EFDA
EUROPEAN FUSION DEVELOPMENT AGREEMENT

10-Feb-2010

EFDA WORKPROGRAMME 2010

Transport

TASK AGREEMENT
WP10-TRA

(covering WP10-TRA-01, WP10-TRA-02, WP10-TRA-03, WP10-TRA-04, WP10-TRA-05)

Between:
The EFDA Leader
and the following Associates

- Belgium_ERM-KMS	- ENEA_RFX	- INRNE	- RISØ
- Belgium_ULB	- FOM_Rijnhuizen	- IPP	- Swiss Confederation
- CCFE	- FZJ	- IPP.CR	- TEKES
- CEA	- Greece_Cyprus	- IST	- VR
- CIEMAT	- HAS	- MEdC	- ÖAW
- ENEA_CNR	- Hellenic Republic	- MHEST	

Start date:	*EFDA Responsible Officer:*	*Tel.:*	*E-mail:*
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Association:	*Signature:*		*Date:*

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Priority Support Summary: CfP-WP10-TRA-01

Task	Association	Start date	End date	Priority Support (ppy)	Manpower (k€)	EU 8.2a contribution 20%	Hardware (k€)	EU 8.2b contribution 40%	EU contribution total (k€)
WP10-TRA-01	Belgium_ERM-KMS	01. Jan 2010		0.20	15.260	3.052	2.000	0.800	3.852
WP10-TRA-04	Belgium_ERM-KMS	01. Jan 2010		0.20	29.648	5.930	0.000	0.000	5.930
Total				0.40	44.908	8.982	2.000	0.800	9.782
WP10-TRA-02	Belgium_ULB	01. Jan 2010		0.20	7.200	1.440	0.000	0.000	1.440
Total				0.20	7.200	1.440	0.000	0.000	1.440
WP10-TRA-01	CCFE	01. Jan 2010		0.20	23.000	4.600	0.000	0.000	4.600
Total				0.20	23.000	4.600	0.000	0.000	4.600
WP10-TRA-02	CEA	01. Jan 2010		0.90	153.900	30.780	10.000	4.000	34.780
Total				0.90	153.900	30.780	10.000	4.000	34.780
WP10-TRA-01	CIEMAT	01. Jan 2010		1.40	126.000	25.200	158.000	63.200	88.400
WP10-TRA-05	CIEMAT	01. Jan 2010		0.20	18.000	3.600	0.000	0.000	3.600
Total				1.60	144.000	28.800	158.000	63.200	92.000
WP10-TRA-01	FZJ	01. Jan 2010		0.30	33.750	6.750	0.000	0.000	6.750
Total				0.30	33.750	6.750	0.000	0.000	6.750
WP10-TRA-01	HAS	01. Jan 2010		0.30	6.737	1.347	50.000	20.000	21.347
Total				0.30	6.737	1.347	50.000	20.000	21.347
WP10-TRA-05	INRNE	01. Jan 2010		0.30	6.528	1.306	0.000	0.000	1.306
Total				0.30	6.528	1.306	0.000	0.000	1.306
WP10-	IPP	01. Jan		0.90	124.446	24.889	0.000	0.000	24.889

TRA-01		2010							
WP10-TRA-02	IPP	01. Jan 2010		0.80	105.960	21.192	0.000	0.000	21.192
WP10-TRA-04	IPP	01. Jan 2010		0.25	25.427	5.085	0.000	0.000	5.085
Total				1.95	255.832	51.166	0.000	0.000	51.166
WP10-TRA-02	IST	01. Jan 2010		0.33	47.520	9.504	2.000	0.800	10.304
WP10-TRA-04	IST	01. Jan 2010		0.20	28.800	5.760	0.000	0.000	5.760
WP10-TRA-05	IST	01. Jan 2010		0.20	26.100	5.220	0.000	0.000	5.220
Total				0.73	102.420	20.484	2.000	0.800	21.284
WP10-TRA-01	RISØ	01. Jan 2010		0.30	26.400	5.280	0.000	0.000	5.280
WP10-TRA-05	RISØ	01. Jan 2010		0.30	26.400	5.280	0.000	0.000	5.280
Total				0.60	52.800	10.560	0.000	0.000	10.560
WP10-TRA-05	Swiss Confederation	01. Jan 2010		0.30	20.533	4.107	0.000	0.000	4.107
Total				0.30	20.533	4.107	0.000	0.000	4.107
WP10-TRA-01	TEKES	01. Jan 2010		0.20	28.000	5.600	0.000	0.000	5.600
WP10-TRA-05	TEKES	01. Jan 2010		0.20	31.000	6.200	0.000	0.000	6.200
Total				0.40	59.000	11.800	0.000	0.000	11.800
WP10-TRA-04	VR	01. Jan 2010		0.20	22.375	4.475	0.000	0.000	4.475
Total				0.20	22.375	4.475	0.000	0.000	4.475
WP10-TRA-05	ÖAW	01. Jan 2010		0.40	24.533	4.907	0.000	0.000	4.907
Total				0.40	24.533	4.907	0.000	0.000	4.907
Grand total				8.78	957.517	191.503	222.000	88.800	280.303

