International Collaboration on Helical Fusion Research IEA Implementing Agreement for Cooperation in Development of the Stellarator-Heliotron Concept –

1 OVERVIEW

The world stellarator-heliotron community has been promoting international collaborations under the auspices of International Energy Agency (IEA) Implementing Agreement on "Development of the Stellarator-Heliotron Concept". The present participating countries in this agreement are Australia, Germany, Japan, Russia, Spain, Ukraine and U.S.A. The Stellarator-Heliotron Executive Committee conducts arrangement of collaboration and endorses proposed activities. The 42nd Stellarator-Heliotron Executive Committee was held in Padova (Italy) in conjunction with the 19th International Stellarator-Heliotron Workshop (joint with the 16th IEA RFP Workshop). NIFS hosts the web page of this activity at http://iea-shc.nifs.ac.jp/. The summary of international collaboration on fusion research among helical systems is given in the following sections.

2 19TH INTERNATIONAL STELLARATOR-HELIOTRON WORKSHOP (JOINT WITH 16TH IEA RFP WORKSHOP)

The 19th International Stellarator-Heliotron Workshop was held in Padova, Italy from 16 to 20 September, 2013, which is jointly organized with 16th IEA RFP Workshop.

The idea of this joint workshop was originated at the 41st Stellarator-Heliotron (SH) Executive Committee Meeting (at the Australian National University in 30 January, 2013). During that meeting, it was pointed out that RFP research had focused on recently-found appearance of three-dimensional structure at the core region, and it was suggested to promote mutual understandings and collaborations among Stellarator-Heliotrons (SH) and RFPs through joint workshop. Primary point of contacts is three-dimensional structure. This idea was also supported by RFP communities, to realize this joint workshop.

188 researchers from 13 countries participated and the total of 168 presentations were provided. This large number of participations and presentations is one of proofs of the success of this joint workshop.

The international program committee (IPC) for this joint workshop was formed as B.Blackwell (ANU, SH side) and M.E.Puiatti (RFX, RFP side) as co-chairs. The entire program (except detailed list of poster presentations) is attached below for reference.

Extensive efforts were made to form the workshop

program to effectively facilitate mutual understandings between SH and RFPs. One of such efforts was to implement introductory talks for both concepts at the beginning of workshop. IPC appointed the following 2 speakers for such an intention.

- H.Yamada (NIFS): "Alternative and Complementary Role of Stellarator-Heliotron and RFP towards Comprehensive Understanding from Configuration Zoology -- Remarks from Stellarator-Heliotron Studies --": Assessment of configuration optimization and performance extension through making full use of advantages of SH towards comprehensive and exact understanding of toroidal plasmas are emphasized. It is anticipated that SH as well as RFP make critical contributions to three-dimensional (3D) physics which is definitely required for tokamaks as well, and this joint workshop to be the touchstone.
- J.Sarff (UW-Madison): "Introduction to the RFP": Multi-configuration (from standard RFP to either current profile control or single-helicity self-organization (where 3D-sturucture becomes apparent)) research towards improved confinement in RFP is emphasized, along with the critical issues such as current sustainment and boundary control. It is anticipated this joint workshop to provide options for solving remaining difficult challenges for magnetic fusion through SH and RFP pairing.

These 2 introductory talks were followed by the complementary invited talk by C.Hegna (UW-Madison) on theoretical aspects; "Differences and Similarities in the 3D Physics of Stellarator-Heliotrons and Reversed Field Pinches". Several physics topics such as 3D equilibrium reconstruction, magnetic island dynamics, energetic ion confinement, impurities, micro-instabilities, divertor physics etc., are introduced complementarily from both SH and RFP. These consecutive 3 talks successfully establish bases for mutual understandings between SH and RFP, and then productive discussions throughout the joint workshop.

The workshop program was organized by topics-basis. The discussion time was allocated at the end of each topical session, so that the overall discussions, bridging SH and RFP beyond the individual presentation, could be enhanced. Among several physics topics, stochastic magnetic field (e.g., invited talk by K.Ida (NIFS)) and 3D equilibrium reconstruction (several practical applications of 3D equilibrium codes both to SH and RFP) were the most overlapping and extensively-discussed sessions.

Based on this successful joint workshop, it has been agreed between SH and RFP Executive Committees to maintain some topical-basis overlapping in the next individual workshop (both in 2015, SH in Germany and RFP in China).

3 JOINT ACTIVITY: COORDINATED WORKING GROUP MEETING (CWGM) FOR STELLARATOR-HELIOTRON STUDIES

During year 2013, two CWGMs (11th and 12th) were held to continuously facilitate the joint activities.

11th CWGM

The 11th Coordinated Working Group Meeting (CWGM11) was held from 11 to 13, Mar. 2013 at CIEMAT in Madrid, Spain. In addition to local participation, video-conference participation was made from (alphabetic order of country name) IPP-Greifswald (Germany), NIFS, Kyoto University (Japan), Kharkov (Ukraine), PPPL and University of Wisconsin-Madison (USA). The materials presented in the 11th CWGM are available at http://ishcdb.nifs.ac.jp/ and http://fusionwiki.ciemat.es/wiki/Coordinated_Working_Group (\rightarrow CWGM11) for those of you having further

interests. Below, you will find the overall summary of the meeting.

The meeting was opened by the welcome address from C. Hidalgo (CIEMAT), in which he mentioned the successful evolution of the CWGM activity for the promotion of the programmatic international collaboration towards systematic understandings, and for the contribution to the world-wide fusion development.

The meeting was composed of 10 sessions as follows:

Flows and viscosity

This session was launched at the previous CWGM (Greifswald, 6-8 June 2012). The evolution and this-year's plans among several helical devices were introduced. Simulation code Verification and Validation the (to be reported in coming International Stellarator-Heliotron Workshop [ISHW]) are underway utilizing experimental data from LHD, TJ-II, W7-AS and HSX. Extensions to the standard neoclassical assumptions, such as the non-local approach, the non mono-energetic treatment and the inclusion of $E \times B$ flow compressibility, will be emphasized owing to the capabilities of the FORTEC-3D code.

Bias experiments in four helical devices in Japan (Tohoku University Heliac, CHS, Heliotron-J [H-J] and LHD) were reviewed. It has been found that the required induced torque seems to increase as the effective ripple increases based on comparison among these devices. The international collaboration is valuable to extend the database. In this regard, the bias experiment in TJ-II on top of this report was discussed. It was pointed out that the "iota window" for H mode transitions in helical plasmas (observed in W7-AS, H-J and TJ-II) should be kept in mind as an extension of such bias experiment.

Isotope effect and multi-scale physics were considered based on experimental findings in TJ-II and TEXTOR. It was proposed to investigate the role of the symmetry properties of the magnetic field in HSX, where the possibility of performing deuterium plasma experiments will be considered. The isotope effect in regard to H mode power threshold has been one of the main issues in the ITPA, so that a link to ITPA activities is to be kept in mind.

<u>3D equilibrium</u>

The validation of HINT2 equilibrium calculations, which has been homework from the 10th CWGM, has progressed in the LHD. It has been systematically found that the effective boundary can be identified with the location of the maximum of the *E*r (radial electric field) shear (deduced from charge exchange spectroscopy). The peak position of field lines' connection length (HINT2) has been found to fit the peak position of the heat flux to divertor plates (measured by IR-camera in collaboration between IPP and NIFS). The plasma response to three-dimensional (3D) magnetic fields will be reported in the invited talk at the 2013 EPS conference (already approved).

Database issues

The extension of the ISHPDB (International Stellarator-Heliotron Profile Database) has been progressing, but some physics topics have had no contributions to the database. As for magnetic configuration data, a minimum set of VMEC-files has been registered. An interface should be available since VMEC-versions may differ from institution to institution.

The extension of the ISHCDB (Confinement Database) towards predictive scaling is mandatory from different size and shape devices and different operation/parameter regimes. An extended joint EPS2012 paper is now in preparation as a publication in Plasma Physics and Controlled Fusion.

An extension of the CERC (Core Electron-Root Confinement) collaboration was proposed to include ECH plasmas in HSX, where data from steady-state power balance and perturbative heat transport can be studied in conditions of different degrees of symmetry in the magnetic configuration.

Energetic particles

International collaborations have been successfully developed among TJ-II, LHD, H-J, and data from CHS. The number of joint papers based on joint experiments has been steadily increasing. It was pointed out the outreach beyond Stellarator-Heliotron community through joint experiments conducted in the ITPA Energetic Particle Physics topical group.

The integrated approach, experiment/theory/simulation, was suggested in order to increase the predictive capability on Alfvén eigenmodes and energetic particles properties.

<u>Transport</u>

Significant plasma potential variation on a flux surface was observed in TJ-II/ECRH plasmas for the first time, which would have an impact on impurity transport such as in HDH (high-density H mode) in W7-AS and impurity hole in LHD, through Epol×B (radial) drift and parallel impurity transport mechanisms.

The status of the joint IAEA paper on neoclassical transport validation in LHD, TJ-II and W7-AS was reported. The energy transport studies are to be extended (candidate shots already identified from LHD) through the application of FORTEC-3D.

The integrated transport suite development (IPP: predictive, NIFS: experimental analysis) has been progressing. A modular ASTRA-core suite is available in CIEMAT for predictive/interpretative analysis (e.g. the ongoing NC-validation activity).

The ion temperature profile obtained by XICS (X-Ray Imaging Crystal Spectrometer) on LHD (in collaboration between PPPL and NIFS) has been incorporated into TASK3D-a suite.

Island dynamics

Recent progress on island experiment in LHD (investigating systematically the plasma parameter and configuration dependence) magnetic and joint-experiment plan in TJ-II (forcing the appearance of iota=n/m=4/2 island with controlled Ohmic induction, where n(m) indicates toroidal (poloidal) mode numbers, respectively) were introduced. Such joint actions will be summarized, and conference presentations are planned in the coming ISHW (2013) and IAEA Fusion Energy Conference (2014). Heat pulse propagation experiments (via ECH modulation) in TJ-II jointly with NIFS colleagues, was also reported: instantaneous ECE response, associated to ECH pump-out, is found when an n/m=3/2 magnetic resonance reaches certain radial locations. VMEC calculations have been provided at various stages of the calculated evolution of the rotational transform as a basis for 3D-equilibrium analysis to be calculated by HINT2 code.

