stellarator news

Published by Fusion Energy Division, Oak Ridge National Laboratory
Building 5700 P.O. Box 2008 Oak Ridge, TN 37831-6169, USA

Editor: James A. Rome Issue 131 April 2011
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On the Web at *http://www.ornl.gov/sci/fed/stelnews*

Coordinated Working Group Meeting for Stellarator-Heliotron Research

About 30 local and 10 remote attendees (from IPP Greifswald, CIEMAT, and Kharkov, see Fig. 1) participated in the Coordinated Working Group Meeting (CWGM8.0). The meeting was held March 16–17, 2011, at the National Institute for Fusion Science (NIFS) in Toki, Japan. Originally, it was planned to have more foreign participants on site with more extensive face-to-face discussions, as had been done at past meetings. However, this was impossible due to the sequence of tragic events triggered by the huge earthquake that occurred on March 11. Consequently, some sessions originally planned for this meeting, such as Validation of Transport Models and Joint Experiments, were postponed, and some sessions were shortened. As a result, the CWGM8.0 became a supplementary meeting to a more complete CWGM8 (say, 8.1) to be held in the near future.

The meeting was composed of six sessions including the Opening, in which a welcome address was given and the highlights of LHD's 14th campaign and the schedule for the 15th campaign were reported, along with a call for joint experiments utilizing LHD (by Prof. H.Yamada).

In the Magnetic Topology session, a model for the interaction between poloidal flow and magnetic islands was presented and applied to interpret the experimental findings in LHD (growth/healing). Some of the experts on this issue (mainly theoreticians) at NIFS also joined in wide-ranging discussions. Also reported was a biasing experiment performed in the Tohoku University Heliac (TU-Heliac) to actively investigate the impact of magnetic islands at the edge as a drag term on the poloidal rotation.

H-mode issues were discussed along with experimental observations in LHD ("Edge transport barrier formation in stochastic region") and TJ-II ("Signature of turbulence spreading during the H-L back transition"). Also reported was an attempt at equilibrium reconstruction for H-mode discharges in W7-AS, by using VMEC2000/diagno. Equilibrium reconstruction (including a stochastic region) will enable us to more accurately investigate the role of neoclassical ambipolar radial electric field as a "bias" to H-mode in helical plasmas, which has been continuously discussed in CWGM collaborations.

The Database Issues session comprised a discussion of a joint paper for the coming EPS meeting, on "Discriminant analysis on International Stellarator-Heliotron Confinement DataBase (ISH-CDB)," to identify the variable causing clustering in the global energy confinement data. The status and progress of the Profile Database (ISH-PDB) were also reported, with remarks on the fast-growing edge turbulence database, requests to update data for high-beta discharges, the recent inclusion of HSX-CERC data, and so on. How to store the equilibrium data (corresponding to registered profile data) has been under discussion, and it was agreed to require authentication for access. An example of this scheme has been prepared for a registered W7-AS high-beta discharge, and we discussed how to notify

In this issue . . .

Coordinated Working Group Meeting (CWGM8.0) for Stellarator-Heliotron Research
Owing to the massive earthquake in Japan on 11 March, an abbreviated (and partially virtual) CWGM meeting was held in Toki, Japan. A summary of the sessions is provided. 1

The earthquake effects in Japanese fusion laboratories
The effects of the earthquake on Japanese fusion research are presented in this brief report. 3

In memoriam: Horst Wobig
On 18 March 2011, Dr. Horst Wobig passed away. He died amidst his family. Dr. Wobig was always a very industrious person and actively pursued scientific research until the very end of his life. He was talented in many fields including music, and he was a valued friend to many. 3

colleagues to generate interest in using PDB for a joint activity.

The contribution to ITPA from Stellarator-Heliotrons (S-H) was also discussed in three dimensions in the ITPA session. In the last ITPA Transport and Confinement (T&C) topical group meeting (Seoul, after IAEA-FEC 2010), contributions, on H-mode, impurity, and flow issues, were made that originated from discussions at the 7th CWGM. S-H representatives in T&C (C. Hidalgo, A. Dinklage, and K. Tanaka) have had discussions to determine the possible contributor list, and to collect any ideas from S-H colleagues. It was pointed out in the CWGM8.0 discussion that linkages with ITPA Energetic Particles (EP) and Edge and Pedestal topical groups have already been established, even forming joint activities. Currently, two contributions to the coming T&C meeting (April 2011 in San Diego) are planned: (1) profile dynamics, flows, and confinement in tokamaks and stellarators (C. Hidalgo), and (2) turbulence and transport in ELMy and ELM-free H-mode in LHD and comparison with tokamaks (K. Tanaka).

