Appendix E5

Short Summary of Personnel Exchanges

From JT-60 to EU

JE153 Comparison of JET-JT60 similarity experiment on H-mode plasmas (H. Urano, July.04-23, 2010)

Based on the IEA/LT framework (JE153), H. Urano (JAEA) vistited JET for the analysis and discussion of the inter-machine experiment between JET and JT-60U. The effects of toroidal field (TF) ripple on the H-mode pedestal characteristics were evaluated. In the analysis of similarity experiment at low plasma current (~1.1MA), where no clear degradation of the H-mode pedestal was seen during TF ripple scan from 0.08% to 1%. Similarly, change of ELM frequency was also very small. However, the toroidal rotation changed rather sensitively with TF ripple. From this inter-machine experiment at 1.1MA, TF ripple less than 1% does not strongly affect the pedestal pressure. However, from the dedicated ripple experiments in JET at 2.6MA, it is found that the effect of ripple on H-mode properties (stored energy and density) varies depending on plasma background parameters. Thus, the development of new models which can reproduce the response of plasmas to TF ripple is urgently required for ITER. The result was reported in the joint paper of IAEA FEC 2010 in Korea by H. Urano et al. Meanwhile, JET ripple experiment with higher current plasmas showed clear pedestal degradation even at low ripple. Since there is no simple correlation between fast ion losses/torque/rotation and confinement explaining these experimental results, the response of the plasma to TF ripple should be modeled to provide more insight into possible effects of ripple on ITER plasmas.

JE154 Integrated modeling of ELMy H-mode plasma and its control (N. Hayashi, Aug.23-27, 2010)

N. Hayashi (JAEA) visited JET for the simulation and discussion of pellet triggered ELM. The triggering mechanism was studied by the integrated modeling in codes JINTRAC (JET) and TOPICS-IB (JAEA). Both codes could reproduce approximately the pellet penetration depth in JET and JT-60U experiments and predicted the following two triggering mechanisms. Both the energy absorption and the transport enhancement by the pellet were found to be able to trigger the ELM. The ablated cloud of pellet absorbs the background plasma energy and causes the radial redistribution of pressure due to the subsequent ExB drift. On the other hand, the sharp increase in local density and temperature gradients in the vicinity of ablated cloud causes the transient enhancement of heat and particle transport. Both mechanisms produce a region of an increased pressure gradient in the background plasma profile within the pedestal, which triggers the ELM. Simulations show that two considered mechanisms have the potential to explain a wide range of experimentally observed phenomena. This result was presented at the 23rd IAEA Fusion Energy Conference as a collaboration paper of the integrated modeling.

From JT-60 to US

JU99, Participation to the Experiment on the effect of edge electron heating on pedestal (N. Oyama, August 1-8, 2010)

The objectives of the experiment in Alcator C-Mod are to evaluate the capabilities of edge electron heating by lower-hybrid (LH) wave injection to modify ELM size (frequency), pedestal structure and plasma confinement. This experiment was performed as a joint experiment so called PEP-22 in ITPA pedestal topical group. In the experiment, we confirmed the reduction of the pedestal density together with the increase in the pedestal temperature in EDA H-mode plasmas even if LH wave cannot be accessible to the core plasma. In addition, the dedicated power scan reveals that the density pump-out effect is insensitive to the total LH wave power at or above ~300kW. Since this kind of density pump-out is also observed in JT-60U during the edge electron cyclotron wave injection with ELM mitigation, new experiments that LH wave injection is applied to ELMy H-mode plasmas will be performed in November/December to investigate changes in ELM characteristics.