Link to ITPA

Strengthening of the link between ITPA and CWGM has been continuously promoted. The status of Integrated Operation Scenario (IOS) topical group was reported, with the emphasis on the contributions from S-H so far,

such as ECH-assisted plasma breakdown and integrated modelling activities.

Recently, organizational process of SSOCG (Steady State Operations Coordination Group) has been progressed by calling the participation of related IEA (International Energy Agency) Implement Agreements and national laboratories. Actively cooled superconducting devices, such as LHD and Wendelstein 7-X in S-H community, should play leading roles in joint programmes to be formulated.

<u>H mode</u>

A revision of H mode phenomenology considering helical devices (W7-AS, CHS, TJ-II, H-J and LHD) highlighted both the generic nature of the H mode and its dependence on the 3D magnetic configuration. Therefore, a joint study of the configuration dependence was proposed the hypothesis, under termed "configuration-biased H mode", that the spin-up of flows to a high-rotation state or the diverse edge instabilities may be biased (or damped) by specific flow conditions in each 3D magnetic configuration. An overview of related data from TJ-II showed a prominent role of low order rationals in H mode phenomenology, including bursty activity that might be put in common with tokamak physics. The study dedicated to He plasmas (main ion species in the first phase of ITER, where the threshold power is to be studied) was suggested.

Reactor, system code

reactor concept was HELIAS introduced by emphasizing issues not directly covered by physics optimization for W7-X, and technological issues. Pellet fuelling has been planned in W7-X to deal with the development of reactor scenarios. It has been found that positive Er can arise for a hollow density profile, which might contribute to avoid impurity accumulation in the core plasma. Improved and validated physics understanding through CWGM activity is to be implemented to system code such as PROCESS and HELIOS.

<u>Highlights in LHD experiment, Invitation to Joint</u> <u>experiment</u>

Extrapolation of physics in depth and width has been continuously progressed in extended parameter regime in LHD. Closed divertor works reasonably (only 1 cryo-pump was installed in the last campaign, though). Validation activity of physics models and large-scale computation has been substantially promoted by utilizing well-documented experimental data. 3D effects in toroidal plasmas such as on viscosity and topology have been clarified through cutting-edge capabilities of LHD. Estimates of the effective mass ratio through simultaneous measurement of GAM and Alfvèn eigenmodes, and of He/H ratio through CXRS has been successfully provided. Schedule of the 17th experiment campaign in FY2013 was shown to call the joint experiment in LHD. The perspectives on the further increase of the ion temperature and on the impurity transport study were discussed.

Throughout the meeting, impurity issues were frequently raised, on which enforced programmatic efforts for intensive research is proposed. In the coming meetings, impurity issues will be extensively treated. Your active participation is anticipated.

The 11th CWGM was full of presentations. This is, of course, a clear sign of progress in a range of topics, at one side; but, on the other side, discussions on programmatic collaboration, such as joint experiment, joint papers and database activity, could not be fulfilled to a mature level. Reflecting this situation, the CWGM format was also discussed. Some ideas were raised, such as the prioritization of topics (e.g. convergence on the Stellarator-Heliotron reactor proposal), the promotion of session/task leaders to focus on discussion and collaboration-oriented sessions, or the nomination of a "CWGM-officer" in each institution. The implementation of some of these ideas will be made towards future CWGMs.

The presented materials in previous CWGMs (except for the 1st one, unfortunately) can be reached through either IPP or NIFS CWGM website (designated at the top of this manuscript).

Acknowledgements

We are indebted to Mr. R. Klatt (IPP-Greifswald) for his kind support to make the video-conference possible through EFDA-TV. The 11th CWGM is partly supported by NIFS (National Institute for Fusion Science)/NINS (National Institutes of Natural Sciences) under the project, "Promotion of the International Collaborative Research Network Formation".

12th CWGM

The 12th Coordinated Working Group Meeting (CWGM11) was held on 20 Sep. 2013 at the occasion of Joint 19th International Stellarator-Heliotron Workshop/16th IEA-RFP workshop in Padova, Italy. This was a very brief meeting (for 1.5 hour) after adjourn of workshop. Nevertheless, we could have more than 25 participants from 6 nations. In this very short meeting, we focused on the progress after the CWGM11 (Mar. 2013

at CIEMAT, report is available in Stellarator News, Jun. 2013) and future joint activities in some topics.

The materials presented in the 12th CWGM are available at http://ishcdb.nifs.ac.jp/ and http://fusionwiki.ciemat.es/wiki/Coordinated_Working_ Group (\rightarrow CWGM12) for those of you having further interests. Below, you will find a breif summary of the meeting.

Inter-machine validation study on transport models has been progressed to get the contents of the joint presentation (IAEA-FEC 2012 by A.Dinklage, IPP) published in Nuclear Fusion (2013). The joint activities have been performed within LHD, TJ-II and W7-AS (materials from published literature). The discharges with comparable ion and electron temperature in medium-to-high density (say, ~ 5×10^{19} m⁻³) have been gathered to form "step-ladder" datasets towards reactor-relevant collisionality regime. Complete sets of equilibrium (VMEC) and measured profiles (density, temperatures, and radial electric field) have been prepared to perform, as the first phase, neoclassical energy diffusion properties through benchmarked (verified) numerical codes. This has been summarized in Nuclear Fusion paper. As an extension of this joint activity, systematic study has been performed to investigate non-local feature of neoclassical transport such as by FORTEC-3D code (cf., ISHW2013 poster by S.Satake, NIFS) by utilizing this dataset (in relation to Flows and viscosity topics). Gyrokinetic simulations are also anticipated by systematically utilizing this dataset for stimulating validation activity. This dataset will be registered onto the International Stellarator-Heliotron Profile Database, to facilitate the common use. Further joint experiments in LHD by using increased power of ECH are being planned. It was pointed out from D.LopezBruna (CIEMAT) that we should facilitate particle transport issues in addition to currently on-going energy transport issues.

Collaborations on **Flows and viscosity** topics have been promoted in terms of neoclassical viscosity analysis by numerical code (mainly FORTEC-3D). The biasing experiment in LHD has been numerically investigated to successfully predict a relevant biasing voltage for transition. In such a way, experimental validation of numerical code has been progressed. FORTEC-3D is now in preparation to be an "open source". It has been already transferred to CIEMAT (V.L.Velasco) and then used for direct comparison with DKES results (non-local – local). It will be also transferred to HSX (Oct. 2013) to investigate neoclassical viscosity in plasmas with a high poloidal Mach number. Other possible collaborations with, such as IPP (potential asymmetry on a flux surface, high-Z impurity transport by EUTERP, J. M. Garcia-Regana), PPPL (J.K.Park), Heliotron J/TU-Heliac (biasing experiment), and JAEA (RMP effects on JT-60/JT-60SA, M.Honda), are also either in progress or consideration. In such a way, various verification and validation activities are going on in terms of viscosity.

Collaborations have been successfully developed among TJ-II, LHD, H-J on Alfven Eigen (AE) modes/Energetic particles topics. Contents of the joint presentation (AE modes in low-shear helical plasmas; IAEA-FEC 2012 by S.Yamamoto, Kyoto U.) are anticipated to be published. Recent highlight topics are the observed effect of ECH/ECCD on AE control in TJ-II (Nuclear Fusion paper by K. Nagaoka, NIFS) and Heliotron J. Mechanism are yet to be clarified, and theoretical explanation will be tried by sharing information on experiment (D.A.Spong, ORNL). The experiment in this regard will be also performed in the coming LHD experimental campaign with participation of E.Ascasibar (CIEMAT). There were also discussions on strong interaction of this topic with the ITPA Energetic Particle (EP) Topical Group (especially, on EP-7: ECH effect on AEs). Next ITPA-EP meeting will be held at CIEMAT in next April, so that contributions from CWGM will be anticipated. Anomalous transport of energetic particles by MHD instabilities are also of common concern among LHD, Heliotron J and TJ-II.

Link to ITPA is also one of main outreaches of CWGM activity in wider fusion community. As introduced in the CWGM11, organizational process of SSOCG (Steady State Operations Coordination Group), co-chaired by T.Mutoh (NIFS) and G.Sips (chair of ITPA Integrated Operation Scenario Topical Group), has been progressed by calling the participation of related IEA (International Energy Agency) Implement Agreements and national laboratories. It has formulated 7 work packages for coordinated actions; one of which (#7) is "Draft a roadmap for developing steady state operation", for which Stellarator-Heliotrons certainly should contribute. Proposals for this issue are anticipated from the S-H community. It is also pointed out it is odd not to have eg., divertor operation in 7 packages. This comment is also transferred to next SSOCG meeting (to be held in Fukuoka, Oct., 2013).

Miscellaneous

It was pointed out from K.Ida (NIFS) that, during the joint ISH-RFP workshop, it has been recognized that magnetic topology (such as stochasticity, magnetic island) affects the impurity transport, and systematic

understandings should be urgent issue. On this regard, M.Kobayashi (NIFS) proposed to lead the international collaboration on this issue, through EMC3/EIRENE code, discussions with based on such as DIII-D (E.A.Unterberg) and TEXTOR (O.Schimtz) during the week. S.Satake (NIFS) also proposed to facilitate impurity transport issue in core plasmas through FORTEC-3D code, by utilizing collaboration with EUTERP code. The progress on impurity transport issues by these joint activities are foreseen in coming CWGMs.

Finally, data viewer named "Autoplot" under development in NIFS is introduced and demonstrated from K.Ida as one of tools for facilitating joint experiment in LHD. The details will be available soon. Visitors for LHD experiments are cordially invited to test and raise comments for improvement. Also, Sam Lazerson (PPPL) mentioned that he developed a utility to convert VMEC output files to the old v.6.90 format. Once compiled it will accept any VMEC output which is supported by the LIBSTELL package it was compiled with. These kinds of data handling/numerical tools should facilitate our joint activities.