EFDA Workprogramme 2010

Transport

TASK AGREEMENT

Chapter 1: Physics of L-H Transition

WP10-TRA-01

Between:
The EFDA Leader
and the following Associates

- Belgium_ERM-KMS	- FZJ	- MEdC
- CCFE	- HAS	- RISØ
- CIEMAT	- IPP	- TEKES
- FOM_Rijnhuizen	- IPP.CR	- ÖAW

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1. Introduction

The edge H-mode pedestal and transition remain unexplained and the large uncertainties still present in the L-H transition power threshold have significant implications in the overall research programme of ITER. At present most experimental evidences strongly support the paradigm of sheared electric field suppression of turbulence to explain pedestal transport, although the underlying mechanisms that generate the electric fields remains an open issue.

2. Objectives

This physics activity focuses on the triggering mechanism (e.g. sheared flow), on the plasma turbulence, and on the profiles behaviour during the L-H transition.

Significant diagnostic developments are needed to progress on this issue, including:

- Pedestal width and height with focus on ion temperature measurements
- Edge Plasma current with appropriate spatial and time resolution
- Neutral density profiles with high spatial (1%) and time resolution (0.1ms)
- Radial electric field Er with high spatial (1%) and time resolution (0.1ms) and independent plasma rotation in view of analysing the role of ExB shear on edge turbulence suppression, the Er evolution during the L-H transition and the edge momentum role on confinement
- Turbulence diagnostics in view of analysing the suppression of turbulence and improved edge confinement: fluctuation levels of plasma potential, density, temperature and magnetic signals, correlation lengths (radial, poloidal and long range toroidal).

This topic is given the highest priority in terms of Priority Support within the Transport Topical Group. The physics of L-H transition may well become an important component of the future experimental campaigns exploiting the new ITER-like wall at JET.

3. Work Description and Breakdown

3.1 Structure

The L-H transition Group Chair is the coordinator of the task

WP10-TRA-01-01

Triggering of the L-H transition

Improvement of the diagnostic capabilities for DC and fluctuation radial electric fields and measurements during edge transport bifurcations.

Investigation of the role of the DC/fluctuating electric field on the L-H transition and transport barrier formation.

WP10-TRA-01-02

Role of multi-scale mechanism in the L-H transition

Experimental and modelling studies of the underlying physics mechanisms linking DC electric fields and the development of zonal flows (in continuation of WP 2008/09 studies showing the amplification of multi-scale mechanisms by externally imposed electric fields in stellarators and

tokamaks), role of magnetic configuration (e.g. safety factor, resonant magnetic perturbation, magnetic shear) and plasma parameters (e.g. collisionality) on long range correlations and influence of multi-scale mechanisms on edge transport.

WP10-TRA-01-03

Pedestal width physics

Multi-machine experiments with simultaneous measurements of profile and fluctuation, to quantify the importance of turbulence / neoclassical mechanisms in setting the pedestal structure (relation between electron, ion, density and Er widths with / without external resonant magnetic perturbations (RMPs), the pedestal and Er evolution in between ELMs and the role of turbulence spreading).

Development of pedestal structure modelling

WP10-TRA-01-04

L-H power threshold and ELM control techniques

Experimental investigation of L-H power threshold with ergodic divertor / resonant magnetic perturbation with different n number; density and Bt dependence; Tokamak-stellarators comparative studies (in particular role of magnetic shear and q).

