Integrated edge modelling plans for ISM 2010/2011

- discussion last week: I.Voitsekhovitch, V.Parail, P.Belo, S.Wiesen

- no new separate projects were defined

- but S.Wiesen and P.Belo will complement to other projects already defined

- the already started task on integrated core-pedestal-SOL modelling with JINTRAC on ITER density evolution (F.Koechl, S.Wiesen et al) shall be continued

- the issue of impurities (which was precluded from the analysis when doing integrated modelling with JETTO/EDGE2D-EIRENE) shall be included now

- other potential co-workers: J.Lonnroth, F.Kochl, R.Kemp(?)

- more input on data on impurities necessary:
L.Lauro-Taroni, M.Valisa, M.Ester, C.Angione…

Project-1 : Validation of the ITM tools (ETS)

Ref.	Task name	Start date	Involved physicist	Possible edge&impurity modelling
ISM-P1-2010-1	Verification of ETS tool on JET ohmic pulse	March 2010	G. Pereverzev, J. Ferreira, J. Bizarro, D. Kalupin, D. Coster, I. Voitsekhovitch G. Pereverzev, J. Ferreira, J. Bizarro, D. Kalupin, D. Coster, I. Voitsekhovitch	
ISM-P1-2010-2	Verification of temperature and density transport solvers in ETS	Sept 2010	J. Ferreira, D. Kalupin, D. Coster, G. Pereverzev, I. Voitsekhovitch	
ISM-P1-2010-3	Verification of impurity solver in ETS	Sept 2010	P. Belo, I. Ivanova-Stanik, D. Kalupin, I. Voitsekhovitch	SANCO runs for benchmarking
ISM-P1-2010-4	Verification of equilibrium solver and PFDE in ETS	Sept 2010	D. Kalupin, F. Koechl, G. Pereverzev, D. Coster, I. Voitsekhovitch	
	ITER Machine description	Sept 2010		

Project-2 : Interpretative & predictive integrated scenario modelling on existing devices

Ref.	Task name	Start date	Involved physicist	Possible edge&impurity modelling
ISM-P2-2010-00	Modelling of current ramp-up in JET, Asdex, Tore Supra	2008	F. Imbeaux, D. Hogeweij, F. Koechl, J. Hobirk	
ISM-P2-2010-1	JET DT extrapolation of the hybrid regime	August 2010	G. Sips, C. Challis, F. Imbeaux, G. Giruzzi, J. Garcia , I. Voitsekovitch, J. Henkins, TRANSP modelling, F. Kochl (Jetto), L. Garzotti	Reference scenario can be analysed with EDGE2D and SANCO
ISM-P2-2010-2	Modelling of plasma rotation in Hybrid Scenario			
ISM-P2-2010-3	Current ramp up JET discharges with li control.			
ISM-P2-2010-4	Modelling of DIII-D current ramp up discharges (ITPA database)		I Voitsekhovitch, J. Hobirk, F. Imbeaux, D. Hogeweij, V. Parail, T Casper, D. Mikkelsen (T&C ITPA), G.L. Jackson, J.M. Park (DIII-D)	

Ref.	Task name	Start	Involved physicist	Possible edge&impurity modelling
ISM-P2-2010-05	**Current ramp-up in JET Hybrid Scenario: modelling and optimisation.**		**E. Joffrin, J. Garcia, D. Hogeweij, F. Koechl ,**	
ISM-P2-2010-06	**Modelling of JET current ramp down experiments – optimisation of flux consumption and li**			Modelling of H-L transition during ramp down (& not only) with EDGE2D: divertor heat loads can be estimated in a snapshot modelling
ISM-P2-2010-07	**Current profile diffusion in JET hybrid scenario**			Impurity modelling: what impurity profile can help to maintain q0>1 in steady-state HS? what would be an effect on performance (radiation?, transport – if impurity dependent?)
ISM-P2-2010-8	**ASDEX interpretative hybrid modelling**	**Sept 2010**	**. J. Hobirk, P. Belo, J. Citrin, J. Garcia, F. Koechl, J. Lonnroth, M. Schneider, I. Voitsekhovitch**	

Ref.	Task name	Start	Involved physicist	Possible edge&impurity modelling
ISM-P2-2010-9	**Predictive JET /JT-60U modelling of the identity experiments**	**Sept 2010**	**V. Parail, T. Tala Y. Sakamoto, P.C. de Vries, A. Salmi**	
ISM-P2-2010-10	**Impurity of JET hybrid**			The reference scenario developed by the group can be examined for impurity transport (core impurity modelling): what will be an effect on performance when impurity is included (similar analysis as for ISM-P2-2010-1)?