Next Meeting

At the end of the meeting, there raised a proposal, from K.Nagasaki (Kyoto U.) to hold the next 13th CWGM in Uji, Kyoto in Feb. or Mar. in 2013. Details will be posted in the Stellarator News or sent via e-mails once they become available.

Acknowledgements

We are deeply indebted to Dr. D.Terranova (Consorzio RFX, Italy) and local organizing committee members to allow us to extend the use of the auditorium after adjourn of joint workshop. The 12th CWGM is partly supported by NIFS (National Institute for Fusion Science)/NINS (National Institutes of Natural Sciences) under the project, "Promotion of the International Collaborative Research Network Formation", and the grant-in-aid from Future Energy Association (Kyoto).

4 AUSTRALIA

The Australian Plasma Fusion Research Facility at the Australian National University houses the H-1 heliac and the MAGPIE linear device. H-1 is a three-period helical axis stellarator with a flexible magnetic topology that allows fundamental studies in plasma confinement and stability, turbulence and flows, and confinement transitions at moderate heating power. Because of its coil-in-tank construction, the device is an ideal test bed for the development of advanced active and passive imaging diagnostic technologies from microwave through to optical frequencies.

In 2013, the new 21 channel plasma density interferometer and high resolution imaging spectrometer were brought into operation part of the ~US\$7M upgrade under the Australian Government's Super Science Scheme. Enhancements to the Facility will enable future growth of Australian capability in fusion science and engineering, and as a focus for collaboration within the Australian community, will support the development of world-class diagnostic systems for application to international facilities in preparation for ITER.

A three view optical emission imaging system was configured to acquire data in synchronism with the MHD signals form the Mirnov coils. Data from the three views allowed limited tomographic reconstruction in the toroidal plane of the camera system using CII light as a proxy for electron density. As the data are in the form of images, there is also data available over 5 degrees each side of that toroidal angle, which will be used to provide additional constraints on the tomographic inversion. The high resolution imaging spectrometer was initially configured for helium line ratio measurements of electron density and temperature. Progress has been made on the new 2 x 200kW RF heating system including remote software control using SMTP protocol and a software tuning iteration system capable of matching to the plasma in one or two iterations. The 21 channel interferometer and the RF upgrades enabled magnetic field scans with minimal variation to the RF heating mechanism to investigate the scaling of the dispersion properties of the observed MHD modes.

As part of a longer term strategy that aims for an Australian involvement with ITER, upgrade funding is supporting the development of a prototype linear, high power-density satellite device "MAGPIE", utilizing the H-1 heating, power and diagnostic systems. This is the first device in the Materials Diagnostic Facility, led by Dr. Cormac Corr and was developed in collaboration with Oak Ridge and the Australian Nuclear Science and Technology Organisation (ANSTO), to facilitate development of diagnostics for plasma wall interactions and for characterizing advanced high temperature materials. In 2013, operation in excess of 10¹⁹m⁻³ in helium and hydrogen was achieved, approaching conditions in the divertor of a fusion reactor. Tungsten, its alloys, diamond and carbon samples were exposed to the plasma to observe effects on both the plasma and the impinging plasma.

In 2013 Dr. Greg von Nessi, previously of the Plasma

Theory and Modelling Group was appointed as an experimental researcher in the Toroidal Plasma Group.

Multilateral Collaborations

Work on the international collaboration on MHD and configuration studies under the IEA Implementing Agreement for Co-operation in Development of the Stellarator-Heliotron Concept focussed on automatic mode classification, searching for unusual mode structures, and full integration of auxiliary data from Heliotron J and LHD into the new version of the data mining analysis. Dr. Blackwell spent three weeks between LHD and Heliotron-J in collaboration with Prof. S.Sakaibara and Dr. S.Yamamoto. The datamining techniques were able to find additional examples of recently discovered mode locking in LHD. 40,000 shots were examined in one day using the new server installed for international collaborators. On H-1, von Mises clustering was applied to new magnetic field and configuration scans, combining two poloidal arrays and the new 16 element, 3 axis helical arrays. Results were presented at the 19th International Stellarator-Heliotron Workshop, the 23rd International Toki Conference.

One and two-dimensional coherence imaging (CI) systems developed by Prof Howard at ANU underpin collaborations with the USA, EU members, which are supported by international agencies and the Australian Government. These include

- (EU) An imaging MSE system has been installed on the ASDEX-U upgrade and first measurements obtained. The results have been validated against a standard multiple discrete channel polarimeter.
- (US) With LLNL and General Atomics, application of Doppler CI systems for imaging flows in the DIII-D divertor and scrape-off-layer. These static systems utilise novel spatial-heterodyne interferometric techniques to capture the 2-D Doppler information. A similar system has been deployed on the MAST divertor and tomographic reconstruction of divertor flows during L and H modes, and ELM events are being analysed.

Collaborations between ANU, IPP (J.Svensson), and the Culham Centre for Fusion Energy (L.C.Appel) have complementary stellarator and compact toroidal components. The project, which was supported by an Australian International Science Linkages grant, aims to develop Bayesian techniques for the integration of various diagnostic data, building on pioneering development of the technique on W7-AS. Publications in 2013 covered Thomson Scattering and a force balance validation tool based on the principle of weak observations, which allows multiple forward models to be associated with a single diagnostic observation. In November, Dr von Nessi presented an invited tutorial on Bayesian equilibrium modelling at the "Validation8" workshop on Fusion Data Processing, Validation and Analysis in Ghent, Belgium. With the addition of Dr Clive Michael to the ANU staff, an expert in fast ion plasma diagnostics, we anticipate a wider collaboration between the ANU and CCFE in the modelling of Fast Ion D-alpha diagnostic using a Bayesian model.

In an application to H-1, Dr von Nessi began developing forward models for He line ratios, for application in a Bayesian inference framework for electron temperature and density estimation.

MRxMHD Equilibrium Code: Significant progress was demonstrated in a collaboration between the ANU (R. Dewar, M. Hole, G. Dennis, B. Blackwell, M. McGann, A. Gibson, G. Von Nessi), PPPL (S. Hudson), RFX-mod (Dr Dominique Escande, David Terranova) and CCFE (Prof. Richard Dendy) on the development of a new variational approach - multi region relaxed MHD (MRxMHD) for calculating 3D plasma equilibria with islands.

In 2013 Em.Prof R.L.Dewar spent 2 weeks at PPPL working with Dr. S.Hudson on theoretical issues related to development the new MRxMHD equilibrium code SPEC. Dr Graham Dennis presented research results at the Sherwood Theory Meeting, and visited PPPL for one week to discuss application of the MRxMHD code SPEC to model RFX-mod, as well as model sawteeth, and spent two weeks at Padua working with RFX-mod staff to constrain the MRxMHD model to data. This work culminated in a Physical Review Letter published in August, led by Dr Dennis, providing a minimum energy explanation of the formation of a helical state with an axis-symmetric boundary. By varying the position of the internal MRxMHD barrier, Poincaré plots of the magnetic field computed by MRxMHD matched those inferred from tomographic inversions of soft x-ray emissivity. Other work published in 2013 included a proof that the infinite interface limit of MRxMHD plasmas reduces identically to ideal MHD. The seminal reference publication for the SPEC code appeared in late November 2012. In wider take-up of this work, the SPEC code was also utilised to model DIIID and MAST plasmas with a resonant magnetic field perturbation, and this work was featured in presentations at the EPS Plasma Physics conference. Also in 2013, Dr Hole presented aspects of this work at an invited talk at the Asia Pacific Physics Conference.

ANU student Mathew McGann completed a PhD on the construction of a Hamilton-Jacobi model to compute the

maximum pressure jump that ideal barriers can support in the MRxMHD model. Finally, PhD student Craig Bowie, under the co-supervision of Prof. Richard Dendy, made significant progress calculating avalanche statistics from a sandpile model, which reproduce observed properties of ELMs well.

Collaborations with EU

An existing collaboration between C.Nührenberg and A.Koenies of IPP Greifswald, J.Bertram, R.Dewar, B.Blackwell, S.Haskey, J.Howard, M.McGann, G.Von Nessi, M.Fitzgerald and M.Hole of the ANU, which involves comparing the experimental observations of MHD activity with eigenvalue calculations using the CAS3D code and the wave-particle interaction code CAS3D-K, was expanded to commence work on continuum damping in 3D. In early 2013, Dr Koenies spent three weeks at the ANU funded by a DAAD grant between the Group of Eight research intensive Australian Universities and German Academic Exchange Service. During this time he assisted with drive calculations of H-1 scenarios and helped PhD student George Bowden formulate his approach to calculation of continuum damping. George subsequently spent three weeks in Greifswald in August, and began implementing changes in CKA-EUTERPE to compute continuum damping with multiple line resonances. A follow-up DAAD grant focusing on continuum damping was successful in 2013, which will support ongoing collaboration exchange in 2014.

Collaborations with JAPAN

In addition to the multilateral datamining collaboration, the following were active in 2013:

R.L.Dewar (Emeritus Prof., Australian National University (ANU)) visited NIFS (H.Sugama) from 4 to 5 Apr., 2013 on recent development of 3D equilibrium issues.

Collaborations with USA

In addition to the multilateral MRxMHD collaboration, and the D3D divertor studies the following were active in 2013:

- ANU and R. Goulding, J. Harris and T.Biewer of ORNL and P. Krstic of Joint Institute of Computational Sciences, U. of Tennessee: development of the Materials Diagnostic Facility Prototype and ANU, and proposals for collaborative grants.
- ANU, PPPL and DIIID The effect of 3D magnetic perturbations on the edge plasma.

3) ANU and B. Breizman, Univ. of Texas, Austin, and G. Chen of ORNL in helicon waves with the electromagnetic wave code EMS, as well as the formation of gaps and gap modes in a periodic linear machine. This work, undertaken by PhD student Lei Chang, was published in 2013, and formed part of his PhD thesis, submitted in 2013.

Workshops and Conferences

Dr. Boyd Blackwell chaired the Stellarator-Heliotron side of the International Program Committee of the Joint 19th International Stellarator-Heliotron Workshop and 16th IEA Reversed Field Pinch Workshop in Padua in September. Australia was represented by Dr. Graham Dennis, Dr. Greg von Nessi, Prof. R Dewar and Dr. Blackwell.

