stellarator news

Published by Fusion Energy Division, Oak Ridge National Laboratory
Building 9201-2 P.O. Box 2009 Oak Ridge, TN 37831-8071, USA

Editor: James A. Rome Issue 74 March 2001
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On the Web at http://www.ornl.gov/fed/stelnews

The fourth LHD experimental campaign

The fourth experimental campaign of the Large Helical Device (LHD) program, which started on 3 October 2000, ended on 16 February 2001. The main objective in this experimental campaign was the development of a physical understanding of large, net current–free plasmas, in addition to the improvement of plasma parameters. The magnetic axis position R_{ax}, the toroidally averaged ellipticity κ, and the aspect ratio A_p have been scanned for 3.5 m ≤ R_{ax} ≤ 4.0 m, 0.88 ≤ κ ≤ 1.17, and 5.8 ≤ A_p ≤ 7.1. These investigations have highlighted the effects of magnetic well and shear, the orbits of high-energy particles, and neoclassical transport. An externally applied m/n = 1/1 perturbation field has also enabled us to investigate the response of plasmas to magnetic islands. An inward-shifted configuration with R_{ax} = 3.6 m is the primary method used to obtain good plasma performance. This approach yielded a factor of 1.6 enhancement in the energy confinement time over the 1995 International Stellarator Scaling (ISS 95) in the third experimental campaign.

Neutral beam injection (NBI) is the main auxiliary heating mechanism, and a port-through power of 5.2 MW was achieved in the fourth experimental campaign. In addition, ion cyclotron radio-frequency (ICRF) power up to 2.7 MW was employed, and plasmas with a stored energy W_p of 0.24 MJ were sustained exclusively by ICRF at the moderate density of 1.7×10^{19} m^{-3}, demonstrating sufficient confinement of high-energy trapped particles.

We achieved $W_p > 1$ MJ by using a combination of 5 MW of NBI and 2 MW of ICRF. During this scan, a favorable dependence of energy confinement on density ($\tau_E \propto n_e^{0.6}$) was maintained for $n_e > 1 \times 10^{20}$ m^{-3}. Figure 1 shows W_p as a function of shot number, representing the progress in the LHD plasma performance. Large jumps in W_p in Fig. 1 correspond to the start of NBI experiments, the increase in the toroidal magnetic field B_t from 1.5 T to > 2.5 T, the adoption of the inward-shifted configuration, and so on. The low W_p values were obtained in the plasmas produced by electron cyclotron heating (ECH) alone. The highest W_p of 1.03 MJ was achieved using a pellet injector, which can inject a series of 5 hydrogen pellets at intervals of 1 ms to 1 h.

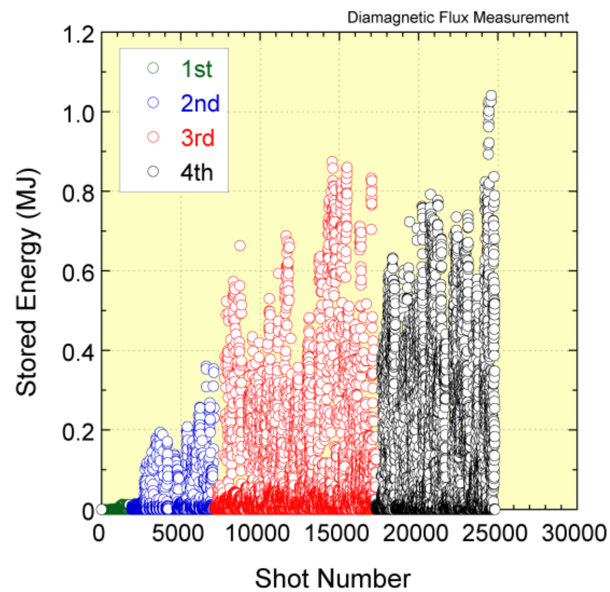

Fig. 1. Dependence of W_p on shot number, illustrating the progress in LHD plasma performance.

The volume-averaged beta ⟨β⟩, measured with a diamagnetic loop, has reached about 3.5% at B_t = 0.5 T. A Shafranov shift of about half the minor radius has been observed, which suggests that the equilibrium beta limit is being approached. No serious confinement degradation due to

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MHD activity has been observed, although an event that seems to be due to the density limit causes oscillation in W_p.

In long-pulse operation, which is one of the main themes of the LHD project, we have made great progress in that plasmas could be sustained for 2 min by 0.5 MW of ICRF.

Construction of the vacuum pumping system for the local island divertor (LID) was completed in September 2000. This system, which has eight cryogenic pumps with pumping speed of 42,000 l/s (H2) and one turbomolecular pump with pumping speed of 5,000 l/s, has been used during the fourth experimental campaign as a vacuum system. Figure 2 shows the LID vacuum pumping system, which is connected to the LHD by a gate valve with an inner diameter of 1.4 m, the largest in the world among fusion devices. The LID pumping system proved to be very useful in shortening the interval between NBI discharges, reducing the time needed to produce an NBI plasma from 9–12 min (during the third experimental campaign) to 3 min.

