Summary of the 2nd Joint Meeting of the ITPA CC and the IEA CTP ITER Organization, Cadarache, France, 5-7 October 2011

M. Shimada

I. OPENING SESSION

Preliminary Safety Report (RPrS licensing documentation). Supporting R&D implemented through the ITPA made an important contribution to numerous aspects of physics analysis

n supporting IO's responses to Council's Charges to specific STAC Charges the scope of the ITPA R&D activities has been essential to building a substantial physics case for ITER's approach to resolving key physics issues in these areas. IC-9 has issued a Charge to ITER STAC for the STAC-12

conductor for the remaining modules, IO is following this strategy. So, this should b

3.2 Diagnostics (R. Boivin)

The Diagnostic Topical Group has refocused its efforts, which are:

- Specific needs:
    - Unmet measurement requirements, e.g. divertor flows.
    - New developments/techniques.
    - Contribute to address physics issues encountered in CDRs & STAC.
    - Present day lost alpha detectors do NOT extrapolate to ITER.
    - JET experience showed that activation probes may contribute to measuring losses.
    - The mission of 10% accuracy of neutron calibration would require a functional link of several types of neutron measurements and well planned calibration processes.
- Mitigate environmental effects: radiation; deposition/erosion; and stray ECH and reflections.
- Integrate measurements for: the Plasma Control System and ITER operations aspects; and calibration and data analysis.
- DEMO specific issues.

V. Chuyanov asked about the status of hot dust measurement. R. Boivin commented that now the measurement requirements are being discussed. A. Kallenbach asked about the castellated wall for lost alpha diagnostics. R. Boivin replied that now a number of ideas are being discussed. Y. Kamada asked about whether it is reasonable to re-examine the requirements of measurements. R. Boivin commented that revisiting of requirements is carried out during the CDR (Conceptual Design Review). G. Sips asked the resolution of the divertor heat profile measurement. R. Boivin commented that the resolution is adequate for measuring the divertor heat profile.

3.3 Edge Pedestal (H. Wilson, N. Oyama)

New H-mode results were reported from EAST, w96 DchH ack6e re

mode grows that is consistent with linear theory and is followed by a short saturated state, and then filaments begin to erupt.

New RMP ELM control results were reported from AUG: ELMs are mitigated provided the

3.7 Transport and Confinement (S. Kaye)

High priority was given to the effort of Working Groups. Physics model validation during current ramp- -Mod, DIII-D, JET) was covered under TC-20. Turbulence and transport in core-pedestal transition regime -10. A group on 3-D effects on transport and turbulence examined stellarator vs. tokamak studies, and focused on defining JEXs between stellarators and tokamaks. Impurity transport (TC-11) was another high priority area.

Medium priority areas included momentum transport and rotation drive, and electron transport.

The TG started 2011 with 16 JEX/JACs, and will close out of four JEX (TC1-4). On TC-1, a range dependences on shape, beta, n/n_G, W_{ped}/W_{th} were found. Is this due to different turbulent modes being dominant at different beta (micro-tearing at high beta)? Non-linear GYRO results indicate good agreement with ITG, but not TEM dominant plasmas (DIII-D). For TC-2, several devices (C- experiments related to access to the H-mode with good confinement while keeping the power close to the L-H threshold. In TC-3, it was well established that each device sees a critical density for $P_{th,min}$ (generally around $3\text{-}4\times10^{19}$ m^{-3} but higher in C-MOD). On TC-

ECEI (modified and extended from an existing HT-7 system); SX arrays (for kinetic equilibrium reconstruction); and more (optic and spectroscopic diagnostics, neutron, gamma-

dropper in collaboration with PPPL).

100 s long pulse divertor operation was attained by slowly sweeping the strike point for heat load control and recycling control with internal cryo-pump and lithium powder injection. A 6.4 s long H-mode was achieved with LHCD (1 MW) + ICRF (0.5 MW). H-mode duration was limited only by hardware. The threshold power of EAST LHCD H-mode agrees with the prediction of International Scaling; the power threshold is similar for I_p ramp-up and flat-top; there is a lower power threshold for I_p ramp-down; and good confinement was observed in a small ELM regime even with power close to the L-H transition threshold.