Project-3 : Predictive scenario modelling for ITER (JT-60SA, DEMO)

Ref.	Task name	Start date	Involved physicist	Status/comments
ISM-P3-2010-01	**Migration of 2009 ISM ITER modelling to ITM-TF Gateway**	**Sept 2010**	**I. Voitsekhovitch (for technical work), all ISM members to suggest the runs, ITM expert to help with ITM conversion tools**	**Can we port JITNRAC to ITM-TF? How about SOLPS?**
ISM-P3-2010-02	**Modelling of deep pellet fuelling in ITER hybrid regime**	**Sept 2010**	**B. Pegourie, L. Garzotti,…**	F.Koechl, S.Wiesen?
ISM-P3-2010-03	**Modelling of the current ramp-up to 15MA baseline scenario**	2008	**F. Imbeaux, D. Hogeweij, F. Koechl, J. Hobirk, T. Casper**	
ISM-P3-2010-04	**ITER Hybrid 0-D modelling with HELIOS**			
ISM-P3-2010-05	**ITER Hybrid 0-D modelling with METIS**			
ISM-P3-2010-06	**Hybrid scenario with revised ITER ECRH antenna configuration**		**J. Garcia, M. Schneider, J. Citrin, F. Koechl, G. Giruzzi, G. Sips, T. Casper, E. Joffrin, J. Hobirk , I Voitsekovitch**	
ISM-P3-2010-07	**Hybrid scenario with revised ITER ECRH antenna and density modelling**		**J. Garcia, M. Schneider, J. Citrin, F. Koechl, G. Giruzzi, G. Sips, T. Casper, E. Joffrin , J. Hobirk, I Voitsekovitch**	**???**

New (redefined) ISM-P3-2010-08 project

ISM Task description

Task name: Integrated modelling of ITER H-mode scenario including impurities (seeded and intrinsic)

Project : P3 (Predictive scenario modelling for ITER, JT-60SA, DEMO…)

Task reference: ISM-P3-2010-08

Version: 1

Date of revision:

Start date: 2010

Tentative completion date: 2011 or later

Physicist involved: S. Wiesen, P. Belo, F. Koechl, J. Lonnroth, V. Parail

Codes involved and version: JETTO/SANCO, EDGE2D

Machine and pulses numbers: ITER

Detailed Task description:

Previous integrated core-pedestal-SOL modelling of ITER H-mode scenario has been performed for pure D-T plasma with pellets. This task will be extended to include the impurity evolution in self-consistent simulations for testing the impurity effect on plasma performance: radiation, dilution, impurity dependent transport (if theory-based models are used?).

What was done beforehand in the ISM:

• investigation of existing database on ITER edge plasma scenarios:
SOLPS4 simulation → scaling laws for Lmode ITER scenarios
(cf. A.Kukushkin, V.Kotov, et al…)

necessary condition: partial detachment, critical limit 10 MW/m^2

• benchmark EDGE2D-EIRENE w/ ITER version of SOLPS4 (S.Wiesen)
→ refinement of atomic and molecular physics necessary for Lmode
scenarios

• setting up for Hmode scenario-2, transport model modification (ETB)
→ impurities necessary to get rid of extra heat in SOL
(combined seeded and intrinsic impurities 20-40 MW+)

