

Plasma and Fusion Sciences Division

Advancing plasma science and contributing to the creation of a sustainable world through fusion energy development and reactive plasma application

This Area will focus on fusion energy development to address common challenges facing humanity, namely, securing sustainable energy and reducing greenhouse gases (GHG) emissions, while also pursuing research on carbon-negative plasma chemistry and plasma agriculture to harness plasma reactivity.

By jointly using the world's largest tandem-mirror device, which achieved an ion temperature of 100 million degrees (required for a $D-T$ thermonuclear fusion reactor at the end of the 20th century), and a high-magnetic-field linear device based on superconducting coils, this Area will pursue higher-density plasmas, deepen our understanding of the physical behavior of $D-T$ thermonuclear fusion reactor divertors, develop millimeter-wave and radio-frequency plasma heating methods for ultrahigh temperatures, and develop advanced plasma diagnostic methods, thereby leading the realization of fusion power generation.

Additionally, this Area will pursue interdisciplinary research by leveraging insights into plasma reactivity gained through our on-going research, with the aim of becoming one of the world's core centers for comprehensive plasma and fusion science.

Area Overview and Mission

World's Largest Tandem-Mirror Device



GAMMA 10/PDX

High-Power Gyrotron for Electron Heating



High-Magnetic-Field Linear Plasma Device



Pilot GAMMA PDX-SC

Research on Fusion Energy Development

- ✓ Taking advantage of the unique capabilities of the world's largest linear plasma device, this Area will conduct experimental, theoretical, and simulation research on divertors for $D-T$ thermonuclear fusion reactors and on advanced fusion.
- ✓ This Area will develop plasma-heating methods for increasing plasma temperatures to those required for fusion reactions and advanced plasma diagnostic methods for measuring plasmas at temperatures exceeding 100 million degrees.

Deepening and Advancing Research Using Advanced Devices

Expanding Interdisciplinary Research Based on Accumulated Insights

Applied Research Using Plasma Technology

- ✓ This Area will develop carbon-negative chemical-synthesis methods using low-temperature plasma technology and insights gained from fusion energy development.
- ✓ Using near-atmospheric-pressure, thermally non-equilibrium plasmas, this Area will promote crop growth and yield and establish the underlying scientific principles.

Mission

- Fusion Energy Development to Address Global Energy and Global Warming Challenges
- Pioneer Advanced Plasma Chemistry and Plasma Agriculture by Harnessing Plasma Reactivity

Area Members (Research Fields)

Haruhiko Himura (Plasma Physics; Plasma Applications)
Mizuki Sakamoto (Divertors; Plasma-Wall Interactions)
Masayuki Yoshikawa (Advanced Plasma Diagnostics)
Naomichi Ezumi (Plasma Sources; Divertor Development)
Ryutaro Minami (Millimeter-Wave Plasmas; Electron Heating in Plasmas)
Mafumi Hirata (Radio-Frequency Plasmas; Ion Heating in Plasmas)
Junko Kohagura (Advanced Plasma Diagnostics)
Tomoharu Numakura (Plasma Physics)
Satoshi Togo (Theory and Simulation)
Dogyun Hwangbo (Plasma-Material Interactions)

Selected Recent Research Topics

MEXT Project for the Development of Infrastructure for a Fusion DEMO Reactor (QST-Commissioned Research)
"Investigation of a Steady-State High-Density Plasma Experimental Device" (FY2024 and FY2025)

Special Joint Research Program (Kyoto Fusioneering Ltd.)
"Joint Research Program on Gyrotron Performance Enhancement" (FY2024–FY2026)

Program for the Formation of Joint Usage/Research Systems (FY2025–)
Program for the Formation of Interdisciplinary Frontier Hubs
"Interdisciplinary Frontier Hub for Low-Temperature Plasma Science and Genetics to Enhance Global Resilience"