HT-7 also used lithium injection for recycling/impurity control and effective ICRF heating. A Material and Plasma Evaluation System has been installed on EAST.

4.2 EU (F. Romanelli)

An Independent Panel, appointed by the DG of Research, has reviewed the potential contribution of JET to ITER and strategic orientation of the EU fusion programme in Horizon 2020 (2014-2020). It found that JET: is vital for ITER; provided strong support to the full exploitation of the ILW plus a DT phase; and can possibly be further extended provided an international framework for JET exploitation is established. There is strong support to fusion as an energy source but the IP requested a profound restructuring of the organization of the EU programme. A working group is being set up to prepare a new organization. A Commission proposal for Horizon 2020 was presented on November 30. An agreement on ITER funds was reached on December 1.

JET has new capabilities: NB power from 20 MW/short pulse to 30 MW/long pulse routine operation (24 MW to 35 MW maximum); a high frequency pellet injector (50 Hz); Enhanced Radial Field Amplifier (already commissioned in 2009); and ~20 new diagnostic systems. Experiments during this phase will be at moderate input power. It aims to demonstrate sufficiently low fuel retention of the ITER-like wall. The assessment of the power handling of the ITER-like wall will include: transient events (documentation) of ELMs and disruptions; and control and mitigation of these transient events (applicable to ITER). JET will investigate beryllium and tungsten erosion, migration and deposition and material mixing. Development of ITER regimes of operation with the ITER-like wall will include control of impurities, the use of extrinsic impurities for power exhaust, and dedicated physics studies. It will prepare for ITER operation with all the control tools foreseen in ITER.

ECRH power in AUG will be further increased to 8 MW. The ICRH antennae will undergo modifications to demonstrate W-compatibility. 2×8 in-vessel coils in 2012 will allow n = 4. ECCD deposition will be feedback controlled from 2012 on. The pellet injection system has been upgraded to allow >100 pellets/discharge with freely programmable timing. HFS MGI valves show promising results. The divertor will be equipped with solid W-tiles.

Tore-Supra will enhance its heating and CD capability in 2011 and test RE suppression by high pressure fast gas injection. FIRE (Fast Injection by Rupture disk Explosion Technique) was successfully developed in 2011. FTU installed a new ECRH launcher for real-time control with 2 steerable mirrors. TCV demonstrated control of individual sawtooth period with ECCD. MAST demonstrated ELM mitigation with RMPs.

4.3 IN (P.K. Kaw)

Repair and refurbishment work of SST-1 has been completed. Operation of SST-1 will be resumed in January 2012. On the ADITYA tokamak, electrode biasing experiments were performed to investigate the underlying physics of L-H transition and experiments on RF

heating and pre-ionization were carried out. ETG-driven turbulence is being investigated in LVPD. Theory and modelling activities include: VDEs and disruptions; flow effects on sawteeth; and interaction between ETG and eGAMS in the pedestal region.

4.4 JA (Y. Kamada)

Under the activity of the JA-DA for the ITER Project, JAEA signed the procurement arrangements for the TF conductor, TF coil structures, TF coil winding, divertor outer target and CS conductor. The fabrication of the TF conductor is now in progress. In parallel, the optimization of fabrication processes and trial fabrication of TF coil structure and TF coil winding are being conducted.

The Broader Approach activity, composed of IFERC, IFMIF-EVEDA, and Satellite Tokamak, are in progress as scheduled. All the research buildings in Rokkasho were

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September 2011, nine procurement arrangements have been concluded for the Satellite Tokamak project (JT-60SA), and the fabrication of PF magnet conductor, vacuum vessel and materials of in-vessel components, etc. is now in progress. The JT-60SA Research Plan (SARP) is being developed under the collaboration with EU and the Fusion Energy Forum of Japan. JT-60SA will be equipped with NB (34 MW × 100 s) and ECRF (110/138 GHz, 7 MW × 100 s).