• For ITER H-mode cases: we have to radiate away ~ 20MW+ of power from the SOL, otherwise we will not get divertor detachment and the steady-state target deposited power will exceed the 10 MW/m^2 limit (P.Belo, S.Wiesen)
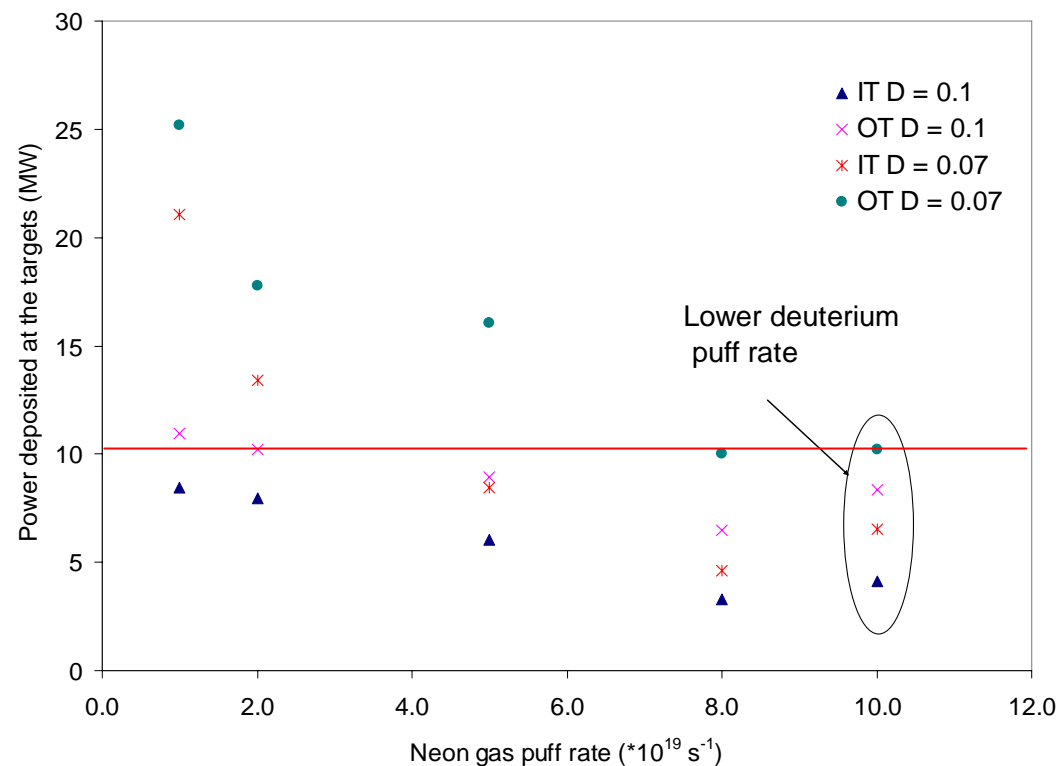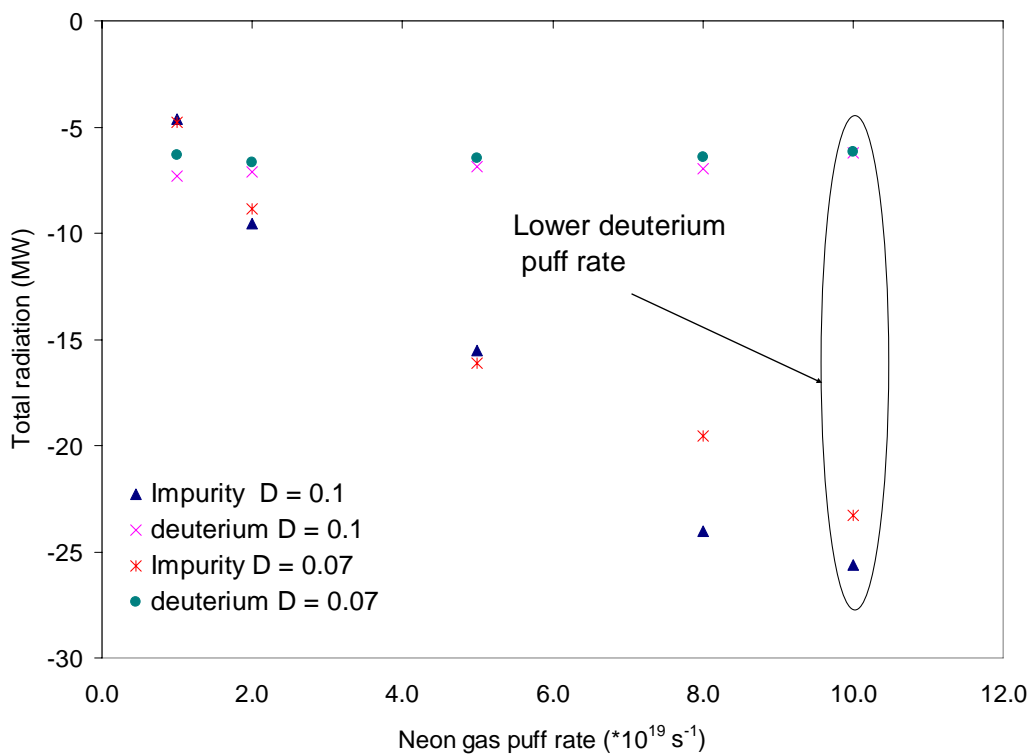
Integrated modelling of density evolution for ITER scenarios