JU100: PARTICIPATION TO THE EXPERIMENT ON EFFECT OF ENERGETIC PARTICLES ON RWM STABILITY (G. Matsunaga, July 11-18, 2010)

The objective of this trip was to progress analyses for the DIII-D experiment in January: D3DMP No. 2010-14-02, "Fishbone Driven Energetic particle interaction with RWMs." Mainly, comparison between DIII-D and JT-60U results has been done. It is found that the observed modes, energetic particle driven modes, in both devices have many similarities, for example, mode frequency, mode structure and waveform distortion. In particular, the waveform distortion seems to characterize this mode. Fast ion behaviors respond to the distortion. As for how the energetic particle driven mode can induce RWM onset, we are focusing on kinetic stabilization effect due to energetic ions. In the DIII-D case, large neutron drop and plasma rotation reduction caused by this mode were observed; these results are different from in JT-60U. These observations are thought to be attributed to fast ion loss. From the experimental results, the kinetic effect of fast ions to RWM stability was evaluated by MARS-K by Y. Liu. According to the MARS-K results, the observed results that the energetic particle driven mode can induce the RWM onset is consistent with a lack of fast ion stabilization to RWM. These results were summarized for the invited talk in APS 2020. Furthermore, we discussed experimental proposals for next campaign in 2011.

From US to EU

No report.

From US to JT-60

UJ300-25 Experiments on Negative Ion Systems

Larry Grisham's time at JT-60SA was primarily spent discussing the physics design strategy of the ITER accelerator with Dr. Kashiwagi, and discussing with Dr. Hanada and Dr. Kojima future experiments to elucidate more about the physical processes which are important for voltage holding in electrostatic accelerators and their support structures. He also discussed possible procedural solutions to resolve Japanese uncertainties about committing to a final design review of the megavolt bushing for ITER at a time when the impacts of complying with European codes for high voltage and pressure vessels are as yet unknown.

From EU to JT-60

EJ59 A. Salmi (12 - 16 July 2010)
Benchmarking the ASCOT and OFMC codes

Code benchmarking between guiding centre Monte Carlo codes ASCOT and OFMC was performed in JT-60U facilities in Naka, Japan. The aim was to verify and validate the newly-implemented OFMC diagnostics for toroidal torque from NB injection which was designed collaboratively and discussed prior to the visit. Accurate and validated calculations of toroidal NB injection torque is important for analysing current experiments and for predicting rotation in ITER.

For the benchmark, an axi-symmetric EFIT equilibrium for JET Pulse No. 72629 was used together with NB geometry information. Torque profiles were compared for all Octant 8 PINIs under one of two assumptions: (1) both codes used their own ionisation model or (2) OFMC used already-ionised ions provided by ASCOT. Excellent agreement was achieved, independent of which assumption was used, giving validation not only to the torque diagnostics implementations but also to the ionisation models and orbit tracing techniques used.

To benchmark successfully two independent codes requires significant care and testing to ensure that the input used is the same. Different co-ordinate definitions and conventions in ASCOT and in OFMC increased the challenge, but the close interaction and on-site presence proved to be extremely beneficial. Within the duration of this short visit all technical issues were resolved and mutual agreement was achieved.

OFMC expert, Honda-san, plans to include these results in his forthcoming IAEA NF article.

From EU to US

EU89-2 M. Zerbini (22 November 2010 – 7 January 2011)
Physics of ECE and toroidal rotation

Mission not yet completed. Report will be given at the next meeting.

EU100 M. Groth (1 – 22 December 2010)
Comprehensive comparisons of measurement again edge codes

Mission not yet completed. Report will be given at the next meeting.

From KO to EU

KE01 : Stability analysis of JET high beta advanced scenario experiments

By Ohjin Kwon (19th July – 27th Aug)

- The purpose of the visit to JET was to perform ideal MHD stability analysis of JET high beta advanced scenario experiments. Experimentally, it was found that continuous n=1 mode can live for many second. The mode begins as kink-ballooning but usually evolves into a tearing mode. Stability calculations are done for various high beta JET shots with qmin~1, 1.5, 2 with MISHKA code. It was found there is a good agreement between experimental onset of the n=1 mode and theoretical prediction. We have also extracted the perturbed poloidal magnetic field from the code to compare with ECE measurements. A good agreement was also found. These results were presented at the 23rd IAEA Fusion Energy Conference at Daejeon, Korea with collaborators including Ian Chapman and Paolo Buratti.