

10. Platform Management Office

As an inter-university research institute, the National Institute for Fusion Science (NIFS) provides research equipment, including extensive facilities such as the Large Helical Device (LHD) and the Plasma Simulator, for shared use and conducts collaborative research with domestic and international universities and research institutes. The Platform Management Office, which comprises three sections: the Large Helical Device (LHD), Computer, and Engineering Facilities, was established in FY2023 to manage and operate the research facilities at NIFS.

In 2024, with the support of a supplementary budget for promoting research and development toward the realization of fusion energy, we were able to launch projects for high-temperature plasma experiments and a fusion energy nano platform. Regarding the high-temperature plasma experiments, we have begun work on refurbishment of the Compact Helical System (CHS), which was shut down in 2006. We aim to initiate plasma experiments in FY2026 with the Compact Helical Device (CHD), a new high-temperature plasma experimental device. This device will undergo refurbishment and be equipped with advanced diagnostics instruments, enabling a wide range of collaborative research that will serve as a foundation for high-temperature plasma research as a follow-on to the LHD. The core research theme is the “Micro-Collective Phenomena of Ultra-High Temperature Plasma and Fusion Science,” as listed in the MEXT Roadmap 2023. We will further develop the advanced plasma measurement techniques cultivated in the LHD project to establish a system for high-performance plasma experiments. Regarding the fusion energy nano platform, we will enhance our capabilities as a collaborative research core for plasma-wall interactions in fusion science by building a group of nanoscale material analysis devices, including high-performance transmission electron microscopes and a focused ion-beam processing facility, and will expand this knowledge into other fields.

LHD Section

In the 2024 fiscal year, the second year of the three-year Academic Research Platform project, the 25th cycle experiment campaign continued until 20 June 2024. Based on 165 experimental proposals submitted by both domestic and international collaborators from 33 institutions, we have conducted interdisciplinary research on the main theme of the Academic Research Platform LHD project and promote the publication of its data. Some of the research results are documented in Units’ research reports, so please refer to them.

In addition, as a means for the removal of tritium generated during the deuterium experiment campaigns, we have carried out a complete replacement of 3,000 carbon tiles installed inside the vacuum vessel during the maintenance period after the 25th cycle experiment campaign. The replacement ensures that the LHD, which will shut down plasma experiments at the end of the fiscal year 2025, can be safely shut down and stored for the long term.

(R. Sakamoto)

Computer Section

The Computer Section is composed of the Plasma Simulator, Database, and Data Analysis Equipment Task Groups (TGs).

The Plasma Simulator “Raijin” is a massively parallel supercomputer system utilized to promote academic simulation research on nuclear fusion science and to support research and development that can contribute to progress in simulation science. The Plasma Simulator “Raijin” consists of 540 computers, each of which is equipped with one scalar processor for controlling the system and eight “Vector Engine” accelerators for high-

speed computing. The 540 computers are connected to each other by a high-speed interconnected network. The computational performance of the system with Vector Engines is 10.5 petaflops. The capacities of the main memory and the external storage system are 202 terabytes and 32.1 petabytes, respectively. The supercomputer system is capable of large-scale simulation of fusion and other complex plasma phenomena. The Plasma Simulator was operated for 353 days and supplied 37 million VE hours of computational time to 83 subjects and 258 users in FY2024. The Plasma Simulator TG provides comprehensive support for the Plasma Simulator, including operation scheduling, maintenance, user simulation code development, code execution, and additional services.

The Database TG provides the NIFS Atomic and Molecular Numerical Database at <http://dbshino.nifs.ac.jp/> for researchers worldwide, which contains numerical data, such as cross-sections, for collision processes between electrons, atoms, and molecules in plasmas. The number of stored data, which totals 1,767,381 as of 1 April 2025, increased from 1,765,059 (4 April 2024) and is the largest among databases of collision cross-sections provided worldwide. Many researchers access the data in our database for their work. We are also making databases, e.g., the Atomic Data and Analysis Structure (ADAS), available for domestic collaborators, which are provided under international collaboration.

The Data Analysis Equipment TG operates the experiment data acquisition and analysis system, the SNET fusion research collaboration network, and the CompleXcope immersive virtual reality system. The experiment data system accumulates over 3 petabytes of diagnostic and analyzed data from NIFS LHD, CHS, and other universities' devices via SNET. The entire 2 petabytes of compressed LHD data are openly accessible to anyone, together with hundreds of analysis programs, device operation parameters, and related documents such as experiment proposals and summary reports, to constitute the "Plasma and Fusion Cloud." It is expected to be used for fusion energy developments and for multi-disciplinary data-driven sciences to promote the "Open Science" of nuclear fusion research. These data have been registered with Digital Object Identifiers (DOIs) to make them FAIR (Findable, Accessible, Interoperable, Reusable), and as of December 2024, we have achieved the world's first registration of ten million DOIs for research data. CompleXcope and a head-mount display (HMD) enable us to enter 3-D data space and observe plasma from various directions to study its complex structures. Omnidirectional images and 3D models of the LHD building have been created for display on HMDs and implemented in VRiderCOMMS to enable multi-user access within a shared VR space. We have also created 3D scan images of the CHS device and begun researching a way to utilize point cloud data in an HMD. Work is ongoing to port the CompleXcope software to HMDs, with the aim of establishing it as a future research platform.

(Y. Todo, H. Miura, I. Murakami and H. Nakanishi)

Engineering Facilities Section

The Engineering Facilities Section has managed experimental facilities in the Plasma Diagnostics Laboratories, the Superconducting Magnet System Laboratory, the Fusion Engineering Research Laboratory, the R&D Laboratories, and the radiation-controlled area in the LHD building. A task group was assigned to each laboratory building to coordinate the experiment days and laboratory usage. From FY2023, users have been responsible for the electricity charges used in experiments, and a usage fee has been set for the main experimental facilities. Users must report time or power usage to the office of the Engineering Facilities Section every month. To maintain the common areas and safety equipment of the buildings, each laboratory building is allocated an annual budget equivalent to 15 to 20 kW of electricity.

In 2024, the framework for the paid use of the platform has been modified to allow broader utilization by private companies, not only for profit-making activities but also for academic research and other purposes.

(S. Imagawa)