• 2D tools: EDGE2D (and other, like SOLPS, if available)
→ can provide separatrix conditions to core models:
  ne, Te, Γ_0, Γ_{imp}
as function of upstream conditions:
  P_{SOL}, Γ_{SOL} from core
plus necessary limitations and constraints:
  detached divertor (P_{target} < 10MW/m^2 in steady-state)
  neutral molecular physics (not scalable!), pump efficiency
  avoidance of density limits (overfuelling of SOL/divertor)
  impurity transport (seeded and intrinsic, mixed materials),…
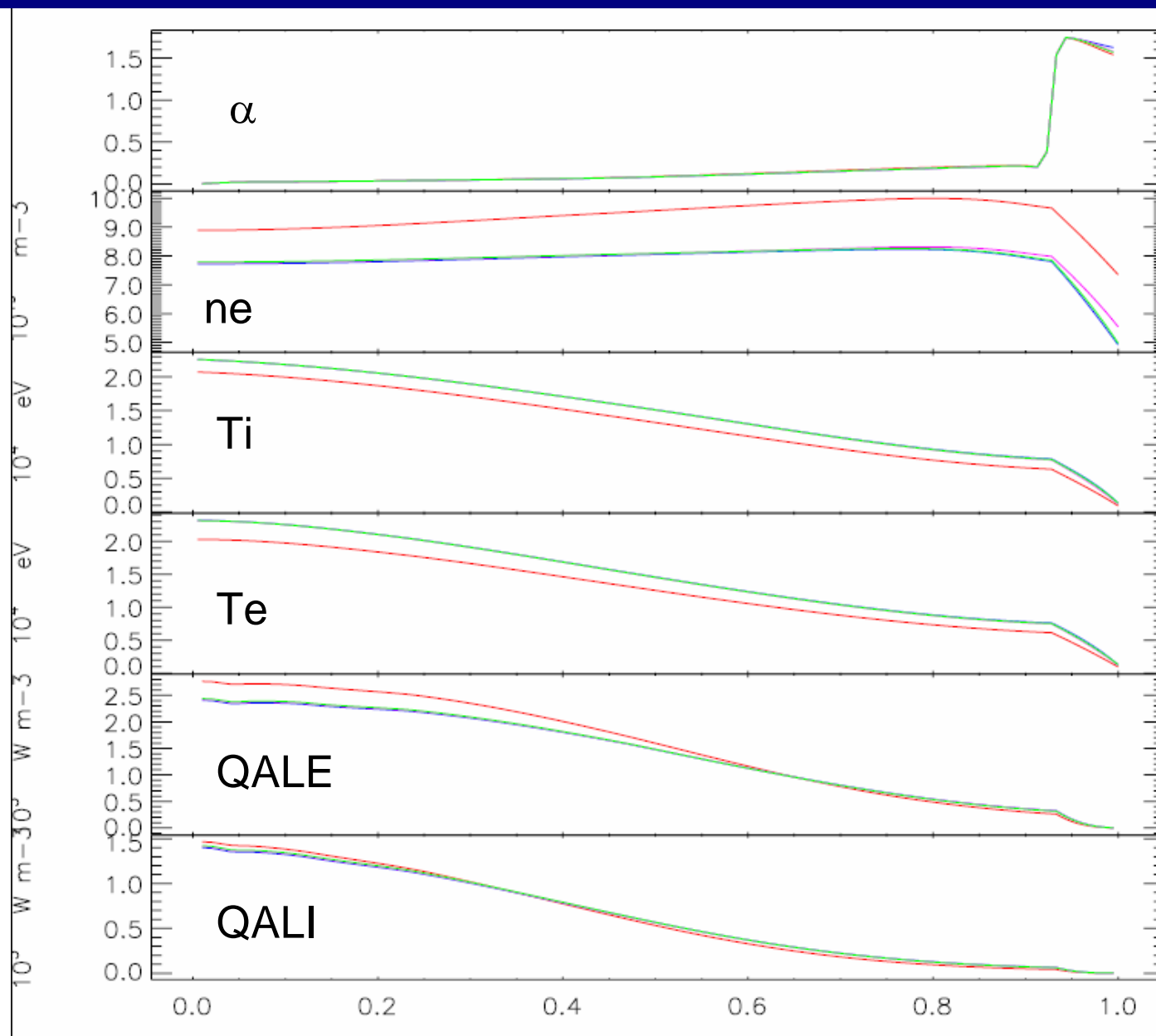above not self-consistent, example: discrete pellets or ELM-events
→ upstream conditions vary strongly in time
→ use a more integrated approach, ie combine core and SOL physics