It should be noted that an EP session was initiated at CWGM8.0. Alfvén eigenmode (AE) studies in LHD, TJ-II, and Heliotron J were reported with emphasis on AE-induced EP transport and EP-induced MHD instabilities. These studies are based on extensive joint experiments among these three devices. The possibility of establishing an AE-database was mentioned, with efforts in the meantime to examine similarities/differences to ongoing MHD databases.

The MHD Documentation Database (MDDB) at
http://h1nf.anu.edu.au/collaborate/mddb/
was discussed. It was recommended that AE members contact MHD database collaborators. The NB-blip experiment in LHD was introduced as a tool for investigating energetic ion confinement. Simulation studies such as an investigation of EP transport due to AE and code benchmarking activity on AE growth rate and on the impact of re-entering particles on NBI heating efficiency and its comparison to LHD experiment were also reported. During the session, quite extensive and wide-ranging collaboration opportunities were identified as a basis for joint activities. It was also mentioned that two ITPA joint experiments have been already started, and one more will start soon.

During the meeting, participants agreed to facilitate joint activities within the working groups through occasional follow-up video conferences.

The presented materials along with session summaries and action plans are available at
http://ishcdb.nifs.ac.jp/cwgm8.html.

Plans for a subsequent meeting (CWGM8.1) will be announced in *Stellarator News*.

All of the CWGM8.0 participants acknowledge Mr. R. Klatt (IPP-Greifswald) for his kind support in making the video conference work smoothly. CWGM8.0 is partly supported by NIFS and the National Institutes of Natural Sciences under the project, "Promotion of the International Collaborative Research Network Formation."

Fig. 1. The meeting live (top) and as displayed to remote participants (bottom).

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CWGM8.0

The earthquake effects in Japanese fusion laboratories

In Japan, we had an enormous earthquake on March 11. Some fusion plasma laboratories in Japan had damages to hardware but fortunately I have not heard any report of any personal injuries at these laboratories. The laboratory closest to the seismic center is the Tohoku University Heliac lab in Sendai city. Although the device itself stands safely, a big capacitor bank slipped down from its insulators. Staff are checking the equipment piece by piece, including the precise positioning of the toroidal coils. After the earthquake, people in Sendai city had a hard time with outages and shortages of electricity, water, gasoline, etc. for about two weeks. The conditions are now gradually improving.

The Naka site of JAEA home of the JT-60U laboratory, also had strong shocks. I heard that the big hardware equipment is safe but there was some damage to the buildings and equipment in the offices. They are examining damage points carefully. In the city, there was damage to the road and it is difficult to obtain some basic necessities of life. The recovery is quicker than Sendai because Naka is farther from the seismic center.

Other stellarator laboratories in the western part of Japan (e.g., LHD at NIFS and Kyoto Heliotron J), including the Tokyo area, suffered almost no damage. The condition of city life is also normal. However, shortages of electric power in the Tokyo area are a big concern because of the loss of electric power generation from the Fukushima fission reactors and damages to some fossil power stations. Tokyo Electric Power Company started scheduled rolling blackouts in March. In April, we have no scheduled blackouts so far because of the warmer weather and the improved efforts of energy saving as well as gradual recovery of damaged power stations. However, we are anxious that the level of energy saving control will be enhanced in this summer, which may strongly affect the schedule of experimental plans in many research laboratories with big facilities.

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In memoriam: Horst Wobig

On 18 March 2011, Dr. Horst Wobig passed away. He died amidst his family. Dr. Wobig (Figs. 1 and 2) was always a very industrious person and actively pursued scientific research until the very end of his life. As long as it was physically possible for him, he regularly visited his office at IPP, where he continued to work discussing plasma-physics related issues with his colleagues, especially from the former Stellarator-System Study group. In the last months these contacts took place in his house in Neufahrn. Driven by his own curiosity, he pursued his rigorous and regular working style from his retirement in July 2002 onward until the beginning of this year. During this period, a number of publications and conference contributions were prepared and published.

To the members of the Stellarator System-Study group led by Dr. Wobig from 1996 onward, it was clear that the prolongation of his research activities, after his official retirement, was very important and fulfilling for him. At the same time, his colleagues became aware of the disease that plagued him during the last few years with increasing severity. The way Dr. Wobig coped with his disease characterizes his way of life and approach to personal problems. He made no secret of the fact that he was suffering from a progressive form of nerve-transmission inhibition and muscular degeneration.