WP10-TRA-01-05

Hysteresis L-H versus H-L transition

Comparative studies in different plasma regimes and description of the transitions in terms of local / global plasma parameters.

WP10-TRA-01-06

Role of atomic physics mechanisms

Investigation of the underlying mechanisms linking wall conditions (clean vs dirty plasmas, neutrals, ….) and isotope effect on L-H transition conditions.

3.2 Work Breakdown and involvement of Associations

The work breakdown and involvement of the Associates which results from the call from participation and the assessment conducted by the EFDA-CSU and the Transport Topical Group is given in Table 3.1

Table 3.1: Work Breakdown

Year	*Work Description*	*Associate*	*Manpower Baseline Support (ppy)*	*Manpower Priority Support (ppy)*	*Hardware, Cons., Other Expenditure Priority Support (kEuros)*
2010	**WP10-TRA-01-02-xx-01/Belgium_ERM-KMS** Role of multi-scale mechanism in the L-H transition Perform density scan (up to density-limit) to investigate the possible impact of plasma parameters, e.g., the collisionality, on the long-range correlation and multi-scale edge transport. Apply RMP (TEXTOR-DED) to investigate the influence of magnetic configurations on long-range correlations and multi-scale edge transport.	Belgium_ERM-KMS	0.30	0.20	2.00
	WP10-TRA-01-03-xx-01/Belgium_ERM-KMS Pedestal width physics Study of the pedestal width physics in the limiter H-mode at TEXTOR with aim to find a possible link between the turbulence properties and pedestal quality.	Belgium_ERM-KMS	0.20	0.00	0.00
	WP10-TRA-01-04-xx-01/Belgium_ERM-KMS L-H power threshold and ELM control techniques Study a threshold in L-H transition as function of the RMP strength applied before bifurcation. Monitor turbulence properties and rotation shear. Try to reestablish the limiter H-mode by increasing the power of NBI and/or ICRH.	Belgium_ERM-KMS	0.20	0.00	0.00
	WP10-TRA-01-01-xx-01/UKAEA	CCFE	0.30	0.20	0.00

	Triggering of the L-H transition Studies of the evolution of the radial electric field and velocity fluctuation on MAST. Measurements of density fluctuations using a prototype beam emission spectroscopy correlating fluctuation levels to DC Er gradients. Studies on MAST of the L/H transition including pellet triggered L/H transitions.				
	WP10-TRA-01-02-xx-01/UKAEA Role of multi-scale mechanism in the L-H transition Further work to make the Er diagnostic on MAST available. Fast stereo imaging of the Dα and He+ will be used to study the spatial structure of the filamentary edge turbulence.	CCFE	0.13	0.00	0.00
	WP10-TRA-01-03-xx-01/UKAEA Pedestal width physics Detailed study of the edge profile evolution with and without RMPs. In particular the evolution of the radial electric field and of the pedestal will be considered in order to determine whether turbulence saturates the pedestal gradients before the first ELM or not as well as the role of the ionisation source for the pedestal development. A multi-machine edge profile database and coordinated pedestal structure analysis techniques is suggested.	CCFE	0.27	0.00	0.00
	WP10-TRA-01-04-xx-01/UKAEA L-H power threshold and ELM control techniques Study of the effect of the RMPs on edge profiles during and before H-mode on Mast.	CCFE	0.15	0.00	0.00
	WP10-TRA-01-01-xx-01/CIEMAT Triggering of the L-H transition Guideline for further developments in plasma diagnostics and transport studies to study the trigger of edge plasma bifurcations, including: • Experimental studies of the interplay between mean and fluctuating radial electric fields field and magnetic topology (low order rationals) and the trigger of edge bifurcations in the TJ-II stellarator. • Further development of plasma diagnostic for studying the properties of mean and fluctuating electric fields during edge plasma bifurcations in the TJ-II stellarator, including Heavy Ion Beam Probe Doppler Reflectometry	CIEMAT	0.00	0.40	18.00

