(1) Study of Deuterium Experiment Program in LHD

To achieve the higher performance plasma and to confirm technical advantages of LHD for designing the future economical steady state helical type reactor, NIFS has been making preparation for an experiment program using deuterium. Since a framework for the preparation was set up in 2005, various activities aimed for the Agreement for Environmental Conservation with local government bodies was carried out. The Safety Assessment Committee of NIFS Deuterium Experiment consisting of outside members only issued a final report in 2007 and the report evaluated The Measures for Safety of LHD Deuterium Experiment is considered reasonable and proper. On March 11th, 2011, the Great East Japan Earthquake and the Fukushima No.1 nuclear power plant accident were happened. After the nuclear accident, the Safety Assessment Committee revalued the reexamined Measures for Safety of LHD Deuterium Experiment from Dec. 2011 to Jan.2012. The committee reported the reexamined measures are also reasonable and proper in Feb. 2012 again.

Recently achievement of high ion temperature, high beta and very high density plasma and steady state operation shows the realistic design base for economical helical fusion reactor. The extensive study of the experiment program was conducted by incorporating a wide range of views from the university researchers through workshops and coordination research.

A major issue of the deuterium experiment is to build up the more reliable model which foresees future reactor design using the heliotron configuration. In the design data base, the definition of mass-dependency (isotope effect) with high accuracy is the most important physics issues. As a result of recent progress of high performance in plasma experiments such as the high ion temperature mode plasma with impurity hall and the super dense core plasma with internal density barrier, deliberating future experiment program is greatly significant.

For the deuterium experiment, following issues have been taken up and examined:

1. Plasma confinement characteristics of deuterium plasma.
2. Upgrade of LHD magnetic confinement device with closed diverter configuration.
3. Enhancements of plasma heating devices and diagnostic devices
4. Estimation of shielding effect for neutrons
5. Required electric power supply and controlling devices

A workshop was held in order to discuss the feasibility and the validity of deuterium experiment in LHD on March 22nd. Approximately, 35 researchers from universities and 50 from NIFS attended this workshop. On the first session, recent experimental results on following topics are reported by NIFS members:

- Achievement of high ion temperature discharges on LHD and their confinement properties
- Initial operation of closed helical diverter system and its performance

In the second and third section, three outside researchers and three NIFS researchers gave talks on following topics:

- Current status of JT-60U disassembly and plan for JT-60SA
- Tritium removal system for deuterium plasma facilities
- Development of accurate neutron measurement system for fusion plasma experiment
- Application of deuterium plasma experiment to the study of fusion-fuel recycling and retention
- Behavior of hydrogen isotopes in the plasma facing components
- Simulation study of hydrogen isotope injection into carbon materials

Statements and comments made for each topic were invaluable and fruitful. A strong demand for realizing LHD deuterium experiment was expressed from researchers in universities.

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