• available tool: JINTRAC/COCONUT (ie JETTO + EDGE2D)
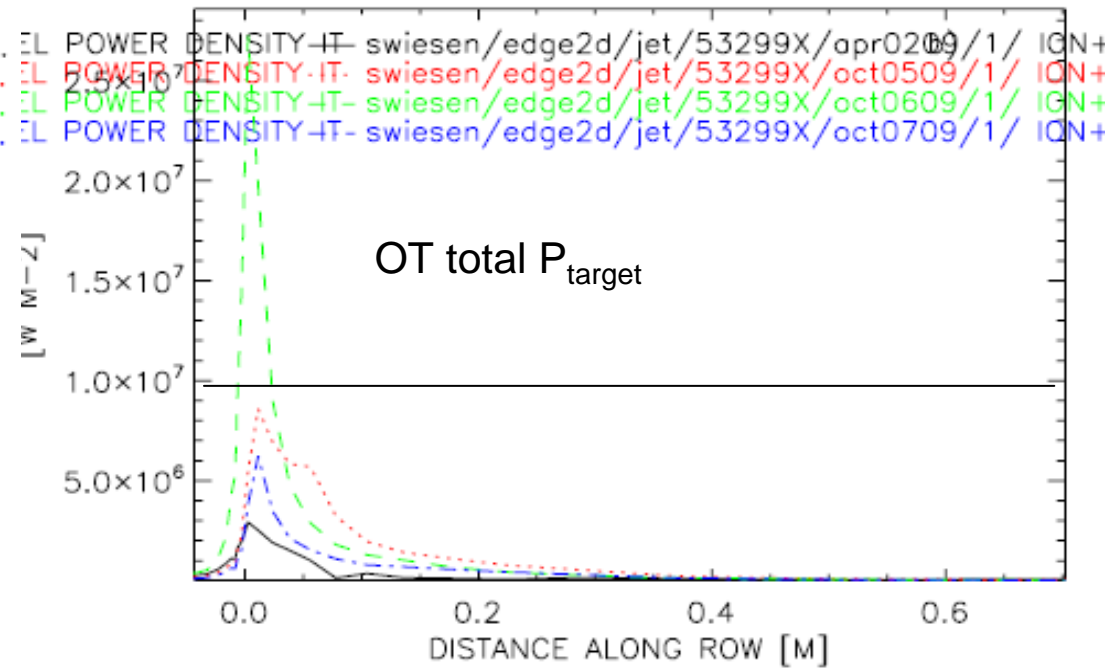
Cont. pellets
Cont. ELMs

(S.Wiesen)

Lisbon, no imps

Oct09 no imps

Oct09 no imps
deeper SOL-TB

Oct09 + 40MW
added radiation
loss in SOL:
• prescribed $P_{rad}(Te)$
• impurity transport
neglected

OMP ne (top-left)

Legend:
- swiesen/edge2d/jet/53299X/apr0209/1/ ENSITY OT
- swiesen/edge2d/jet/53299X/oct0509/1/ ENSITY OT
- swiesen/edge2d/jet/53299X/oct0609/1/ ENSITY OT
- swiesen/edge2d/jet/53299X/oct0709/1/ ENSITY OT

y-axis: [M-3]
x-axis: DISTANCE ALONG ROW [M]

OMP Te (top-right)