Dr. Cormac Corr and Dr. Blackwell presented results at the 23rd International Toki conference in November.

Dr Hole represented Australia at the 52nd IFRC meeting and presented research highlights and summarised progress in upgrade of H-1 and the new materials diagnostic facility of the Australian Plasma Fusion Research Facility. Dr Hole also presented research results at the EPS Conference on Plasma Physics, and presented an invited talk at the Asia Pacific Physics Conference.

5 EU

5.1 GERMANY

Collaborations with EU

- 1) F. Warmer (IPP Greifswald) visited CCFE Culham, 07.01. – 25.01.2013
- D. Frederic, F. Louche, A. Messiaen, G. Offermanns, J. Ongena, B. Schweer (Laboratory for Plasma Physics LLP – ERM/KMS, Brussels) to IPP Greifswald, 28.01.
 - 30.01.2013
- C. Ham (CCFE Culham) to IPP Greifswald, 03.02. 09.02.2013
- 4) I. Abel (Oxford University) to IPP Greifswald, 18.02. 17.03.2013
- 5) J. Svensson (IPP Greifswald) visited CCFE Culham, 10.02. 04.05.2013
- 6) P. Helander (IPP Greifswald) visited Chalmers, Göteborg, 13.03. – 15.03.2013
- 7) M. Drevlak (IPP Greifswald) visited Chalmers Göteborg, 17.03. – 23.03.2013
- T. Wauters (Laboratory for Plasma Physics ERM/KMS, Brussels) to IPP Greifswald, 25.03. -05.04.2013

- 9) F. Brochard, G. Bonhomme, G. Bousselin (University Nancy) to IPP Greifswald, 01.04. 06.04.2013
- 10) I. Predebon (Padua) to IPP Greifswald, 05.05. 18.05.2013
- 11) T. Bird (IPP Greifswald) visited CCFE Culham, 12.05. - 25.05.2013
- 12) A. Kus (IPP Greifswald) visited CIEMAT, Madrid, 13.05. 24.05.2013
- P. Dumortier, J. Ongena, B. Schweer, M. Vervier (Laboratory for Plasma Physics LLP – ERM/KMS, Brussels) to IPP Greifswald, 15.05. - 17.05.2013
- M. Drevlak (IPP Greifswald) visited Chalmerd Göteborg, 11.06. – 13.06.2013
- K. Ireneusz (Opole University, Poland) to IPP Greifswald, 16.06. - 21.06.2013
- H. Smith (IPP Greifswald) visited Chalmers Göteborg, 24.06. – 01.07.2013
- P. Helander (IPP Greifswald) visited Chalmers Göteborg, 25.06.2013 – 01.07.2013
- J. Svensson (IPP Greifswald) visited CCFE Culham, 28.06. – 27.07.2013
- S. Qvarfort (Imperial College London) to IPP Greifswald, 21.07.2013 – 28.09.2013
- 20) T. Wauters (Laboratory for Plasma Physics ERM/KMS, Brussels) to IPP Greifswald, 04.08. -10.08.2013
- P. Knight (Culham Science Centre, Abingdon) to IPP Greifswald, 11.08. – 17.08.2013
- 22) A. Zocco (CCFE Culham) to IPP Greifswald, 11.08. 23.08.2013
- H. Oosterbeek (University of Technology, Eindhoven) to IPP Greifswald, 15.08. – 17.08.2013
- 24) P. Cabrera (University of Technology, Eindhoven) to IPP Greifswald, 15.08. 22.08.2013
- 25) T. Stoltzfus-Dueck (IPP Greifswald) visited EPFL Lausanne, 25.08. 30.08.2013
- 26) M. Beurskens (CCFE Culham) to IPP Greifswald, 26.08. 28.08.2013
- D. Dikkinson (University York) to IPP Greifswald, 01.09.-04.09.2013
- J. Alcuson Belloso (UC3 Madrid) to IPP Greifswald, 15.09. – 13.12.2013
- 29) P. Helander (IPP Greifswald) visited Chalmers Göteborg, 26.09. 27.09.2013
- A. Mollén (Chalmers Göteborg) to IPP Greifswald, 26.09. – 12.10.2013
- J. Svensson (IPP Greifswald) visited CCFE Culham, 27.09. - 24.11.2013
- 32) H. Peraza (UC3 Madrid) to IPP Greifswald, 14.10.2013 - 08.11.2013
- 33) T. Stoltzfus-Dueck (IPP Greifswald) visited EPFL Lausanne, 30.10.2013 – 07.11.2013
- 34) S. Kasilov (TU Graz) to IPP Greifswald, 01.11. -

30.11.2013

- 35) A. Mollén (Chalmers Göteborg) to IPP Greifswald, 07.11.2013 – 20.12.2013
- 36) M. Kubkowska, W. Figacz, L. Ryc, J. Kacmarczyk (IPPLM) to IPP Greifswald, 25.11. 28.11.2013
- 37) T. Szabolics (Wigner RCP) to IPP Greifswald, 18.11. -29.11.2013

Collaborations with Japan

- 1) M. Nunami (NIFS) to IPP Greifswald, 12.02. 14.02.2013
- 2) S. Murakami (University of Kyoto) to IPP Greifswald, 17.02. 23.02.2013
- M. Kobayashi (NIFS) to IPP Greifswald, 03.03. 17.03.2013
- 4) S. Kobayashi (Institute of Advanced Energy, Kyoto University) to IPP Greifswald, 10.03. 15.03.2013
- 5) Y. Suzuki (NIFS) to IPP Greifswald, 11.03. 16.03.2013
- 6) A. Dinklage (IPP Greifswald) visited NIFS, Toki, 25.07. 09.08.2013
- 7) S. Masuzaki (NIFS) to IPP Greifswald, 13.08. 17.08.2013
- M. Yokoyama (NIFS) to IPP Greifswald, 23.09. 27.09.2013
- A. Kus (IPP Greifswald) visited NIFS, Toki, 30.09. 18.10.2013
- M. Preynas (IPP Greifswald) visited NIFS, Toki, 28.10. - 08.11.2013
- 11) M. Preynas (IPP Greifswald) visited Kyoto University (Japan), 11.11. 22.11.2013
- J. Geiger (IPP Greifswald) visited NIFS, Toki, 16.11. 30.11.2013
- 13) A. Dinklage (IPP Greifswald) visited NIFS, Toki, 25.11.- 29.11.2013
- 14) M. Yokoyama (NIFS) to IPP Greifswald, 09.12. 13.12.2013

Collaborations with Russia

- T. Richert, J. Baldzuhn and R. Vilbrandt (IPP Greifswald) visited the Budker Institute Novosibirsk, 17.02. – 22.02.2013
- M. Mikhailov (Kurchatov Institute Moscow) to IPP Greifswald, 02.04. – 31.05.2013
- R. König (IPP Greifswald) visited the graduate school St. Petersburg on Technologies of steady-state diagnostics, 12.05. - 16.05.2013
- V. Sergeev, E. Gusakov, v. Rozhansky, P. Goncharev, V. Bulanin, V. Gusev, S. Lebedev (RLPAT) to IPP Greifswald, 11.09. - 14.09.2013
- 5) T. Khusainov (Nizhniy Novgorod) to IPP Greifswald,

21.09. - 29.09.2013

- 6) Kolmogorov, Belavskiy, Abdrashitov, Drachnichnikov, Selivanov, Shikhovtsev (BINP), 03.11. 30.11.2013
- 7) M. Mikhailov (Kurchatov Institute Moscow) to IPP Greifswald, 04.11. 20.12.2013

Collaborations with USA

- 1) A. Boozer (Columbia University NY) to IPP Greifswald, 06.01. 19.01.2013
- 2) G. Wurden (LANL) to IPP Greifswald, 31.03. 27.04.2013
- 3) G. Plunk (IPP Greifswald) visited PPPL, 14.04. 25.04.2013
- M. L. Reinke (MIT) to IPP Greifswald, 18.04. -20.04.2013
- D. Mikkelsen (PPPL) to IPP Greifswald, 28.04. 04.05.2013
- 6) R. Ochoukov (MIT) to IPP Greifswald, 12.05. -15.05.2013
- 7) G. Wilkie (University Maryland) to IPP Greifswald, 17.06. 24.08.2013
- J. Lore, A. Lumsdaine (ORNL) to IPP Greifswald, 24.08. - 30.08.2013
- 9) A. Lumsdaine, J. Harris, H. Neilson (MIT) to IPP Greifswald, 24.08. 30.08.2013
- M. Landreman (University Maryland) to IPP Greifswald, 25.09. – 12.10.2013
- 11) H. Smith (IPP Greifswald) visited PPPL, 12.10. 10.11.2013
- 12) P. Helander (IPP Greifswald) visited PPPL, 26.10. 02.11.2013
- 13) G. Plunk (IPP Greifswald) visited PPPL, 26.10. 05.11.2013
- 14) D. Gates, S. Lazerson (PPPL) to IPP Greifswald, 08.12.
 14.12.2013

Participation in joint projects

International stellarator/heliotron profile data base

Contributions from A. Dinklage, A. Kus, C. Beidler, H. Maaßberg, S. Marsen

ITPA diagnostics

- 1) R. König: San Diego (USA), 04.06. 07.06.2013
- R. König: Remote participation ITER IO, Cadarache (France), 15.10. - 18.10.2013

ITPA confinement and transport

Contributions from M. Jakubowski, A. Dinklage chairs the 3D working group within the ITPA Transport and Confinement group.