	Edge Probes.				
	WP10-TRA-01-01-xx-03/CIEMAT/BS Triggering of the L-H transition Guideline for further developments in plasma diagnostics and transport studies to study the trigger of edge plasma bifurcations, including: • Experimental studies of the interplay between mean and fluctuating radial electric fields field and magnetic topology (low order rationals) and the trigger of edge bifurcations in the TJ-II stellarator. • Further development of plasma diagnostic for studying the properties of mean and fluctuating electric fields during edge plasma bifurcations in the TJ-II stellarator, including Heavy Ion Beam Probe Doppler Reflectometry Edge Probes.	CIEMAT	0.30	0.00	0.00
	WP10-TRA-01-02-xx-01/CIEMAT Role of multi-scale mechanism in the L-H transition Guideline for further developments in plasma diagnostics and transport studies to study the role of multi-scale physics mechanisms during the development of edge plasma bifurcations, including: Characterizing the edge radial structure (12 points in about 4 cm) of plasma structures showing long-range correlations. Studies of the impact of zonal flows on plasma / impurity transport in different plasma regimes (using EUTERPE) and long-range (global flows) theoretical studies. Development of analysis tools (Hilbert Transform) to study edge bifurcations. Further development of plasma diagnostic for studying the properties of long-range correlations in the TJ-II stellarator.	CIEMAT	0.40	0.40	100.00
	WP10-TRA-01-03-xx-01/CIEMAT Pedestal width physics Experiments on TJ-II to contribute to the understanding of the pedestal formation making a bridge between two traditionally unconnected fields namely turbulence spreading and edge pedestal physics.	CIEMAT	0.00	0.40	40.00
	WP10-TRA-01-03-xx-01/CIEMAT/BS	CIEMAT	0.30	0.00	0.00

	Pedestal width physics Experiments on TJ-II to contribute to the understanding of the pedestal formation making a bridge between two traditionally unconnected fields namely turbulence spreading and edge pedestal physics.				
	WP10-TRA-01-05-xx-01/CIEMAT Hysteresis L-H versus H-L transition Guideline for further developments in plasma diagnostics and transport studies to study L-H hysteresis, including: • Experimental studies of L-H and H-L transition versus local parameter in the TJ-II stellarator (density, temperature, electric fields). • Further development of plasma diagnostic for studying the properties of H-L and L-H edge plasma bifurcations in the TJ-II stellarator in particular Heavy Ion Beam Probe (plasma potential), Doppler Reflectometry (density), Edge Probes (density potential), Thomson scattering.	CIEMAT	0.30	0.20	0.00
	WP10-TRA-01-06-xx-01/CIEMAT/BS Role of atomic physics mechanisms Study of the influence of atomic physics on plasma bifurcations, including experimental studies of the decay time of radial electric fields and perpendicular velocity in H / He plasmas and in plasma regimes with different recycling.	CIEMAT	0.40	0.00	0.00
	WP10-TRA-01-01-xx-01/FOM_Rijnhuizen Triggering of the L-H transition A theoretical study will be made of the bifurcation in transport responsible for the LH transition in tokamaks. In particular, recovery of the H-mode after ELMs, important for the frequency and size of the ELMs, will be investigated.	FOM_Rijnhuizen	0.20	0.00	0.00
	WP10-TRA-01-02-xx-01/FZJ Role of multi-scale mechanism in the L-H transition Perform density scan (up to density-limit) to investigate the possible impact of plasma parameters, e.g., the collisionality, on the long-range correlation and multi-scale edge transport. Apply RMP (TEXTOR-DED) to investigate the influence of magnetic configurations on long-range correlations and multi-scale edge transport.	FZJ	0.20	0.30	0.00

	In collaboration with ERM/KMS and the Hungarian Association.				
	WP10-TRA-01-03-xx-01/FZJ Pedestal width physics Pedestal investigations in limiter H-mode with/wo RMP by correlation reflectometry and BES (Hungarian association). The influence of the RMP in different base mode is a further point which will investigated.	FZJ	0.40	0.00	0.00
	WP10-TRA-01-04-xx-01/FZJ L-H power threshold and ELM control techniques Investigation of the power threshold in L-H transition as function of the RMP strength, frequency and base mode.	FZJ	0.30	0.00	0.00
	WP10-TRA-01-01-xx-01/HAS Poloidal flow and density profile measurement using BES at the LH transition Perform measurements during the limiter H-mode of TEXTOR. Poloidal flow velocity measurements on TEXTOR: No diagnostic hardware development foreseen, but the data evaluation techniques will be further refined. Especially the reconstruction of the density profile is planned to be improved by application of Bayesian technique. Collaboration with reflectometry on TEXTOR is a key element of the proposal.	HAS	0.40	0.00	0.00
	WP10-TRA-01-02-xx-01/HAS Coordinated multi-diagnostic correlation measurements on TEXTOR: BES Turbulence measurements on TEXTOR with a series of diagnostics including Li Beam Emission Spectroscopy diagnostic. A more detailed experimental appoach to the measurements is included in the reflectometry proposal of FZJ. The probe measurements will be performed by the Belgian Association.	HAS	0.50	0.00	0.00
	WP10-TRA-01-03-xx-01/HAS Pedestal width physics Measurements of the dependence of the pedestal width on the toroidal current	HAS	0.40	0.30	50.00

