EFDA
EUROPEAN FUSION DEVELOPMENT AGREEMENT
Task Force
INTEGRATED TOKAMAK MODELLING

ISM working session, 07-11 March 2011

INTEGRATED SCENARIO MODELLING

Agenda, List of task for ISM working session
07 March 14h - 11 March 18h, Cadarache

Presented by X LITAUDON & I VOITSEKHOVITCH

TF Leader : G. Falchetto
Deputies: R. Coelho, D. Coster

EFDA CSU Contact Person: D. Kalupin

ISM meeting rooms

- **Room "Salle des maquettes bat 506" + lunch**
  - for the joint Activity 1 with IMP3 activity
- **Room « Hot spot" bat 507 first floor**
  - for the Act 2 and Act 3
- **Room "SOL" bat 508 ground floor**
  - for meeting and remote participation

- **Activity- 1: Support Validation of the ETS**

- **Activity- 2 : Developing and validating plasma scenarios simulations for existing devices**

- **Activity- 3 : Support to predictive scenario modelling for future devices (ITER , etc)**

Agenda: Monday March 7

14.00 - 14.20	**Salle des maquettes bat 506** **Welcome, Agenda and working groups, Local information**	**G. Falchetto, X. Litaudon, V. Basiuk**
14.20 - 14.30	**ISM web page – short demonstration**	**I. Voitsekhovitch**
14.40 – 18h00	**ISM Working session** **1) "Salle des maquettes bat 506" for the joint Act-1 and IMP3 activity** **2) "Hot spot bat 507 first floor" for the Act 2 and Act 3**	**All**

Agenda: Tuesday March 8

9.00 - 18.00	ISM Working session 1) "Salle des maquettes bat 506" 2) "Hot spot bat 507 first floor"	All
10.00-12.00	Room "SOL" bat 508 ground floor : integrated core-SOL modelling for ITER: present status & perspectives 0. Introduction 1. ITER needs 2. integrated core-edge-SOL modelling 3. ETS 4. input to 2011 ISM actions	Presentations from I. Voitsekovitch W. Houlberg & A. Kukushkin S. WiesenV. Parail D. Coster
12.00 - 13.00	Lunch bat 506 First floor	All
13.00 - 16.30	ISM Working session	All
16.30 – 18.00	Room "SOL" bat 508 ground floor Modelling of current ramp down Current diffusion in JET hybrid discharges EPED modelling (reply to Ph Snider)	All P Belo J. Garcia X. Litaudon

Agenda: Wednesday March 9

9.00 - 18.00	ISM Working session 1) "Salle des maquettes bat 506" for the joint Act-1 and IMP3 activity 2) "Hot spot bat 507 first floor" for the Act 2 and Act 3	All
12.00 - 13.00	Lunch bat 506 First floor	All
13.00 - 17.00	ISM Working session.	All
17.00 – 18.00	Room "SOL" bat 508 ground floor 1) Presentation on JET/ITER ramp-up modelling at next ITPA-T&C 2) ITER hybrid modelling	I. Voitsekovitch J. Garcia

Agenda: Thursday March 10

9.00 – 18.00	**ISM Working session** **1) "Salle des maquettes bat 506" for the joint Act-1 and IMP3 activity** **2) "Hot spot bat 507 first floor" for the Act 2 and Act 3**	**All**
11:00-12:00	**Status of JT60-SA modelling (tbc)** **Room "SOL" bat 508 ground floor**	**All interested ISM members** **G. Giruzzi**
12.00 – 13.00	**Lunch bat 506 First floor**	**All**
13.00 – 18.00	**ISM Working session**	**All**

Thursday social dinner

Agenda: Friday March 11

9.00 - 13.00	ISM Working session 1) "Salle des maquettes bat 506" for the joint Act-1 and IMP3 activity 2) "Hot spot bat 507 first floor" for the Act 2 and Act 3	All
13.00 - 14.00	Lunch bat 506 First floor	All
14.00 – 18.00	Room "SOL" bat 508 ground floor : Activity 1-3 REPORTS : ETS validation ASDEX-U/JET hybrid modelling Edge modelling SOUL/EDGE-2D JET ramp-down modelling ITER hybrid ramp-up ITER hybrid Density modelling JT-60SA modelling Concluding remarks	All V. Basiuk J. Citrin C. Guillemaut V. Parail D. Hogeweij L. Garzotti G. Giruzzi X. Litaudon