ITPA Fast Particles

A. Könies: 10th Meeting of the ITPA Energetic Particles Physics Topical Group, Culham (UK), 21.04. – 25.04.2013

A. Könies, A. Mishchenko: 13th IAEA Technical Meeting on Energetic Particles in Magnetic Confinement Systems, Beijing (China), 17.09. – 20.09.2013

5.2 SPAIN

Collaborations with Russia

- A. Melnikov and L. Eliseev and members of the HIBP Kurchatov Institute team were visiting CIEMAT to investigate the structure of plasma potential and plasma fluctuations in ECRH and NBI plasmas (in Lithium coated wall conditions) and measurements with two slit HIBP detector. The second HIBP system has been built for long-range (zonal flows) correlation studies and the commissioning is in progress. Secondaries have been successfully detected in 2013 and full operation is foreseen in 2014.
- Collaboration with General Physics Institute, Moscow on the characterization of the plasma reflected power on gyrotron performance. This includes preparation and installation of experimental systems in TJ-II, participation in experiments and analysis of the results. The visiting scientists of GPI involved have been: D. Malakhov (19 March-19 April and 23 October-22 December), N. Kharchev (26 April-26 May and 27 September-26 October), V. Borzosekov (26 April-26 May), E. Konchekov (27 September-26 October), K. Sarksyan (2 -16 October).
- Collaboration with Ioffe Institute (Sant Petersburg) on the update of the neutral particle diagnostics in TJ-II. V. Nesenievich visited Ciemat from 6th to 14th July 2013.

Collaborations in Europe

Germany

Collaboration agreement (IPP/CIEMAT) in the field of development and operation of diagnostics (reflectometry) and related physics evaluation for W7-X

Portugal

1) C. Silva and I. Nedzelskiy were visiting CIEMAT to

continue our collaboration on edge studies (edge turbulence, asymmetries and transport studies and diagnostic development including RFA and probes) during 2013.

- D. Baião was working on soft x-ray based Te diagnostic for high density plasmas in the TJ-II stellarator (May / November).
- 3) S. Da-Graça was visiting CIEMAT in May 2013 to continue our collaboration on reflectometry in TJ-II.

Italy

Collaboration with M. Spolaore and the RFXmod team to participate on edge diagnostic development and measurements in TJ-II including the design, development of electromagnetic probes and characterization of the electromagnetic nature of plasma filaments in TJ-II.

Bulgaria

T. Popov was visiting CIEMAT (June) to investigate non-Maxwellian electron distribution functions in the plasma boundary region and the influence of plasma heating.

Romania

F L Tabares and D Alegre visited the laboratories of Dr Dinescu at Magurele in the frame of the collaboration on tungsten plasma nitriding as PFC for fusion devices.

The Netherlands

D Alegre visted DIFFER and run experiments in Pilot PSI in the frame of collaboration on tungsten nitrides for PFCs.

Collaborations with USA

- 1) E. Hollmann (USCD) was visiting CIEMAT (1 week, June 2013) working on parallel / radial impurity transport studies and role of Z.
- I. Calvo spent the month of September, 2012 at MIT to work on gyrokinetic theory. In 2013, he visited MIT from May 6 to June 16.

Collaborations with Ukraine

1) The Heavy Ion Beam Probe team (leaded by L. Krupnik, Institute of Plasma Physics, National Science Center "Kharkov Institute of Physics and Technology", been fully involved Kharkov) has in the characterization of radial electric fields and plasma fluctuations in ECRH and NBI plasmas in the TJ-II stellarator during 2013 experimental campaign. The development of the second HIBP system has been finalized and installed (injector and analyzer) in TJ-II with on-going commissioning activities (December 2013).

 F. Tabarés was visiting IPP Kharkov to discuss the QSPA project and contribute to the wall conditioning of Uragan 2M.

Collaborations with Japan

- C. Hidalgo was visiting NIFS (October 2013) to study the influence of the electron-ion root transition on low frequency fluctuations and Long Range Correlations in LHD for comparison with previous studies in the TJ-II stellarator.
- 2) E. Ascasibar was visiting NIFS (November 2013) to study the influence of plasma heating (ECRH) on Alfven Eigenmodes in LHD for comparison with previous experiments in the TJ-II stellarator.
- 3) Y. Narushima visited CIEMAT during one week (June 2013) to work on island healing in stellarators.
- Collaboration on fast particle physics. Joint experiments were planned in advance and performed in TJ-II on March 2013. The visiting scientists involved were: T. Ido, K. Nagaoka and A. Shimizu (NIFS); S. Yamamoto and Ohshima (Kyoto University).
- 5) D. López-Bruna visited NIFS to participate in a joint experiment with the LHD device on magnetic island healing via Electron Cyclotron Current Drive around the island region.
- 6) J.L. Velasco visited NIFS during April to discuss on the comparison between two neoclassical approaches (FORTEC-3D and DKES) for TJ-II and LHD.

Participation in Joint Projects

Stellarator-Heliotron working groups and ITPA

The 11th and 12th Coordinated Working Group meetings (CWGM) were held in Madrid (March 2013) and Padova (September 2013) to discuss joint activities. Ciemat staff has participated on different topics including L-H physics, momentum and impurity transport, and fast particle physics.

CIEMAT scientists have been directly involved in the ITPA activities along 2013: E. Ascasibar was attending the ITPA Integrated Operational Scenarios meeting (Kyushu, October 2013); C. Hidalgo was attending the ITPA Transport and Confinement meetings (April-2013 Garching, Germany; October-2013 Kyushu, Japan); J. Vega was attending the ITPA Diagnostic meeting.

6 JAPAN

International collaborations by the LHD team at NIFS

Collaborations with Australia

- R.L.Dewar (Emeritus Prof., Australian National University (ANU)) visited NIFS (H.Sugama) from 4 to 5 Apr., 2013 on recent development of 3D equilibrium issues.
- B.D.Blackwell (ANU) visited NIFS (S.Sakakibara) from 13 to 15 Nov. 2013 for LHD experiment data analyses and attending 23rd International Toki Conference.

Collaborations with EU

- S.Imagawa (NIFS) visited IPP-Greifswald in Germany from 15 to 20, January, 2013 to attend the W7-X Commissioning Workshop and to give a presentation entitled "The commissioning and 15 year's operation of LHD".
- E.Winkler (IPP Greifswald) has stayed in NIFS (T.Morisaki) since 18, January, 2013 and will stay until 31, July, 2014 to develop the helium beam diagnostics which is a newly established collaboration program between LHD and W7-X.
- M.Kisaki visited Consorzio RFX from 6 Jan. to 8 Feb. 2013 to modify the numerical codes for particle trajectories in N-NBIs on LHD.
- 4) M.Nunami (NIFS) visited Max-Planck-Institut fuer Plasmaphysik (IPP, Greifswald, Germany) from 11 to 16 February, 2013 to discuss on benchmarking of gyrokinetic turbulence simulations in stellarators. He discussed with Dr. P.Xanthopoulos about the simulation results obtained from GKV-X code and GENE-GIST code.
- M.Kobayashi (NIFS) visited IPP-Greifswald from 2 to 15, Mar. 2013 to discuss Upgrade of edge plasma Transport simulation code. The code has been adopted To LHD magnetic configuration.
- T.Ido(NIFS) visited CIEMAT (Madrid, Spain) from 3 to 15 March 2013. He joined experiments performed in TJ-II for investigation of the radial electric field formation, and discussed technical issues on heavy ion beam probes.
- A.Shimizu (NIFS) visited CIEMAT from 3 to 15, Mar., 2013 to conduct the joint experiments in TJ-II to study AE burst mode.
- 8) Y.Suzuki (NIFS) visited Max-Plank Institute fuer Plasmaphysik (Greifswald, Germany) and Forschungszentrum Juelich GmbH (Juelich, Germany) from 10th to 21st March 2013 in the international

collaboration on 3D MHD equilibrium calculation in stellarator/heliotron and tokamak. These collaboration results were reported at 531st Wilhelm and Else Heraeus Seminar (Badhonef, Germany, May 2013) and Joint 19th ISHW and 16th IEA-RFP workshop (Padova, Italy, Sep. 2013).

- Y. Narushima visited CIEMAT from 10 to 21, Mar, 2013 for experiment of magnetic island dynamics in TJ-II.
- 10) K.Mukai (NIFS) visited CIEMAT from 11 to 13, Mar, 2013 to talk about microwave reflectometer and imaging bolometer at CWGM 11 and to progress the collaboration related to these diagnostics.
- G.Motojima (NIFS) visited Ghent university in Belgium to give presentations of "Helical systems" and "Technology progress and physics achievements in LHD", from 27 to 29 March 2013 within a framework of Erasmus Mundus Program.
- 12) T. Morisaki (NIFS) participated in the 6th International Workshop on Stochasticity in Fusion Plasmas from 18 to 20, March, 2013 in Juelich. He chaired a discussion session on "Transport and exhaust in helical and island divertors", in addition to his presentation concerning the density profile formation in the stochastic region in LHD.
- J.L.Velasco (CIEMAT, Spain) visited NIFS (S.Satake) from 1 to 30 April 2013 to discuss on the benchmark of neoclassical transport simulation codes and application of FORTEC-3D code developed by Satake to analyze TJ-II plasmas.
- 14) T.Tokuzawa (NIFS) visited Ecole Polytechnique from 20 to 26, Apr, 2013 to attend the workshop of "11th international reflectometry workshop" and give a talk of "Development of multi-channel Doppler reflectometer in LHD and THz pulse diagnostics for higher dense plasma".
- 15) T.Mutoh and S.Kubo (NIFS) attended Steady-State Operation Coordination Group meeting held in France from 12 to 19 May. 2013.
- 16) H.Sugama (NIFS) visited Mediterranean Institute for Advanced Research (IMéRA, Marseille, France) from 1 to 8, June, 2013 to give an invited talk titled "Transport Processes and Entropy Balance in Toroidal Plasmas" at the Workshop on "Turbulence, Transport, and Structures in Magnetized Plasmas". Discussions about theories, simulations, and experimental researches on turbulent transport processes in magnetized plasmas are done.
- 17) M.Nunami (NIFS) visited Mediterranean Institute for Advanced Research (IMéRA, Marseille, France) from 1 to 8, June, 2013 to give a talk with the title "Turbulent Transport Modeling in Helical Plasmas" at the Workshop on "Turbulence, Transport, and

Structures in Magnetized Plasmas". He discussed about theories, simulations, and experimental researches on turbulent transport physics.