	density that flows in the pedestal as well as on the level of fluctuations of the poloidal magnetic field is envisaged (both type of measurements are subject to the outcome of the forthcoming tests). The derivation of the characteristics of electron density fluctuations from measured ABP data will also by attempted, but this needs some preliminary theoretical studies.				
	WP10-TRA-01-03-xx-02/HAS Pedestal measurements: BES Complement the pedestal measurements proposed by FZJ with reflectometry on TEXTOR: study the profile of fluctuations and density using the Li Beam Emission Spectroscopy diagnostic with and without RMPs.	HAS	0.20	0.00	0.00
	WP10-TRA-01-04-xx-01/HAS RMP measurements with Li-BES Turbulence and ELM characteristics will be determined using Li Beam Emission Spectroscopy measurements on TEXTOR with and without RMP.	HAS	0.50	0.00	0.00
	WP10-TRA-01-01-xx-01/IPP Triggering of the L-H transition - role of Er Investigation of the role of mean and fluctuating radial electric fields in triggering the L-H bifurcation on the ASDEX Upgrade tokamak.	IPP	0.00	0.20	0.00
	WP10-TRA-01-03-xx-01/IPP Pedestal width physics - LH transition Pedestal studies on ASDEX Upgrade in close cooperation with the Austrian association and the Hungarian association. Sqrt(beta) dependence will be explored for the ASDEX Upgrade data as well as other possible dependencies such as on q95, nu*. Effects of the magnetic perturbations on the pedestal width will also be considered.	IPP	0.00	0.50	0.00
	WP10-TRA-01-04-xx-01/IPP L-H power threshold and ELM control techniques Investigation of the L-H transition in the presence of resonant magnetic perturbations: • influence of such perturbations on the L-H threshold power as well as on the edge plasma parameters at the L-H transition;	IPP	0.00	0.20	0.00

	• possible dependence upon density and magnitude of the magnetic perturbation; • relation between the perturbation required for ELM control and its effect of the L-H transition, • possible influence on the H-mode hysteresis. The experiment will be carried out in close collaboration with the RMP Team.				
	WP10-TRA-01-02-xx-01/IPP-CR Role of multi-scale mechanism in the L-H transition Two reciprocating manipulators, equiped with many electrostatic probes, would reciprocate into the pedestal during L-H transition, at the same time and radius. Equipped with Ball-pen probe, it is expected to demonstrate on Compass whether LRC appears on temperature or plasma potential fluctuations. SOL plasma biasing will be performed using a fixed electrode or divertor tile. The design and construction of the probe heads will be optimized to sustain high heat fluxes even inside the H-mode pedestal.	IPP.CR	0.70	0.00	0.00
	WP10-TRA-01-03-xx-01/IPP-CR Pedestal width physics Construction of high resolution pedestal profiles for Te, ne using HRTS, Lithium beam and reflectometer in discharges with/without external RMP. Edge turbulence measurement in L- and H-modes using Lithium beam (swept regime), reflectometer (hopping regime) and electrostatic probes Collaboration: CCFE, IPP-Garching, HAS, IST	IPP.CR	0.70	0.00	0.00
	WP10-TRA-01-04-xx-01/IPP-CR L-H power threshold and ELM control techniques Characterisation of the L-H threshold dependence on BT and ne in the COMPASS tokamak in presence of RMP with n = 2 and 4. Collaboration: CEA Cadarache, CCFE Culham	IPP.CR	0.50	0.00	0.00

