

# Sunjae Lee

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## RESEARCH INTERESTS

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

## EDUCATION

<b>Seoul National University</b> <i>College of Liberal Studies</i>	<i>Mar 2021 – Feb 2026 (Expected)</i> Seoul, Korea
◦ B.S. in <b>Computer Science &amp; Engineering</b> and in <b>Physics</b> ◦ <b>Relevant Coursework:</b> Fusion Plasma Theory (Grad); Intro to Nuclear Fusion; E&M; Thermal & Stat. Physics; Mathematical Methods of Physics; Scalable HPC (Grad); Numerical Analysis; Intro to ML; Deep Learning	

## RESEARCH EXPERIENCES

<b>Dept. of Nuclear Engineering, Seoul National University</b> <i>Undergraduate Research Intern, 3DST Lab</i>	<i>Sep 2024 – Present</i> Seoul, Korea
<b>3 Dimensional Stellarator &amp; Tokamak Lab - Advisor: Prof. Jong-Kyu Park</b>	
◦ Conducted stability analysis of NT using ideal, drift-kinetic, and kinetic MHD models with DCON ◦ Identified a second-stability region of the $n = 1$ in DIII-D NT and analyzed the effect of magnetic shear ◦ Simulated edge ballooning mode near the second stability region using BALOO	
<b>Princeton Plasma Physics Laboratory (PPPL)</b> <i>Research Student, SNU-PPPL Summer Collaboration</i>	<i>Jul 2025 – Aug 2025</i> Princeton, NJ, USA
◦ Participated in the PPPL-SNU Summer Research Collaboration, focusing on nonlinear 3D 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	
<b>Dept. of Nuclear Engineering, Seoul National University</b> <i>Undergraduate Research Intern, NUPLEX Lab</i>	<i>Sep 2023 – Aug 2024</i> Seoul, Korea
<b>Seoul National University Plasma &amp; Ion Beam Laboratory - Advisor: Prof. Y. S. Hwang</b>	
◦ Designed and implemented a database for the VEST using the IMAS-HSDS data architecture ◦ Developed a post-processing tool (VAFT) for automated analysis of experimental diagnostic shot data ◦ Explored operational space for the first time, identifying performance limits from current-driven instabilities	

## PUBLICATIONS

*J: Journal, C: Conference*

- [J.1] Hong-Sik Yun<sup>†</sup>, Sunjae Lee<sup>†</sup>, 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*, DOI:10.1088/1361-6587/ae1b6a

<sup>†</sup> 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

### 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 linear stability analysis from tokamak equilibrium

### High-Performance CUDA Programming Project – Accelerator Programming Summer School

Jun 2024

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

Seoul, Korea

- 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

Seoul, Korea

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

## TEACHING EXPERIENCE

### Teaching Assistant, Computer Architecture — SNU

Fall 2025

## LEADERSHIP & VOLUNTEER EXPERIENCES

### Vice President, Sorijigi (Classical Music Listening Club) – SNU

Mar 2023 – Present

### Volunteer, Habitat for Humanity Korea (Snuhabitat) – SNU

Sep 2022 – Present

### Volunteer, Tail – SNU

Mar 2022 – Dec 2023

## SKILLS & ADDITIONAL INFORMATIONS

- **Programming Languages:** Python, C/C++, Fortran, Julia, Linux, CUDA, MATLAB, OpenCL, MPI, OpenMP
- **Simulation Tools:** DCON, GPEC, BALOO, KineticEFITtime
- **TOEFL MyBestScore:** 105/120 (Reading 27, Listening 28, Speaking 27, Writing 23)