- 18) Tomohiko Watanabe (NIFS) visited Mediterranean Institute for Advanced Research (IMéRA, Marseille, France) from 1 to 8, June, 2013 to attend the Workshop on "Turbulence, Transport, and Structures in Magnetized Plasmas".
- 19) G. Kawamura (NIFS) visited Max-Planck IPP Greifswald from 13 May to 29 June, 2013 to promoto collaboration with Dr.Y,Feng on three-dimensional transport simulation of LHD divertor plasma.
- 20) H V.Antoni and G.Serianni (Consorzio RFX, Italy) visited NIFS (K. Tsumori) from 24 to 28 Jun. 2013 to discuss the future collaboration.
- 21) .P.Summers, M.O'Mullane, and A.Giunta (Univ. Strathclyde, UK) visited NIFS (I.Murakami and D.Kato) from 15 to 22 June 2013 to participate the ADAS/ADAS-EU Workshop and Advanced Training Course held on June 18-21, 2013, at NIFS. During the workshop they gave lectures on ADAS (Atomic Data and Analysis Structure) and discuss on related topics using atomic data and ADAS with Japanese participants.
- 22) A.Dinklage (IPP, Germany) visited NIFS (M.Yokoyama) from 29 Jul. to 5 Aug. 2013 to discuss on the joint experiment on LHD for the transport validation collaboration.
- 23) G.Motojima (NIFS) visited Culham Centre for Fusion Energy from 28 August to 9 September 2013 to join MAST experiments for observing hydrogen pellet ablation.
- 24) I.Murakami (NIFS) visited the IAEA Headquarters in Vienna, Austria from Sep. 4, 2013 to Sep. 6, 2013 to attend the IAEA Technical Meeting on Technical Aspects of Atomic and Molecular Data Processing and Exchange (22nd Meeting of the Atomic and Molecular Data Centers) to present recent activities on atomic and molecular data and database for fusion science conducted in NIFS, to exchange information and related activities on atomic and molecular data, and to discuss on data validation and other related activities for fusion within the Data Center Network..
- 25) Y.Suzuki (NIFS) visited Forschungszentrum Juelich GmbH (Juelich, Germany) from 8 to 13 September 2013 in the international collaboration on 3D modeling in the tokamak configuration with the resonant magnetic perturbation field and conceptual design of edge plasma diagnostics in Wendelstein 7-X.
- 26) K.Saito (NIFS) visited Speyer, Germany from 9 to 11, Sep, 2013 to attend US-EU-JPN RF Heating Technology Workshop.
- 27) T.Goto (NIFS) visited IPP-Garching from 11 to 13,

Sep., 2013 to discuss on the joint work for the BA DEMO design collaborative research about the cost model of fusion reactors.

- 28) S.Masuzaki (NIFS) visited Berlin Technology Institute and IPP-Greifswald from 13 to 17 Sep., 2013.
- 29) H.Yamada (NIFS) attended the International Stellarator-Heliotron Workshop (joint with RFP workshop) held in Padova, Italy from 16 to 20 Sep. 2013. During this workshop, he also attended the 42nd Stellarator-Heliotron Executive Committee Meeting. He also visited IPP-Garching from 23 to 25 Sep. to attend IPP Fachbeirat Meeting.
- 30) M.Yokoyama (NIFS) attended the International Stellarator-Heliotron Workshop (joint with RFP workshop) held in Padova, Italy from 16 to 20 Sep. 2013. During this workshop, he also attended the 42nd Stellarator-Heliotron Executive Committee Meeting. He also visited IPP-Greifswald from 23 to 28 Sep. to extend the International Stellarator-Heliotron Profile Database, and to discuss the application of statistical analyses on it.
- 31) T.Morisaki (NIFS) participated in the 19th International Stellarator Heliotron Workshop and 16th IEA-RFP Workshop from 16 to 20, September, 2013 in Padova. He made an oral presentation concerning to the radiated power distribution during impurity injection discharges in LHD.
- 32) M.Kobayashi (NIFS) visited Padova, Italy from 15 to 20, Sep. 2013 to attend the international stellarator/heliotron workshop to give an invited talk concerning Detachment control in LHD.
- 33) H.Tanaka (NIFS) visited Padova in Italy from 15 to 21, Sep, 2013 to join the 19th ISHW and 16th IEA-RFP workshop.
- 34) Y. Yoshimura (NIFS) visited Padova, Italy from 15 to 21, Sep, 2013 to participate the Joint 19th ISHW and 16th IEA-RFP workshop, having poster presentation about resent results of ECH activities in LHD.
- 35) S.Morita, S.Okamura, Y.Takemura, K.Ida, C.Suzuki, T.Seki, R.Seki, K.Nagaoka, H.Takahashi, H.Sugama. K.Ichiguchi, M.Nunami, M.Sato, K.Ogawa, A.Shimizu, H.Tsuchiya, C.Dong and T.Min (NIFS) attended the International Stellarator-Heliotron Workshop (joint with RFP workshop) held in Padova, Italy from 16 to 20 Sep. 2013.
- 36) T.Goto (NIFS) visited Palau de Congressos de Barcelona (Spain) from 16 to 20, Sep., 2013 to attend 11th International Conference on Fusion Nuclear Technology (ISFNT-11) for a poster presentation.
- 37) A.Sagara, T.Muroga, H.Chikaraishi, T.Tanaka, H.Tamura, and J.Yagi (NIFS) participated ISFNT-11 in Barcelona from 16 to 20, Sept, 2013 to give an invited talk on helical reactor FFHR design activities.

- 38) H.Nakanishi (NIFS) visited F4E, Barcelona, Spain from 17 to 19, Sep. 2013 to attend the 2nd Technical Coordination Meeting (TCM-2) on IFERC Remote Experimentation Center (REC). There held the technical discussions for the ITER REC construction activities between EU and Japan. As a collaborating task member for studying fast data transfer technology, some progress report was made.
- 39) G.Serianni (Consorzio RFX, Italy) visited NIFS (K. Tsumori) 17th Sep. 2013 to discuss on the beam diagnostic experiment performed in the test stand in NIFS.
- 40) M.Kraus (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany) visited NIFS (contact person: Prof.H.Sugama) from 30 September to 4 October, 2013 to discuss on simulations of plasma turbulence. He gave a seminar titled "Variational Integrators in Plasma Physics".
- 41) M Kobayashi (NIFS) visited Krakow, Poland from 21 to 27, Sep. 2013 to attend the international workshop on plasma edge theory to give an oral talk concerning Recent code development of edge transport simulation in LHD and first results of Comparison with experiments.
- 42) G.Kawamura (NIFS) visited Cracow Poland from 24 to 26 September, 2013 to make a poster presentation for the 14th international workshop on Plasma Edge Theory in fusion devices.
- 43) A.Kus (IPP-Greifswald) visited NIFS (M.Yokoyama) from 30 Sep. to 18 Oct. 2013 to discuss the statistical approach applied for International Stellarator-Heliotron Confinement and Profile Database. He also made a series of seminars on application of statistics.
- 44) F.Delahaye and N.Moreau (Observatoire de Paris, France) visited NIFS (I.Murakami, H.A.Sakaue, and D.Kato) from Oct. 29, 2013 to Nov. 1, 2013 to participate the forum seminar on atomic and molecular data and their applications held on Oct. 30 Nov.1, 2013 at NIFS and gave presentation on the Virtual Atomic and Molecular Data Center (VAMDC) project and tutorials on VAMDC. They also discuss how to implement the NIFS Atomic and Molecular Numerical Database to the VAMDC web portal for future collaboration.
- 45) D.Lopez-Bruna (CIEMAT, Spain) visited NIFS (Y. Narushima) from 29 Oct 2013 to 8 Nov 2013 for experiment of magnetic island control by ECCD in LHD.
- 46) M.van Berkel (Eindhoven University of Technology) visited NIFS (N. Tamura) from November 21, 2013 (planned until November 20, 2014) with a JSPS Postdoctoral Fellowship to join the LHD experiments regarding a electron heat transport.

- 47) M.Preynas (IPP-Greifswald) visited NIFS (S.Kubo) from 26 Oct. to 10 Nov. 2013 for participation to ECH experiments in LHD.
- 48) J.Geiger (Max-Plank Institute fuer Plasmaphysik, Germany) visited NIFS (Y.Suzuki) from 17th to 30th November 2013 to discuss applications of HINT2 code to Wendelstein 7-X.
- 49) M.Yokoyama (NIFS) visited IPP-Greifswald (A.Kus) from 9 to 13 Dec. 2013 for joint work on statistical analyses for heat diffusivity database in LHD created by TASK3D-a.
- 50) R.Sakamoto and T.Goto (NIFS) attended the 2nd IAEA DEMO Program workshop held in Vienna, Austria from 16 to 22 Dec. 2013.

Collaborations with Russia

- I.A.Sharov (St. Petersburg Polytechnical University, Russia) will visit NIFS (S.Sudo and N.Tamura) from January 27th to February 7th, 2014 to discuss a future plan of the collaboration research about a spatial structure of the ablation cloud of the Tracer-Encapsulated Solid Pellet by measuring a Stark broadening with a spatial resolution on LHD.
- V.Kulygin and A.Spitsyn (Kurchatov Institute) visited NIFS (T.Muroga) on 30 Jan. 2013 for collaborative research.

Collaborations with USA

- T.Tokuzawa (NIFS) visited UCD from 13 to 18, Jan, 2013 to attend the workshop of "Present status and future direction of electromagnetic-wave imaging diagnostics" and give a talk of "Development of THz pulse wave diagnostics for high-density plasma".
- H.Tsuchiya visited University of California Davis from 14 to 16, Jan, 2013, to attend U.S.-Fapan Workshop on "Millimeter Wave Technology and Fusion Plasma Fluctuation Diagnostics".
- T.Tokuzawa (NIFS) visited UCLA and GA from 11 to 23, Feb, 2013 to implement the Japan / U. S. Cooperation in Fusion Research and Development and discuss about the "microwave diagnostics for turbulent plasma phenomena".
- K.Ida (NIFS) attended EU-US Transport Task Force meeting held in Santarosa, USA from 8 to 14 Apr. 2013.
- 5) K.Ida (NIFS) visited General Atomics from 12 to 18 Apr. 2013, and from 25 Aug. to 1 Sep. 2013 on collaborative research between LHD and DIII-D.
- 6) H.Yamada (NIFS) visited Princeton Plasma Physics

Laboratory for the PPPL Advisory Committee Meeting from 23 to 27, Apr., 2013.