Legend:
- swiesen/edge2d/jet/53299X/apr0209/1/ EL. T
- swiesen/edge2d/jet/53299X/oct0509/1/ EL. T
- swiesen/edge2d/jet/53299X/oct0609/1/ EL. T
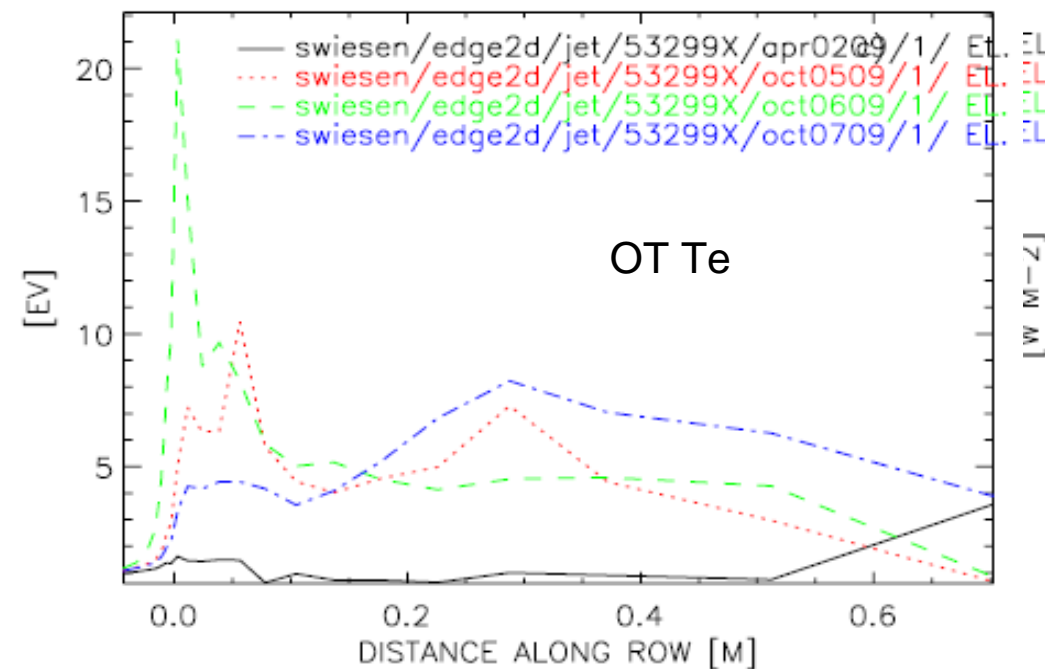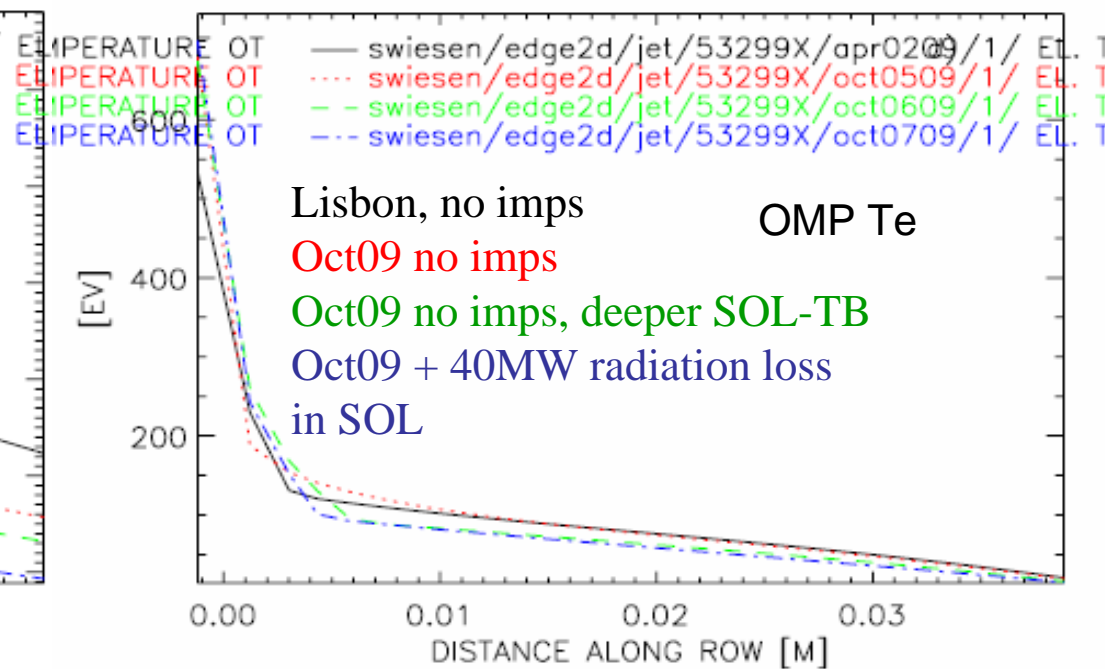