

### 1-3. Study of Deuterium Experiment Program in LHD

In order to improve plasma parameters and to confirm technical advantages of LHD to design the future economical 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 were 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 is considered reasonable and proper.

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 a 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 divertor 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

Including above issues, a workshop was held aimed to have a discussion to enhance the validity and feasibility of the deuterium experiments in LHD.

The workshop was held on 15th January and approximately 35 researchers from universities and 60 from NIFS attended. On the first session, following reports are presented by NIFS members in charge and discussed.

- High density plasma performance and the effect of deuterium plasma in LHD
- Recent results of potential measurement by HIBP and the prospect to deuterium experiment
- Edge impurity transport study in LHD
- Research of high energy particle confinement and prospect to deuterium experiment
- Effect of ion mass to neoclassical transport analysis
- New ICRF heating antenna design in LHD
- Simulation analysis and construction of closed divertor structure in LHD vacuum chamber
- Technology of measurement and removal of trace amount of tritium
- Neutronic analysis on helical type reactor

In the second session, three outside researchers presented two research tasks which supported by the Grant-in-Aid for Scientific Research on Priority Areas which closed last year, and one simulation study.

- Task of Advanced Diagnostics for Burning Plasma of Priority Area and deuterium experiment in LHD
- Task of Tritium Science and Technology for Fusion Reactor of the Priority Area
- Simulation study of D-D reaction plasma heated by NBI and ICRF

Invaluable statements and comments were made for each issue, which made a significant fruitful workshop. Opinions that the collaborative works in universities should be best use for the deuterium experiment in LHD are expressed.

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