Remote participation for meeting in Room ”SOL” bat 508 ground floor (from Tuesday-Friday)

- H323 (IP) multi-point videoconference participation

All participants have to dial the following E.164 number to connect
0049 100 979 19004 (this is not a phone number)

- For participation using phones

Please use the DFNVC - ISDN/IP gateway as follows to connect to the conference:
Dial with any phone this German telephone number
+49-711-6330190
Wait a second until you are asked to enter the conference ID.
Then please skip the 0049100 and enter only the rest of the string, namely:
97919004 followed by a # (hash).

- Screen broadcasting with “TSTV”

Slides will be broadcasted via Tore-Supra Tstv on which you can connect using any internet browser at : http://tstv.partenaires.cea.fr:5804 password solirfm

- SOL meeting room phone number : +33 4 42 25 6169
- Technical contacts :

Technical support hotline + 33 4 42 25 49 70
Secretary : SCCP: + 33 4 42 25 45 55
X. Litaudon : +33 6 37 84 28 38

Remote participation for meeting in Room "Salle des maquettes bat 506" (from Tuesday-Friday)

- H323 (IP) multi-point videoconference participation

All participants have to dial the following E.164 number to connect
0049 100 979 19005 (this is not a phone number)

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- Screen broadcasting with "TSTV"

Slides will be broadcasted via Tore-Supra Tstv on which you can connect using any internet browser at : http://tstv.partenaires.cea.fr:5808 password DRFC506

- meeting room phone number : +33 4 42 25 4246
- Technical contacts :

Technical support hotline + 33 4 42 25 4970
Secretary : SCCP: + 33 4 42 25 4555
X. Litaudon : +33 6 37 84 28 38

Participants:

- CCFE: I. Voitsekhovitch, V. Parail, L. Garzotti,
- IPP: J. Hobirk, E. Fable
- FOM: J. Citrin, D. Hogeweij
- FZJ: D. Harting, S. Wiesen
- RFX: M. Baruzzo
- ENEA: E. Barbato
- IST: J. Ferreira, J. Bizarro
- OAW: F. Koechl
- VR: S. Moradi
- CEA : X. Litaudon, V. Basiuk, G. Giruzzi, M. Schneider, J. Garcia, J. Artaud, J. Johner, F. Imbeaux, E. Nardon, B. Pegourie, F. Liu, D. Moreau, C. Guillemaut, R. Goswami
- ITER-IO : Th Casper, A. Polevoi, W. Houlberg , Sunhee Kim, A. Kukushkin, R. Pitts, A. Loarte, S. Lisgo

LOC : V. Basiuk & V. Icard

Activity- 1
Support Validation of the ETS

- **ASTRA, CRONOS, JETTO and TRANSP simulations for benchmarking of ETS modules:**
  - current diffusion with various models for bootstrap current and current conductivity,
  - density and temperature evolution with various transport models,
  - impurity evolution (SANCO runs)
  - Sharing of Fortran routines for transport models.

Activity- 1
Support Validation of the ETS

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities
Benchmarking of NCLASS	01/01/11	30/06/11	ASTRA, CRONOS, JETTO simulations	IMP3-ACT1, IMP4-ACT3 (NCLASS in ETS)
Benchmarking of Sauter neoclassical model	01/01/11	30/06/11	TRANSP runs for selected parametric domain	IMP3-ACT1, IMP4-ACT3
Benchmarking/sharing of transport models	01/01/11	31/08/11	New transport model in ETS. ASTRA, CRONOS, JETTO, simulations	IMP3-ACT1
Benchmarking of ETS impurity solver	01/01/11	28/02/11	JETTO/SANCO runs: benchmarking of reaction rates and radiated power	IMP3-ACT1,2

Working groups: ACT1

- **ETS V&V (Te, Ti, j, equilibrium): Vincent Basiuk, Joao Bizarro, Emiliano Fable, Jorge Ferreira, Irina Voitsekhovitch, Denis Kalupin, David Coster**

- **ETS/impurity: Irena Ivanova-Stanik, Sara Moradi, IMP3, AMNS**

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In preparation of benchmarking activity – modelling assumptions & input to be setup in ASTRA/CRONOS/JETTO/TRANSP:

- **JET 77922: hybrid scenario with current overshoot, Btor = 2.3 T, Ipl = 1.7 MA, high triangularity (0.38), 18 MW of NBI, nl = 4.8e19 m-3, βN = 2.8**
- **Selected initial time slice 47.7 s: same input data for all codes taken from TRANSP run I14 with normalised square root of toroidal flux coordinate. PPFs: voits/TRAU/TE,TI,NE,NC,ZEFF,CUR,Q,OMEG seq. 418**
- **Bohm/gyroBohm transport model for χe and χi and constant density profile taken at 47.7s**
- **Gaussian profile for H&CD (centred at ρ=0, half-width $\Delta\rho$=0.3), Ptot=18 MW, Ini=0.12 MA. Power & current are not evolving. 70% on ion and 30% electron**
- **Two cases : i) Spitzer resistivity, zero BS current, ii) Neoclassical resistivity & BS current**
- **Run till steady state: 40 s with CRONOS, ASTRA, JETTO**
- **ASTRA (E. Fable), CRONOS (V. Basiuk/J. Garcia), JETTO (D. Kapulin, F. Koechl, J. Bizarro), TRANSP (I. Voitsekhovitch)**
- **ETS (V. Basiuk, D. Kalupin, S. Moradi)**
- **Exp2itm (D. Kalupin), CRONOS->CPO (V. Basiuk), TRANSP->CPO (J. Ferreira, done)**
- **Impurity simulations (Irena Ivanova-Stanik & Sara Moradi)**

Activity 2
Developing and validating plasma scenarios simulations for existing devices

- **Interpretative and predictive modelling of hybrid scenario for existing EU devices:**
  - current ramps in hybrid scenario; validation of transport models
  - current diffusion during main heating phase, effect of impurities on sawtooth-free operation
  - first steps towards momentum transport in hybrid scenario: validation of existing transport models (GLF23, Weiland)
  - edge MHD stability analysis
- **Collaboration with T&C and IOS ITPA groups on current ramp-up simulations (e.g. DIIID) and modelling of JET/JT-60U identity experiments**

Activity 2
Developing and validating plasma scenarios simulations for existing devices

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities
Current profile diffusion in hybrid scenario	04.01. 2011	31.12. 2011	Current diffusion simulations including ramp up, main heating and ramp down phases.	
Modelling of plasma rotation in hybrid scenario	04.01. 2011	31.12. 2011	Test of existing models for plasma rotation: GLF23, Weiland models.	
Modelling of current ramp-down	04.01. 2011	31.12. 2011	Validated transport models on existing dedicated ITER ramp-down experiments	
Modelling of DIII-D current ramp up discharges	04.01. 2011	ITPA T&C meeting, 2011	Current diffusion simulations and transport modelling: test of transport models	data from ITPA database
Validation and benchmarking of SOUL 1-D	01.06. 2011	31.12. 2011	Validation and benchmarking of SOUL 1-D: SOUL 1-D and EDGE2D runs for JET plasmas	-

Working groups: ACT2 (I)

- **AUG modelling – finalisation of the EPS paper Jonathan Citrin, Joerg Hobirk, Mireille Schneider**
  - Thermal transport with GLF23 NBI benchmarking

- **Current ramp down at JET: Vassili Parail, Paula Belo (remotely)**
  - other transport models in addition to BgB
  - Impurity simulations
  - Transition from type I to type III during ramp-down

- **Current diffusion in JET hybrid scenarios: Jeronimo Garcia, Jonathan Citrin, Florian Koechl:**
  - "Validation of current diffusion modelling for low and high δ starting from the beginning to the end of the heating phase. Extend over 3tR in a predictive way these cases in order to infer the final q profile. Validation of transport models. Pulses: 76858, 77933, 77922, 77914." (E. Joffrin)

  77922, 76858, 77914 – current diffusion &T (BgB) modelling is done during EFTM measurements phase (CRONOS&JETTO)
    - **Extend over 3tR ? Current ramp up?**

Working groups: ACT2 (II)

- **Benchmarking of SOUL-1D and EDGE2D: Frederic Imbeaux, Cristophe Guillemaut, Jean-Francois Artaud, Rajiv Goswami, Derek Harting, Sven Wiesen, Paula Belo (remotely)**
  - agree on pulse list, simulation assumptions and parameters, setup runs