	WP10-TRA-01-05-xx-01/IPP-CR Hysteresis L-H versus H-L transition Work to be performed: • measure density profiles and their fluctuations in the pedestal and SOL regions using atomic beam and microwave reflectometer; • measure density and potential fluctuations by electrostatic probes in the divertor area and at the reciprocating and fixed manipulators; determine particle fluxes; • measure magnetic signals by set of coils and hall sensors; • measure temperature profiles using the high resolution Thomson scattering (frequency up to 60 Hz) All these data will be acquired before, during and after the L-H and H-L transition.	IPP.CR	0.60	0.00	0.00
	WP10-TRA-01-06-xx-01/IPP-CR Role of edge plasma parameters connected with atomic physics in L-H transition on the COMPASS tokamak • Commissioning and calibration of the multi-channel system for observations of the plasma core/edge in a visible range of wavelengths. • Measurements of distribution of the spectrally resolved emission at the plasma edge resulting in an estimation of the density of neutrals.	IPP.CR	0.30	0.00	0.00
	WP10-TRA-01-02-xx-01/MEdC Zonal flow generation and particle trapping in the structure of the turbulent potential Further studies of a newly proposed model of zonal flows including DC electric fields.	MEdC	0.40	0.00	0.00
	WP10-TRA-01-04-xx-01/MEdC Quasi-coherent precursors and generation of filaments in the H-mode rotation layer Study of the quasi-coherent modes and and of the stationary state of the Edge Localized Modes Study of the stationary parallel dynamics and saturation of the filaments generated in strong Kelvin-Helmholtz events in the H-mode regime.	MEdC	0.40	0.00	0.00

	WP10-TRA-01-05-xx-01/MEdC Stochastic reduced models of different plasma regimes and description of the transition in term of global parameters Elaboration and study of two different scenarios (S-shape bifurcation and stochasticity induced bifurcation) in the framework of stochastic reduced models of plasma turbulence. Comparative study of predictions on the hysteresis effects in the framework of reduced stochastic models of the L/H transitions. In both class of models the dependence of the edge turbulent transport on the main parameter- the fuelling rate, will be studied. The results will be compared with experimental aspects of L/H transitions.	MEdC	0.20	0.00	0.00
	WP10-TRA-01-03-xx-01/RISO Pedestal width physics Investigation of the influence of transport barrier breakdown, realised by using an empirical ELM model, on the post ELM evolution of the profiles in the presence of turbulence spreading.	RISØ	0.00	0.30	0.00
	WP10-TRA-01-03-xx-02/RISO Pedestal width physics Investigation of the influence of transport barrier breakdown, using an empirical ELM model, on the post ELM evolution of the profiles in the presence of turbulence spreading.	RISØ	0.25	0.00	0.00
	WP10-TRA-01-01-xx-02/TEKES Triggering of the L-H transition The Full-f gyrokinetic particle code Elmfire is to be used for investigating phenomena behind L-H transition. Simulation of larger tokamaks such as AUG or Textor will be considered but in that case very limited number of cases can be studied.	TEKES	0.00	0.20	0.00
	WP10-TRA-01-01-xx-01/OEAW Triggering of the L-H transition Improvement of diagnostics for electric fields in the SOL.	ÖAW	0.60	0.00	0.00

	Investigations of the L-H and H-L transition by means of electric and magnetic diagnostics in the SOL at AUG and, if possible, in COMPASS. Collaboration with IPP, IPP.CR, ENEA-RFX, RISÖ				
	WP10-TRA-01-02-xx-01/OEAW Modelling studies of multi-scale mechanism in the L-H transition Modelling studies using the code ATTEMPT on multi-scale mechanisms in the presence of imposed electric fields and resonant q.	ÖAW	0.30	0.00	0.00
	WP10-TRA-01-03-xx-01/OEAW Pedestal width physics Design and construction of a new optical head with toroidal viewing geometry onto the Lithium beam at ASDEX Upgrade which will allow to observe the Zeeman splitting of the Li Line. In collaboration with IPP Garching	ÖAW	0.40	0.00	0.00
	Total		11.70	3.80	210.00

3.3 JET related activities

No JET experiments are foreseen to be implemented under this Task. However, should JET carry experiments in this area, a close coordination with the JET Task Forces will be sought.