- F.Waelbroeck (University Texas-Austin) visited NIFS (A.Ishizawa) from 12 to 18 May 2013 for collaborative research on magnetic island in LHD.
- 8) S.Hudson (PPPL) visited NIFS (Y.Suzuki) from 3 June to 4 September as the guest professor of NIFS. He studied the chaotic coordinate system in non-axisymmetric tori and its application to the LHD. This collaboration result was reported at 23rd International Toki Conference (Toki, Japan, Nov. 2013).
- 9) M.Yokoyama and Shin Nishimura (NIFS) attended US-Japan JIFT workshop on Present status and prospects of theory and simulation on 3D physics in toroidal plasmas, held in University of Wisconsin-Madison from 3 to 5 Jun. 2013.
- 10) T.Oishi (NIFS) visited Massachusetts Institute of Technology from 8 to 21 Jun. 2013 for collaborative research.
- S.Imagawa (NIFS) visited the Sanfrancisco stanford hotel in USA from 9 to 15, June, 2013 to attend the 25th Symposium on Fusion Engineering (SOFE) and to give a presentation entitled "LHD Accomplishments/Plans in Support of Fusion Next-Steps".
- 12) N.Yanagi (NIFS) attended the 23rd International Conference on Magnet Technology (MT-23) held at Boston, MA, USA, from 14 to 19, July, 2013 to give an oral talk on "Progress of the design of HTS magnet option and R&D activities for the helical fusion demo reactor".
- 13) N.Yanagi (NIFS) visited Plasma Science and Fusion Center and Francis Bitter Magnet Laboratory of Massachusetts Institute of Technology (MIT) at Cambridge, MA, USA, from 22 to 23, July, 2013 to discuss issues on the development of large current-capacity high-temperature superconductors.
- K.Ogawa (NIFS) visited PPPL from 14 to 21, Jul. 2013 to discuss on the fast ion profile measurement in LHD and NSTX-U.
- 15) K.Rule (PPPL), M.King (GA), L.Cadwallader (INL) visited NIFS(K.Nishimura) from 29 July 2013 to 30 July 2013 to observe and to discuss the safety program on experiments in NIFS.
- N.A.Pablant (PPPL, USA) visited NIFS (S.Morita) from 24 Jul. to 11 Aug. 2013 for collaborative research on XICS measurement in LHD.
- S.Ohdachi (NIFS) visited General Atomics from 25 Aug. to 1 Sep. 2013 on collaborative research between LHD and DIII-D.
- C.H.Skinner (PPPL) visited LHD from 1 to 8, Sept, 2013 as the US-J program to demonstrate real time

measurement of dusts by using the fine particles analyzer.

- 19) N.A.Pablant (PPPL) visited NIFS (S.Morita and M.Yokoyama) from 1 Oct to 23 Dec., 2013 to participate 17th LHD experiment campaign, and to conduct XICS measurement and its implementation to integrated transport analyses.
- 20) S.Satake (NIFS) visited Princeton Plasma Physics Laboratory (U.S.) from 7 to 12 October 2013 to discuss with J. K. Park and K. Kim on the benchmark and application of delta-f neoclassical transport codes to evaluate neoclassical toroidal viscosity in tokamaks with magnetic perturbation. Then, Satake also visited Wisconsin University from 14 to 23 October 2013 to discuss with J. Talmadge and J.Smoniewski on the application of FORTEC-3D neoclassical transport code on HSX configuration, and also discussed on the biasing experiments in LHD and HSX.
- 21) H.Yamada (NIFS) visited Princeton Plasma Physics Laboratory for the PPPL Advisory Committee Meeting from 5 to 9, Nov., 2013.
- 22) D.Nishijima (UCSD, US) visited LHD from 9 to 21, Nov, 2013 as the US-J program to measure molybdenum neutral line emission with time in response to divertor exposure.
- 23) S.Yoshimura (NIFS) visited the Sheraton Denver Downtown Hotel, Denver, CO, USA to attend the 55th Annual Meeting of the APS Division of Plasma Physics from 11 to 15, Nov. 2013. He gave a contributed oral presentation entitled "Spatial structures of intermittent local electron flux in a linear ECR plasma".
- 24) T.Tokuzawa (NIFS) visited Denver from 10 to 17, Nov, 2013 to attend the APS conference and give an invited talk of "Observation of multi-scale turbulence and non-local transport in LHD plasmas".
- 25) A.Shimizu (NIFS) visited University of Wisconsin-Madison from 5 Dec. 2013 to 29 Mar. 2014 to conduct the joint experiment and discuss the cooperation research of density and potential fluctuation measurement in MST and LHD.
- 26) C.Skinner (PPPL, USA) visited NIFS (N.Ashikawa) from 7th Oct 2013 to 18th Oct 2013 to join experiments of the electrostatic dust detector in LHD.

International collaborations by the Heliotron J team at Kyoto University

Collaborations with EU

 M. Prenyas (Postdoctoral fellow, Max-Planck Institute) visited Kyoto University from Nov. 11 to Nov. 22 2013. Concerning plasma breakdown using the second harmonic X-mode ECH in stellarator/heliotron devices, she joined the Heliotron J experiment, and scanned gas pressure, EC power and rotational transform in order to clarify the physics of ECH plasma breakdown. She also presented recent research activities on plasma breakdown using a 2.45GHz and 70GHz microwaves in the WEGA stellarator and future plan in W7-X.

- 2) S. Yamamoto plans to visit CIEMAT in March 2014. He will join the TJ-II experiment to investigate the characteristics of energetic-ion-driven MHD instabilities such as Alfvén eigenmodes (AEs) in low magnetic shear stellarator/heliotron plasmas. He is preparing a paper on the iota dependence of AE and the effect of AE on energetic ion transport taken in TJ-II and Heliotron J.
- K. Nagasaki have been conducting a collaboration 3) research on ECH/ECCD physics with Ν Marushchenko (IPP, Greifswald). They developed a ray tracing calculation code "TRAVIS" for the Heliotron J device to calculate the EC power deposition and EC driven current efficiency. The TRAVIS code was also applied to an interferometer system of Heliotron J to calculate the beam trajectory for designing the transmission system. A paper "Stabilization of energetic-ion-driven MHD modes by ECCD in Heliotron J" was published in Nucl. Fusion 53 (2013), which was a collaboration research work with N. Marushchenko (IPP, Greifswald), T. Estrada (CIEMAT) and G. Weir (U. Wisconsin).
- 4) Discussions with W7 team (IPP) were kept along the same line as in 2012.
- 5) Collaborations with CIEMAT were continued along the same lines as in 2012.

Collaborations with Australia

- B. Blackwell (senior fellow, The Australian National University) visited at Kyoto University from Nov. 25 to Nov. 29, 2013. We have been studying the MHD instabilities including pressure-driven and energetic-ion-driven modes in helical plasmas with 3-D field by using a data mining technique. Recently, his group modified the way to automatically extract the coherent modes from big data and to access the SQL database of H-1 plasmas. We tried to apply the new way to the Heliotron J database with a different structure from H-1.
- 2) Discussions with H-1 team (ANU) were kept along the same line as in 2012.

Collaborations with US

- 1) S. Kobayashi plans to visit the University of Wisconsin, Madison from Dec 9 to Dec 13, 2013. He is proposing an installation of beam emission spectroscopy (BES) diagnostic in a helical device "The Helically Symmetric eXperiment (HSX)" in University of Wisconsin, The BES diagnostic can provide the density fluctuation at a local position where the neutral beam and sightline are intersected, and it has been utilized for the radial profile of the density fluctuation measurements in Heliotron J. During his stay, he will apply a calculation code for BES into HSX, which has been developed in Kyoto Univ., to discuss the candidate sightlines for the BES diagnostic in HSX.
- 2) K. Nagasaki plans to visit Columbia University and the University of Wisconsin, Madison from Dec. 12 to Dec. 18, 2013. F. Volpe (Columbia University) and K. Nagasaki have been carrying out collaboration research on electron cyclotron heating and current drive for Alfven Eigenmode stabilization. They have been also developing a radiometer system for electron Bernstein waves diagnostic, which is beneficial for electron temperature profile measurement in high-density plasmas. The electron temperature measurement using this diagnostic will start in Heliotron J. K. Nagasaki will discuss reflectometer system and its application to measurement on density profile and density fluctuation with K. Likin and D. Anderson (U. Wisconsin).
- Discussions with the HSX (Wisconsin Univ.) team and CTH (Auburn Univ.) team, groups of ORNL and PPPL, etc.) were kept along the same line as in 2012.

Collaborations with Ukraine

 Discussions with Kharkov team about the collaboration in U-2M project were kept along the same line as in 2012.

Collaborations with Russia

 Discussions with Kurchatov Institute related to development of advanced stellarator/heliotron systems were kept along the same line as in 2012.

Others

 F. Sano, T. Mizuuchi, K. Nagasaki, H. Okada, T. Minami, S. Kobayashi, S. Yamamoto and S. Ohshima attended Joint 19th International Stellarator Heliotron Workshop and 16th IEA-RFP Workshop held at Padova, Italy on September 16-20, 2013. They presented experimental results on Heliotron J and discussed the future collaboration research with researchers from TJ-II, W7-X, H-1 and HSX. A new gas fuelling by supersonic molecular beam injection (SMBI) was successfully applied to ECH/NBI plasma in Heliotron J. The collaboration of fuelling control studies are being discussed with TJ-II team and NIFS.

7 RUSSIA

Collaborations with Germany

- 1) M. Mikhailov (Kurchatov Institute Moscow) to IPP Greifswald, 02.04. 31.05.2013
- H. Braune, V. Erckmann, H.P. Laqua, G. Michel, T. Stange: 25th Joint Russian-German Workshop on ECRH and Gyrotrons, Germany, 24.06. –29.06.2013
- M. Mikhailov (Kurchatov Institute Moscow) to IPP Greifswald, 04.11. – 20.12.2013

Collaborations with Japan

- I.A.Sharov (St. Petersburg Polytechnical University, Russia) will visit NIFS (S.Sudo and N.Tamura) from January 27th to February 7th, 2014 to discuss a future plan of the collaboration research about a spatial structure of the ablation cloud of the Tracer-Encapsulated Solid Pellet by measuring a Stark broadening with a spatial resolution on LHD.
- V.Kulygin and A.Spitsyn (Kurchatov Institute) visited NIFS (T.Muroga) on 30 Jan. 2013 for collaborative research.