Low priorities activity

- **Modelling of DT operation for JET: Irina Voitsekhovitch, … Henri Weisen (remotely), Paul Thomas – on request of Henri/Paul**

- **DIII-D modelling and ITPA model benchmarking: Irina Voitsekhovitch, Dick Hogeweij or Jonathan Citrin (1 CRONOS run with empirical model), Johnny Lonnroth or Florian Koechl (1 JETTO run with BgB)**

Activity-3
Support to predictive scenario modelling for future devices (ITER , etc)

- **Support to predictive modelling of hybrid scenario in future devices (ITER, JT60-SA)**
  - repeat previous ITER modelling with the revised ECRH antenna configuration, assess the effect of ECRH on q-profile evolution
  - study the pellet fuelling and effect of peaked density profile
  - modelling of the current ramps including free-boundary equilibrium,
  - scan the 0D operation space (Ti/Te, density, current, confinement factor etc)
  - develop model based control matrices for real time profile control
  - assess MHD stability
- **JT-60SA modelling**
  - Define operational space (0-D modelling)
- **Integrated edge and core modelling of H-mode scenario including impurity seeding for radiative divertor**

Activity-3 Support to predictive scenario modelling for future devices (ITER , etc)

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities
Hybrid scenario with revised ITER ECRH antenna configuration	04.01. 2011	04. 2011	scenario to be developed and passed for density modelling	ITER-IO provides the exact ECRH configuration
Hybrid scenario with revised ITER ECRH antenna and density modelling	04.01. 2011	31.12. 2011	scenario to be developed and passed for MHD analysis and impurity modelling	
Modelling of deep pellet fuelling in ITER hybrid regime	04.01. 2011	31.12. 2011	Assess the pellet penetration in ITER hybrid scenario	
Hybrid 0-D modelling	04.01. 2011	31.12. 2011	Estimation of operational space for hybrid scenario in future devices	
ITER hybrid current ramp-up and free boundary equilibria calculation	04.01. 2011	31.12. 2011	Optimised q-profile during ramp-up phase for Hybrid regime Scenario operational space constrained from PF limits)	
MHD stability of hybrid scenario	04.01. 2011	31.12. 2011	Stable MHD domain	
hybrid real time q profile control	04.01. 2011	31.12. 2011	Model based matrices for profile control	
Integrated modelling of ITER H-mode scenario including impurities	04.01. 2011	31.12. 2011	Core-edge-SOL simulations: temperatures, density, current diffusion, impurity	
JT-60SA modelling	04.01. 2011	31.12. 2011	Define operational space (0-D modelling)	

Working groups: ACT3

- **Current ramp up in ITER HS: Dick Hogeweij, F. Koechl, Tom Casper, Jonathan Citrin: fixed boundary calculation, check q-profile shaping**
- **Revised ITER HS –> divertor loads: Jeronimo Garcia, Derek Harting (EDGE-2D), Sven Wiesen**
  - Input from CRONOS ITER modelling are needed to Derek Harting
- **H-mode in ITER + impurity: Sven Wiesen, Derek Harting, Paula Belo**
- **Pellet fuelling for ITER: Bernard Pegourie, Luca Garzotti, Florian Koechl.**
  - Repeat the latest CRONOS Hybrid Scenario in JETTO and then pellet modelling
- **Revised HS with density modelling: Luca Garzotti, Florian Koechl, Jeronimo Garcia**
  - Sensitivity studies on the density profiles
- **Current profile control: Didier Moreau, F. Liu**
  - Modulation of actuactors using Hybrid runs from METIS
- **Operational domain for ITER: Alexei Polevoi, Irina Voitsekhovitch, Tom Casper with the help of all ISM members to collect the data for already performed simulations**
- **JT60SA modelling: Gerardo Giruzzi, Xavier Litaudon, Emilia Barbato, Matteo Baruzzo, Mireille Schneider, Jean-Francois Artaud, Jeronimo Garcia, Jean Johner, Irina Voitsekhovitch**
  - METIS modelling
  - LHCD modelling with prescribed profiles
  - Ohmic modelling with prescribed shape (JETTO, ASTRA)
- **Edge MHD for revised ITER HS: Xavier Litaudon, Phil Snyder**