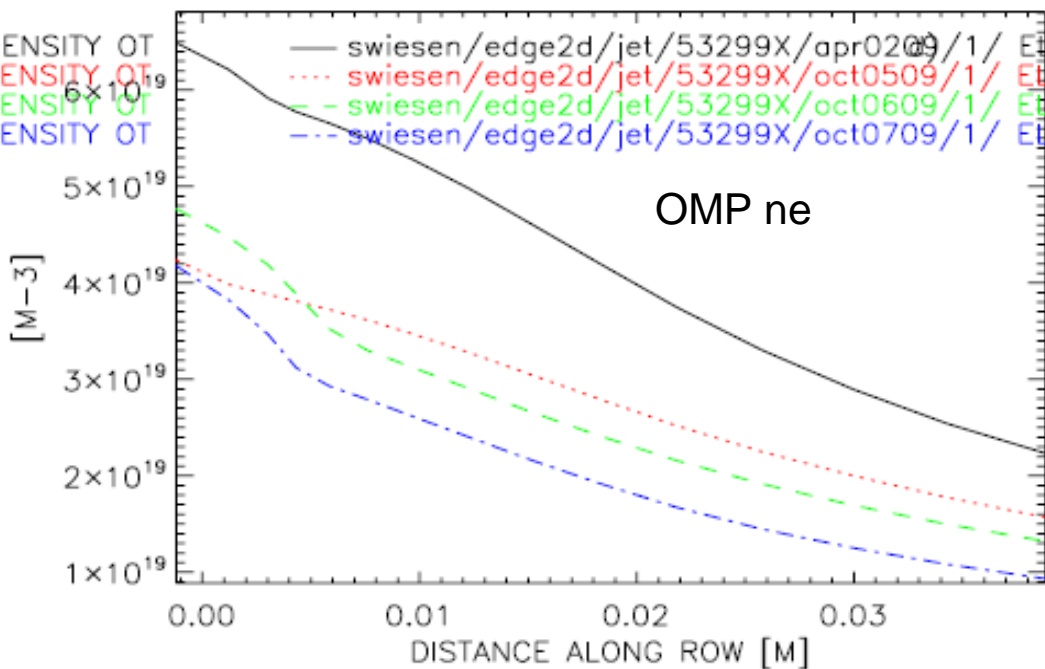- swiesen/edge2d/jet/53299X/oct0709/1/ EL. T
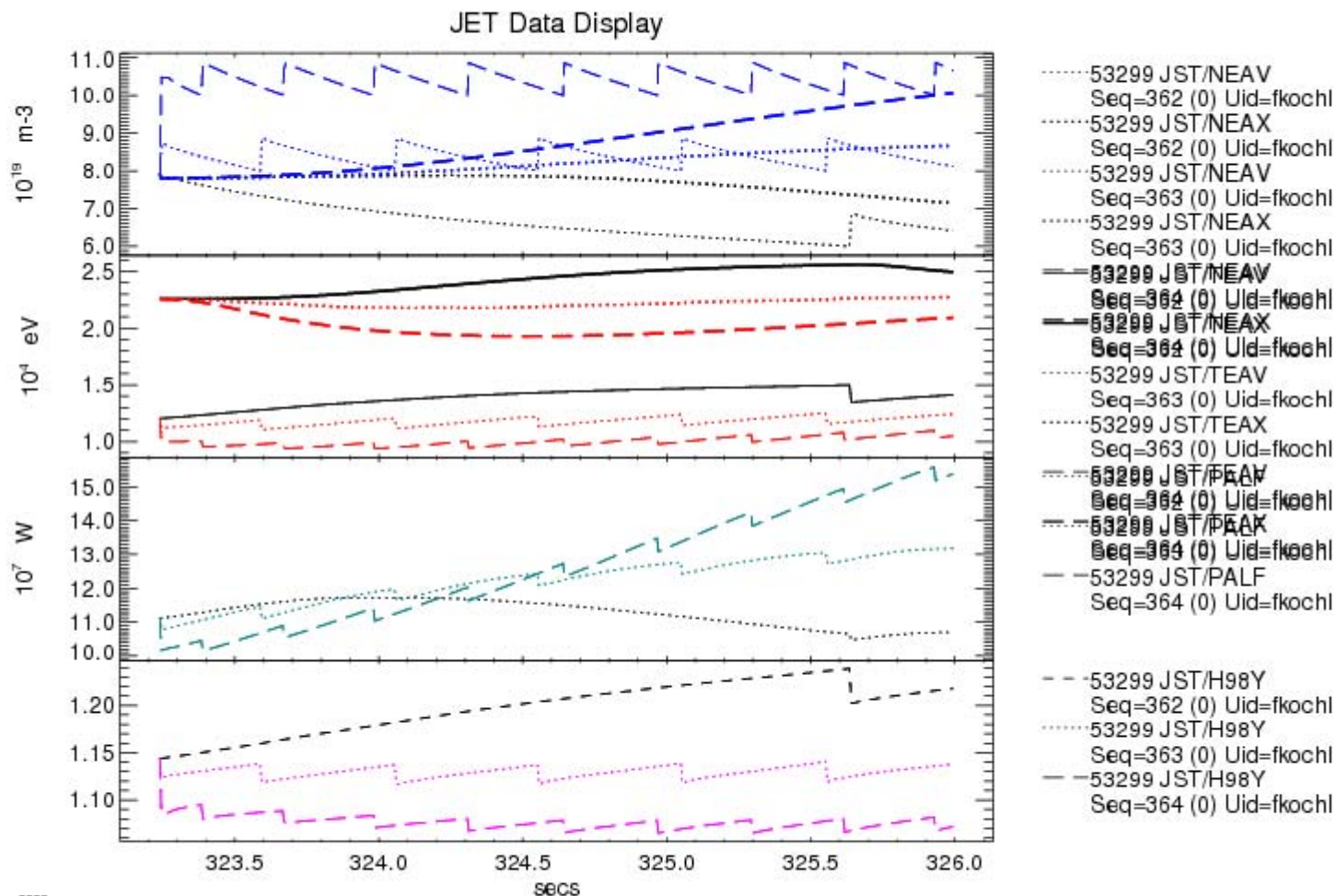
Lisbon, no imps
Oct09 no imps
Oct09 no imps, deeper SOL-TB
Oct09 + 40MW radiation loss in SOL

