

Sunjae Lee

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RESEARCH INTERESTS

My research focuses on contributing to the realization of a **commercially viable magnetic-confinement fusion reactor**. Especially, 1) MHD stability in **negative triangularity(NT)** and 2) development of **AI-based high-performance simulations**.

EDUCATION

Seoul National University

College of Liberal Studies

Mar 2021 – Feb 2026 (Expected)

Seoul, Korea

- B.S. in Computer Science & Engineering and in Physics

RESEARCH EXPERIENCES

Dept. of Nuclear Engineering, Seoul National University

Undergraduate Research Intern → incoming M.S. Student

Sep 2024 – Present

Seoul, Korea

3 Dimensional Stellarator & Tokamak Lab - Advisor: Prof. Jong-Kyu Park

- Conducted stability analysis of NT using ideal, drift-kinetic, and kinetic MHD models with DCON
- Identified a second-stability region of the $n = 1$ kink in DIII-D NT and analyzed the effect of magnetic shear
- Simulated edge ballooning mode near the second stability region using kineticEFIT and BALOO

Princeton Plasma Physics Laboratory (PPPL)

Visiting Research Student, SNU-PPPL Summer Collaboration

Jul 2025 – Aug 2025

Princeton, NJ, USA

- Participated in the PPPL-SNU Summer Research Collaboration, focusing on nonlinear 3-D MHD modeling, transport analysis, and pilot-plant design for NSTX-U and KSTAR plasmas
- Learned and applied the BALOO code for edge-stability analysis in the K-DEMO project and NT plasmas

Dept. of Nuclear Engineering, Seoul National University

Undergraduate Research Intern, NUPLEX Lab

Sep 2023 – Aug 2024

Seoul, Korea

Seoul National University Plasma & Ion Beam Laboratory - Advisor: Prof. Y. S. Hwang

- Designed and implemented a database for the VEST using the IMAS-HSDS data architecture
- Developed a Python-based post-processing tool (VAFT) for automated analysis of experimental shot data
- Explored operational space for the first time, identifying performance limits from current-driven instabilities

PUBLICATIONS

J: Journal, R: Under Review, C: Conference

- [J.1] Hong-Sik Yun[†], Sunjae Lee[†], Laurent Jung, et al. (2025). **Developing an IMAS-Compatible Platform for the University-Level Tokamak VEST and Its Application in Operating Characteristics Analysis**. *Plasma Physics and Controlled Fusion*, Vol. 00, Issue 0, pp. 000-000. DOI: 00.0000/00000.0000.000000

[†] These authors contributed equally to this work.

ORALS & POSTERS

P: Poster presentations, O: Oral presentations

- [P.1] S. J. Lee, J. B. Cho, O. Nelson, C. Paz-Soldan, J.-K. Park. (2025). **Kinetic MHD Stability of Low- n Modes in Negative Triangularity Plasmas**. *67th Annual Meeting of the APS Division of Plasma Physics*, Long Beach, CA, USA (Nov 2025 - Planned)

- [P.2] **S. J. Lee, J. B. Cho, O. Nelson, C. Paz-Soldan, J.-K. Park. (2025). Kinetic stability of negative-triangularity plasmas.** *29th Workshop on MHD Stability Control*, Princeton, New Jersey, USA (Jul 2025)
- [P.3] **S. J. Lee, J.-K. Park, H.S. Yun, L. Jung, G. W. Nam, G. G. Seo, J. M. Lee (2025). Standardized Data Infrastructure for Tokamak: Implementation in VEST (Versatile Experiment spherical tokamak).** *2025 Spring meeting of the Korean Physics Society*, Seoul, Korea (Apr 2025)
- [P.4] **S. J. Lee, H.S. Yun, Laurent Jung, Jung-Hwa Kim, Y.S. Hwang (2024). Improvements of database system and analysis suite in VEST.** *3rd International Fusion and Plasma conference (IFPC)*, Seoul, Korea (Jun 2024)

PROJECTS & AWARDS

Perturbed Equilibrium Code Hackathon – Columbia Fusion Research Center

Jul 2025

Tools: Julia, Fortran, GPEC (reference), Plasma Physics Modeling

Columbia, NY, USA [🌐]

- Participated in a hackathon to reproduce DCON's energy-principle-based ideal MHD stability solver in Julia
- Developed coordinate transformation and numerical routines to compute mode stability from tokamak equilibrium

High-Performance CUDA Programming Project – Accelerator Programming Summer School

Jun 2024

Tools: CUDA, NVIDIA GPU, Nsight, C++

- Implemented parallel programs in CUDA/C++ for high-throughput computation
- Analyzed performance using Nsight Systems, identifying bottlenecks in memory access and execution flow

Text-to-Image Generation with Conditional GAN, 2023 OUTTA Deep Learning Bootcamp

Jun 2023 – Aug 2023

Tools: PyTorch, Conditional GAN, Google Colab

2nd Prize Winner

- Built a text-to-image generation model using conditional GAN architecture and Ranked 2 out of 60 teams

TEACHING EXPERIENCE

Teaching Assistant, Computer Architecture — Seoul National University

Fall 2025

VOLUNTEER EXPERIENCE

Home Renovation Volunteer, Habitat for Humanity Korea (Snuhabitat)

Sep 2021 – Feb 2022

Animal Shelter Volunteer, Tail – SNU (@tail_snu)

Mar 2022 – Aug 2023

SKILLS & ADDITIONAL INFORMATIONS

- **Programming Languages:** Python, C/C++, Fortran, Julia, Java, Linux, CUDA, MATLAB, OpenCL, MPI, OpenMP
- **Simulation Tools:** DCON, GPEC, BALOO, KineticEFITtime
- **TOEFL iBT MyBestScore:** 105/120 (Reading 27, Listening 28, Speaking 27, Writing 23)
- **Relevant Coursework** Fusion Plasma Theory(Graduate), Introduction to Nuclear Fusion, Electricity and Magnetism, Thermal and Statistical Physics, Scalable High-Performance Computing(Graduate), Introduction to Numerical Analysis, Introduction to Machine Learning, Introduction to Deep Learning,