using five different Skyrme mean-field potential sets.
- In the ^{12}C -induced reactions, it was found that the fragment production at forward angles can differ by a factor of up to 20, with a tendency to decrease at backward angles.



Nuclear Physics, Machine Learning

Paper Title: Fission trajectory analysis using ML techniques

[[PDF](#) | [DOI](#)]

Y. Mukobara, S. Chiba, K. Fujio, T. Katabuchi, and C. Ishizuka, EPJ Web Conf. 306, 01042 (2024).

- Analyzed the symmetric and asymmetric fission trajectories obtained from the 4-dimensional Langevin model using a hybrid neural network combining Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU).
- The results showed that it is possible to classify these trajectories with over 70% accuracy before reaching the final fission mode (symmetric or asymmetric).

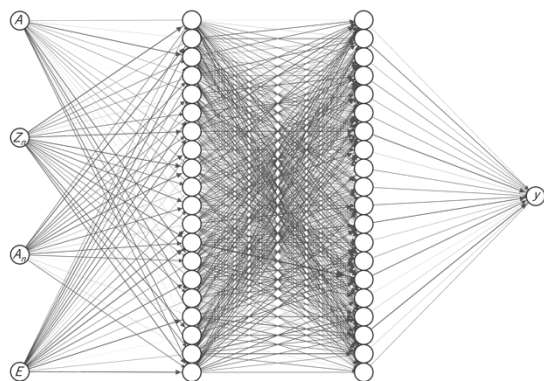
Nuclear Physics, Machine Learning

Paper Title: Bayesian approach to energy dependence of fission product yields of ^{235}U by data augmentation

[[PDF](#) | [DOI](#)]

J. Chen, **Y. Mukobara**, C. Ishizuka, T. Katabuchi and S. Chiba, J. Nucl. Sci. Technol. 61, 12 (2024).

- Predicted the energy dependence of fission yields using a Bayesian Neural Network (BNN) model.
- By applying data augmentation, the energy dependence was accurately predicted.
- I was responsible for constructing the BNN for this study.



Natural Language Processing, Machine Learning

Paper Title: Rethinking Loss Functions for Fact Verification

[[PDF](#) | [ARXIV](#) | [URL](#) | [GitHub \(Source Code\)](#) | [Intro Blog](#)] Explanatory Article [[PDF](#) | [DOI](#)]

Y. Mukobara, Y. Shigeto, and M. Shimbo, in Proceedings of EACL, pp. 432–442 (2024).

- Investigated loss functions for fact verification in the FEVER shared task.
- Standard cross-entropy loss could not capture the class imbalance in the FEVER dataset, so two custom objective functions were developed tailored to the task.
- By combining the developed objective functions with simple class weighting, the class imbalance in the training data was effectively addressed, leading to improved accuracy.

Programming, Ray Tracing

GitHub Repository: ray_tracing

[[GitHub \(Source Code\)](#)]

- One of the projects from École 42.
- Accepts input files with the .rt extension and uses ray tracing to render various shapes.
- The following can be configured:
 - Window size
 - Position, number, and light intensity of lamellas
 - Position, number, and color of lights
 - Position, number, color, and size of 5 types of objects