Familiarizing himself with the literature available on his illness, he learned that much subsequent work was based a 1952 publication by Hodgkin and Huxley on the propagation of voltage pulses in an electrolytic environment. As a plasma physicist, he re-investigated the propagation of nerve pulses and found areas in which this seminal work could possibly be improved. This resulted in a scientific IPP report which is being prepared for further publication. It was characteristic of Dr. Wobig that he engaged himself intensively in applying his own intellectual capabilities to the practicable advancement of another scientific discipline. This should be mentioned, even if his enquiry was driven in part by concerns about his personal health.

Let us give a brief summary of his early vitae here.

Horst Wobig began research after graduating in 1963 with a diploma in theoretical physics at the University of Munich. In February 1964 he became a scientist at the

Max-Planck-Institute for Physics and Astrophysics in Munich and studied theta pinches in toroidal field geometry. In the same year he became a member of IPP and worked till 1971 as a theoretician in the theory division of IPP headed by Prof. Arnulf Schlüter. Horst Wobig wrote his PhD thesis "Equilibrium and Stability of a Plasma with Surface Currents" in 1965, supervised by Prof. Schlüter and Prof. F. Bopp.

During his sojourn as a visiting scientist at Princeton Plasma Physics Laboratory (PPPL) in Princeton NJ, in 1968 and 1969, he came into contact with the U.S.A. stellarator program, the field that occupied him from then on and in which he made his most important contributions. There is hardly any topic that he did not tackle in his long and fruitful research career after 1971, when he moved to the experimental stellarator division headed by Prof. G. Grieger. He worked on questions relating to plasma equilibrium, stability, neoclassical and turbulent transport in confinement configurations, and edge plasma behavior. In addition, he was intensively involved in the definition phase of Wendelstein 7-AS, Wendelstein 7-X, and somewhat later also as a leading scientist in conceptual design studies of the Helias fusion reactor.

Dr. Wobig took a special interest in the Hamiltonian relations of the magnetic field and its perturbations. This line of research also had historical implications, because magnetic resonances, internal fluctuations, and external field perturbations play an important role in particular for the Wendelstein stellarator line with its low magnetic shear. Perhaps he already saw and grasped this at PPPL while working to understand the unexpectedly low confinement properties of the C-stellarator.

Besides being an outstanding theoretician, he was also interested in and endowed with a feeling for experimental results and, of course, their interpretation. He participated with great zest and commitment in the experimental development of the Wendelstein stellarators and enriched the experimental work with his theoretical analyses and contributions. In view of his continuous attention to the experimental work, it is no surprise that he came up with quite a few practical suggestions, the most important of these being the modularization of the helical coils. His name is linked with this concept, the Wobig-Rehker coils, which was first published in the *Proceedings of the Symposium on Fusion Technology* in October 1972. The modular coil structure opened the way to improving large-scale stellarator devices and is an indispensable tool when it comes to steady-state fusion reactors.

Fig. 1. Horst Wobig.

Horst Wobig was multitalented. He worked as a creative scientist who figured out and promoted his own important topics and research areas. He was, however, also active as a project head and manager of a large team and, when needed, as acting division head. He was able to handle whatever came his way. His colleagues and those working around him were aware of his great teaching talent. This was his other professional passion, which he pursued with great success. He taught at many summer schools and also in seminars run by the Technical University of Munich. His contributions to seminars were a great asset for us when he explained complex situations and spontaneously clarified matters on the blackboard.

Horst Wobig's personality would be inadequately described if only his professional talents and abilities were mentioned. His friendliness and amiability were infectious. He was a physicist who saw the whole picture. He had no difficulty in connecting the physics of magnetic fields with the physics governing the orbits of asteroids, leading finally to the creation of the Noerdlinger Ries crater. His speeches on more festive and social occasions were often witty with a subtle sense of humour. His talent was well known to all, and attendance at particular events was often prompted less by the actual reason than by Wobig's presence and by what he made out of the occasion.

His musical gifts were legendary. Depending on the mood and on the instruments available, he could perform as a saxophonist and as a clarinetist, but he was also skilled with a mandolin or guitar.

Fig. 2. Horst in discussion with his colleagues.

Horst Wobig was a great colleague and an outstanding scientist who has left behind an indelible mark on the development of fusion energy. He was also an excellent teacher with an overall view of the unity of physics. For these contributions and for his friendship with many of us, he will be fondly remembered.

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