JT-60 experiments/data analyses and computer simulations contribute to ITER physics (ITPA) and the advanced tokamak physics for JT-60SA and DEMO. The TBM fabrication

T-10 experiments are carried out in Ohmic and ECRH discharges: spatial structure of plasma turbulence; plasma turbulence distribution by correlation reflectometry (CR); measurements of plasma potential, radial electric field and turbulence rotation velocity; plasma potential distribution by heavy ion beam probing (HIBP); experiments with lithium gettering; control of runaway electrons; ECR-assisted discharge start-up; and small magnetic island locking by error fields.

T-11M (TRINITI) conducted experiments with a liquid lithium limiter. Deuterium was recovered by heating to 500 ºC, suggesting that tritium can be removed from Li PFC by heating up to ~500 ºC. Globus-M (Ioffe Institute) conducted experiments on ion-beam driven instabilities and plasma start-up by RF. TUMAN-3M (Ioffe Institute) observed GAM evolution during the H-mode transition. FT-2 (Ioffe Institute) studied the spatial structure of GAMs. Tokamak T-15MD is being designed as a compact tokamak with flexible configuration with aspect ratio in the range of 2.2-3. The proposal to place the Italian tokamak IGNITOR in TRINITI by Moscow is under consideration.

Theory and modelling activities are continued in support of ITER in Kurchatov Institute, Efremov Institute, Keldysh Institute, TRINITI, SPbPTU, and Moscow State University. The integrated modelling program focuses on the ITER top priority issues, including disruptions, REs, VDEs, current ramp-up, ramp-down and ELMs. The modelling activities are coupled strongly to ITER engineering and diagnostics development. Future plans for theory and modelling include: continue supporting the ITER needs; code development for consistent simulation of disruption with REs in line with IMEG guidelines; supporting design and software development for diagnostic systems (Ha, NPA, neutrons procured by RF); and

TGs include some information about unpublished work, so the complete summaries should not be public.

Presently, the CC and all TG Chairs and Deputies have read access to all internal sites. We would like to extend this privilege to all members of the POP Directorate and the Diagnostics Division in the IO. The Diagnostics TG has opened their site to all with ITER accounts. Ensuing discussion by the CC approved access to all ITPA material by POP and IO Diagnostics.

A new ITPA Website Manager will be needed 1 April 2012, unless the present Manager continues in a voluntary capacity.

VII. ACTION ITEMS

7.1 ITPA Database Access and Release Policies

Y. Kamada will circulate the draft policies among the ITPA CC Contact Persons.

7.2 Working Group on Particle Confinement (A. Loarte)

Activities of the ITPA Particle Working Group have had a slow start but they are now gathering momentum. Most of work done so far has been under the ITPA Pedestal Group but involvement of Divertor-SOL Group and Transport Group in 2012 will be required to progress further. Work in 2011 has already highlighted some issues and provided important output for ITER. The use of transients to determine edge particle transport looks challenging from modelling and measurement points of view (use of reflectometer?). Evolution of the plasma density after H-mode with low core fuelling points towards no major difficulty in access to burning plasma conditions in ITER more experiments with low core source are required. Significant progress in another two areas (pellet fuelling and influence of ELM control on particle transport) is expected in 2012. Present ITPA Chairs/co-Chairs are gratefully acknowledged for their support and we look forward to collaborating with the new ones.

7.3 Approval of Meeting Plans

A tentative list of dates and venues of ITPA Topical Group meetings has been circulated. R. Pitts comments that Divertor and SOL Topical Group may hold its fall 2012 meeting in a place other than San Diego.

7.4 Preparation for the Next CC Meeting

The date of the next meeting, starting on Monday 10 December 2012, is tentatively agreed with the assumption that the ITER International Summer School does not fall on this date. Possible shortening the meeting to 3 days is suggested, which will be discussed during the ExCo meeting.

7.5 Discussion and Approval of Meeting Record

A draft summary of the meeting was circulated. The participants are requested to give comments to the Secretariat (michiya.shimada@iter.org).