y-axis: [EV]
x-axis: DISTANCE ALONG ROW [M]

OT Te (bottom-left)

Legend:
- swiesen/edge2d/jet/53299X/apr0209/1/ EL.
- swiesen/edge2d/jet/53299X/oct0509/1/ EL.
- swiesen/edge2d/jet/53299X/oct0609/1/ EL.
- swiesen/edge2d/jet/53299X/oct0709/1/ EL.

y-axis: [EV]
x-axis: DISTANCE ALONG ROW [M]

OT total P$_{target}$ (bottom-right)

Legend:
- EL POWER DENSITY IT swiesen/edge2d/jet/53299X/apr0209/1/ IGN+
- EL POWER DENSITY IT swiesen/edge2d/jet/53299X/oct0509/1/ IGN+
- EL POWER DENSITY IT swiesen/edge2d/jet/53299X/oct0609/1/ IGN+
- EL POWER DENSITY IT swiesen/edge2d/jet/53299X/oct0709/1/ IGN+

y-axis: [W M-2]
x-axis: DISTANCE ALONG ROW [M]

• inclusion of discrete pellets (F.Koechl, S.Wiesen, preliminary results)

• finalise paper on density evolution (october 2010)

• revisit JINTRAC simulations of last year (cont. ELMs, discrete pellets) and introduce impurities: eg. C+Ne or Be+Ne (W+Ne)

(JETTO/SANCO is now correctly coupled to EDGE2D-EIRENE since sep2010 and is currently being tested through JET TFE modelling activity)

• tungsten is a separate issue: stronger impact on core confinement than on SOL plasma (W will not radiate much in SOL & will not change particle and momentum balance dramatically there)

→ can be possibly treated kinetically in SOL (eg DIVIMP or EIRENE-TIM)
→ pass over W fluxes to JETTO/SANCO
(those models should be checked w/ existing data/expts, AUG and later JET)

• insert discrete ELMs in the analysis (cf N.Hayashi, V.Parail et al IAEA2010)