Collaboration with Ukraine

- Dr. L.I. Krupnik and HIBP team (IPP NSC KIPT) in collaboration with Dr. A.V. Melnikov and T-10 team (Kurchatov Institute).
- 2) Adjustment and calibration of new modification of the multi-sleet (5 sleets) energy analyzer.
- Providing the experiments directed to investigations of the Geodesic Acoustic modes and their features in the OH and ECRH regimes.

Start collaboration in designing of the probing beam diagnostics to tokamak T-15 (HIBP two complexes and Li⁰ atom beam injection).

25th IAEA Fusion Energy Conference (FEC2014) will be held in St. Petersburg from 13 to 18 October 2014.

(Hosted by the Government of the Russian Federation through the State Atomic Energy Corporation ROSATOM)

http://www-pub.iaea.org/iaeameetings/46091/25th-Fusi

on-Energy-Conference-FEC-2014

8 UKRAINE

Institute of Plasma Physics of the National Science Center "Kharkov Institute of Physics and Technology" of the NAS of Ukraine (IPP NSC KIPT, NASU)

International collaborations of the NSC KIPT in 2013

Multiple Collaboration

Collaboration of V.V. Nemov, S.V.Kasilov and V.N. Kalyuzhnyj with Technische Universität Graz, Austria Max-Planck-Institut fur Plasmaphtsik, Greifswald. Germany, National Research Centre Kurchatov Institute, Moscow, Russia, and University of Wisconsin, Madison, USA.

Collaboration with CIEMAT

Dr. L.I.Krupnik et al (IPP NSC KIPT) in collaboration with Dr. C. Hidalgo and TJ-II team (CIEMAT).

 Heavy Ion Beam Probe diagnostic system (the first one) was upgraded to perform measurements of the different type of the potential oscillations and transport flows on TJ-II:

- development and tuning new control and data acquisition systems

- new Cs emitter installation and tuning focusing system of the injector.

- 2) Providing the experiments with upgraded first HIBP diagnostic of the TJ-II Stellarator. Investigation of the asymmetric structure of plasma potential, behavior of the different kind of Alfven Eigen modes and non -Alfvenic plasma fluctuations in ECRH and NBI plasmas (in with Lithium coated walls). Study of the fluctuation induced transport in core and edge of plasma confinement volume.
- Adjustment of the all parts of hardware (Injector and Detection systems and control and data acquisition systems) for second Heavy Ion Beam Probe diagnostic on TJ-II stellarators. Tracing of the probing beam.

Collaboration with Kurchatov Institute, Moscow, Russia

Dr. L.I. Krupnik and HIBP team (IPP NSC KIPT) in collaboration with Dr. A.V. Melnikov and T-10 team (Kurchatov Institute).

1) Adjustment and calibration of new modification of the

multi-sleet (5 sleets) energy analyzer.

- Providing the experiments directed to investigations of the Geodesic Acoustic modes and their features in the OH and ECRH regimes.
- Start collaboration in designing of the probing beam diagnostics to tokamak T-15 (HIBP two complexes and Li0 atom beam injection).

Collaborations with Max-Planck-Institut für Plasmaphysik, EURATOM Association, Garching, Germany

V.S. Voitsenya et al. (IPP NSC KIPT) in collaboration with Drs. M. Balden and O. Ogorodnikova (IPP, Garching, Germany) investigated the behavior of specimens of different kind tungsten under long term sputtering.

Collaboration with Russian Kurchatov Institute, Moscow

- Joint development two kinds of the probing beam diagnostics for new tokamak T-15. (HIBP two systems and Injection of the neutral atoms Li0 and Na0.
- 2) Investigation of the nature Tl ion emission and increase intensity of the probing beam.

Study of the plasma potential and density and their fluctuations by upgraded HIBP system in regimes with high plasma density. Comparative study of the GAMs (and AEs) behavior in the T-10 tokamak and TJ-II stellarator during ECR heating with high intensity heavy ion probing beam.

9 UNITED STATES

Collaborations with EU

- 1) D.Mikkelsen (PPPL) visited IPP-Greifswald from April 29 to May 7 to continue benchmarking calculations for LHD ion-ITB plasma comparing GS2 and GENE.
- D.Gates (PPPL) visited IPP Greifswald from July 10-29 to develop collaborations including a recently approved project to build an X-ray diagnostic for the W7-X project.
- D.T.Anderson (UW-Madison) participated in the review of the W7X TDU Scraper Element on 8/28/2013.
- H.Zohm (IPP Garching) spent fall Semester in 2013 at UW-Madison as a visiting professor.
- 5) N.Pablant (PPPL) visited IPP-Greifswald from September 23-26 to discuss design issues with the

XICS diagnostic being planned for the W7-X facility.

- 6) V.Q.Mas (CIEMAT) visited PPPL on October 3 to give a talk on novel approaches for stellarator construction.
- H.Smith (IPP-Greifswald) visited PPPL from October 14 through November 9 to work on a theoretical model of stochastic heating by Alfven wave turbulence.
- 8) D.Gates, S.Lazerson, and H.Neilson (PPPL) visited IPP-Greifswald December 9-13 to discuss PPPL-IPP collaborations on W7-X. Topics included Equilibrium reconstruction, stellarator turbulence optimization, diagnostic development and use of the US built trim coils.

Collaborations with Japan

- K.Tanaka(NIFS) visited PPPL from February 18 to March 7. He conveyed experimental data for new ion-ITB shot from LHD. Carried out GS2 calculations for new ion-ITB shot from LHD (for heat transport studies) and for a JT-60U ELMy H mode shot (to study particle transport). Learned procedures for grid generation using new grid generator, and for convergence testing.
- M.Nunami (NIFS) visited PPPL from February 25 to March 5 to make benchmark calculations and comparison figures for LHD ion-ITB shot.
- N.Pablant (PPPL) visited NIFS from March 18 to April 8 to work on data analysis of High Te regimes for experiments run on LHD in 2012.
- S.Kobayashi (Kyoto Univ.) visited HSX 3/26/2013 to discuss collaborations and will again visit HSX 12/9-13/2013 to discuss collaborations on CHERS and BES
- 5) M.Zarnstorff (PPPL) visited NIFS on 29 March 2013 to collaborate with S.Ohdachi and S.Okamura on optimization of high beta plasmas in LHD.
- 6) K.Ida (NIFS) visited General Atomics from 12 to 18 Apr. 2013, and from 25 Aug. to 1 Sep. 2013 on collaborative research between LHD and DIII-D.
- H.Yamada (NIFS) visited Princeton Plasma Physics Laboratory for the PPPL Advisory Committee Meeting from 23 to 27, Apr., 2013.
- UW-Madison (C.Hegna in charge) hosted the US-Japan JIFT Workshop on "Theory and Simulation of 3-D physics in Stellarators/Heliotrons and RFPs" in Madison, June 3-5
- 9) T.Oishi (NIFS) visited Massachusetts Institute of Technology from 8 to 21 Jun. 2013 for collaborative research.
- 10) S.Hudson (PPPL) visited NIFS from June 10 to September 10 in the role of visiting professor where he worked with Yasuhiro Suzuki on the HINT2 code.
- 11) K.Ogawa (NIFS) visited PPPL from 14 to 21, Jul. 2013 to discuss on the fast ion profile measurement in LHD

and NSTX-U.

- 12) K.Rule (PPPL, USA), M.King (GA, USA), L.Cadwallader (INL, USA) visited NIFS(K.Nishimura) from 29 July 2013 to 30 July 2013 to observe and to discuss the safety program on experiments in NIFS.
- 13) N.A.Pablant (PPPL) visited NIFS (S.Morita) from 24 Jul. to 11 Aug. 2013 for collaborative research on XICS measurement in LHD.
- 14) S.Murakami (Kyoto Univ.) visited HSX in July for collaborations with the GNET code for modeling ICRH driven fluxes in HSX
- 15) S.Ohdachi (NIFS) visited General Atomics from 25 Aug. to 1 Sep. 2013 on collaborative research between LHD and DIII-D.
- 16) N.Pablant (PPPL) visited NIFS from October 1 to December 23 to operate the US built XICS diagnostic on LHD, to participate in the 2013 LHD run and to further analyze data from the 2012 run.
- 17) C.Skinner (PPPL) visited NIFS in Oct 7 18. The dust detector was installed on Oct. 11 on LHD, and measurements were started from Oct. 16.
- S.Satake (NIFS) visited PPPL from September 7 to 11 to work with J.K.Park and S.Lazerson on stellarator modeling using FORTEC3D.
- 19) S.Satake (NIFS) visited HSX 10/14-18/2013 to collaborate on HSX calculations using the FORTEC-3D code to analyze plasma electric fields near the helical ion resonance.
- H.Yamada (NIFS) visited Princeton Plasma Physics Laboratory for the PPPL Advisory Committee Meeting from 5 to 9, Nov., 2013.
- 21) D.Nishijima (UCSD, US) visited LHD from 9 to 21, Nov, 2013 as the US-J program to measure molybdenum neutral line emission with time in response to divertor exposure.
- 22) A.Shimizu (NIFS) visited University of Wisconsin-Madison from 5 Dec. 2013 to 29 Mar. 2014 to conduct the joint experiment and discuss the cooperation research of density and potential fluctuation measurement in MST and LHD.
- 23) K.Nagasaki (Kyoto Univ.) visited HSX from Dec. 16 to Dec. 18, 2013 to discuss collaborations on ECE pulse propagation measurements and EBW heating.
- 24) M.Zarnstorff (PPPL) visited NIFS on Dec. 9 to participate in the external review committee on LHD.
- 25) M.Zarnstorff (PPPL) visited NIFS December 10-13 to collaborate with S.Ohdachi and S.Okamura on optimization of high beta plasmas in LHD.

(Komori, A., Yamada, H., Yokoyama, M.)