A significant increase in the power of the heating devices is planned. Hence, further improvement of plasma parameters and performance is expected in the next experimental campaign.

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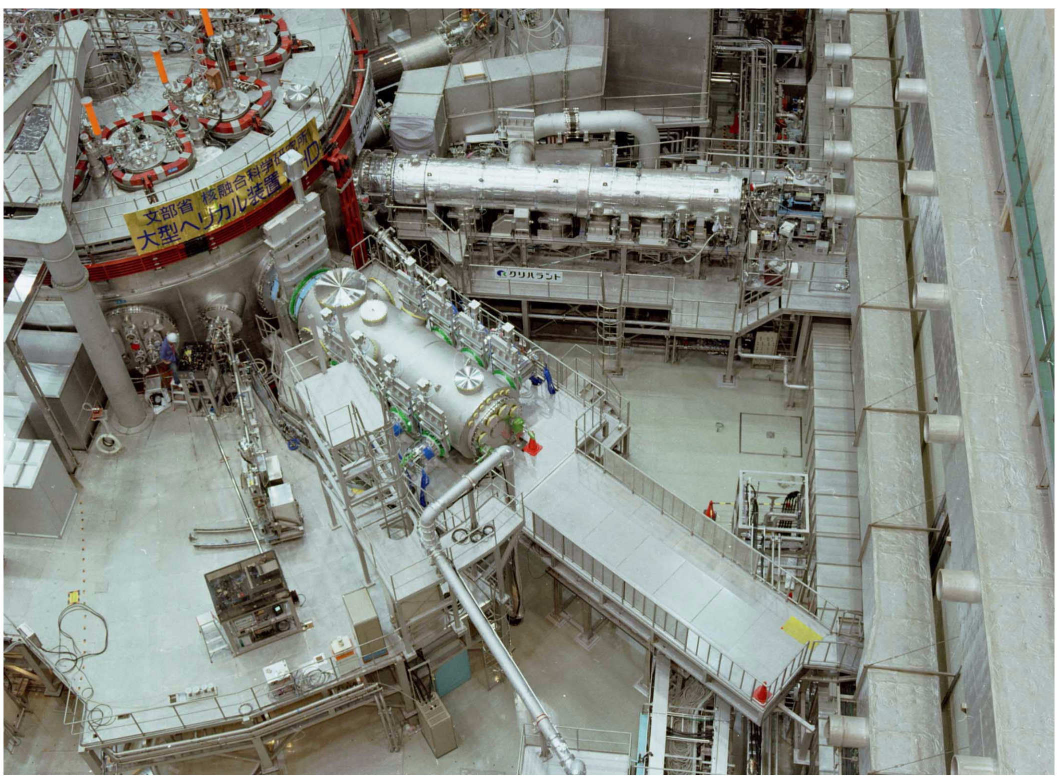

Fig. 2. Vacuum pumping system of the LID, shown in the center of photograph.

First announcement
13th International Stellarator Workshop

24-28 September 2001

We are pleased to communicate preliminary details for the 13th International Stellarator Workshop, to be held in Canberra, Australia from 24–28 September 2001. The topic of the workshop will be research on fusion plasma confinement in stellarator, heliotron, and related toroidal confinement geometries.

The conference is being organized by the Plasma Research Laboratory in the Research School of Physical Sciences and Engineering (RSPSE) at the Australian National University (ANU), and will be chaired by Prof. Jeffrey Harris. The conference venue will be the Huxley Lecture Theatre of the ANU

Workshop Fee

The Workshop fee will be $A500 (with a reduced rate of $A350 for students). This includes lunches during the conference, and the conference banquet, to be held in Old Parliament House, the seat of Australian Government from 1927 until 1988, when the new Parliament House was opened.

Registration Deadline

The closing date for receipt of the registration fee will be announced on the www site which will be available from 15 February 2001.

Abstract Deadline

The deadline for abstracts is 1 June 2001.   A call for abstracts and more detailed information concerning the Workshop will be available from 15 February, 2001 at http://www.rsphysse.anu.edu.au/admin/stellarator

Accommodation

Blocks of rooms have been reserved at University House, and Burgmann College, both located on the Australian National University campus. University House is a 5-minute walk from the conference venue, with an estimated price of A$100 per night for a single room, Burgmann College, a Student Hall of Residence is a 10-minute walk to the conference venue, with a daily bed and breakfast rate (inclusive of GST) of A$35.20 for students and A$48 for non-students. Other hotel accommodations are available in the city of Canberra.

As of 15 January, 2001, $A 1.00 is approximately equal to US$0.55.

Canberra can be reached most easily by air via Sydney or Melbourne, with a transfer to a domestic connection on QANTAS, Ansett, or Impulse airlines. Canberra is about a 3 hour drive from Sydney International Airport.

Expression of Interest

As an aid to determining approximate attendance, we request that prospective attendees send their contact details as below by e-mail or fax to the Conference Organizer, helen.hawes@anu.edu.au

Full Name:

Affiliation:

Street Address:

City State/Zip Code:

Country:

Telephone:

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E-mail address:

Student:?

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