3.4 Publications

4. Scientific and Technical Reports

4.1 Progress Reports

At the end of each calendar year, the Task Agreement Coordinator shall present his reports on activities under the Task Agreement to the EFDA Leader for his approval. These reports shall integrate the progress made by each Association on each activity, and they shall indicate the level of achievement of the objectives, the situation of the activities, the allocation of resources and recommendations for the next year when applicable. The EURATOM financial contribution will be made through the usual procedures for baseline support through the Contract of Association.

4.2 Report of achievements under Priority Support (final report and, when appropriate, intermediate reports)

Achievement of Priority Support deliverables will be reported separately to the EFDA Leader. A final report (and intermediate reports marking substantial progress in the achievement of deliverables, if the EFDA Leader so requests) shall be prepared by the Task Coordinator and submitted to the EFDA Leader. If part of or all the activities carried out relate to JET, the Associate Leader for JET will be involved in clearing the report. These reports shall include specific sub-sections for each of the Associations involved. They shall document the degree to which the deliverables in Table 4.1 have been achieved, and shall include a breakdown of expenditure for each Association, under the headings of Annex 1. The EURATOM financial contribution will be made after approval by the EFDA Leader of these reports.

Table 4.1: Task Deliverables

Activity	*Association*	*Priority Support Deliverables*	*Due Date*
WP10-TRA-01-01-xx-	CIEMAT	Report on the interplay betwee	31. Dec 2010

01/CIEMAT		radial electric field and magnetic field in the L-H transition.	
WP10-TRA-01-01-xx-01/IPP	IPP	Report on the interplay between electric field and magnetic field in the L-H transition on AUG.	31. Dec 2010
WP10-TRA-01-01-xx-02/TEKES	TEKES	Report on ELMFIRE simulations	31. Dec 2010
WP10-TRA-01-01-xx-02/UKAEA	CCFE	Report on experiments on MAST.	31 Dec 2010
WP10-TRA-01-02-xx-01/Belgium_ERM-KMS	Belgium_ERM-KMS	Report on experiments performed on TEXTOR.	31. Dec 2010
WP10-TRA-01-02-xx-01/CIEMAT	CIEMAT	Report on multi-scale physics mechanisms and related diagnostics developments.	31. Dec 2010
WP10-TRA-01-02-xx-01/FZJ	FZJ	Report on TEXTOR experiments.	31. Dec 2010
WP10-TRA-01-03-xx-01/CIEMAT	CIEMAT	Report on experiments on TJ-II	31. Dec 2010
WP10-TRA-01-03-xx-01/HAS	HAS	Report on the physics of the pedestal.	31. Dec 2010
WP10-TRA-01-03-xx-01/IPP	IPP	Report on experiments on AUG	31. Dec 2010
WP10-TRA-01-03-xx-01/RISO	RISØ	Report on ELM dynamics and turbulence spreading.	31. Dec 2010
WP10-TRA-01-04-xx-01/IPP	IPP	Report on RMP effects on L-H physics.	31. Dec 2010
WP10-TRA-01-05-xx-01/CIEMAT	CIEMAT	Report on studies and diagnostic developments performed for the understanding of the hysteresis in L-H/H-L transitions.	31. Dec 2010

4.3 Milestones

- Mid 2010 Activity Meetings: Collection and discussion of results obtained from the evaluation of theoretical work and experiments performed in 2009 and early 2010.
- End second trimester 2010 Annual meeting of the EU Transport Topical Group: coordinated presentation of the results from the theoretical work and experimental campaigns in 2010.
- December 2010 Final report sent to EFDA-CSU.

5. Priority Support Expenditure Forecast

The forecast of the total expenditures eligible for priority support in this Task Agreement is **593.592 kEuro**. A full breakdown of forecast of expenditures is given in Annex 1. The Community financial contribution will be up to a maximum of **160.718 kEuro** under Art. 8.2a and 8.2b of the Contract of Association.

For exchange of scientists between the involved Associations details of the forecast of expenditure under the Mobility Agreement is shown in Annex 2. This data shall be included in the annual Mobility Plan of the Associations [1].

6. Intellectual Property

The Associates shall identify, in the Task Agreement reports, all information relevant from the Intellectual Property Rights point of view. Guidelines regarding the content of this IPR chapter are given in the EFDA Explanatory Note to the Associates of 28 November 2007 (IPR report (art.5) final).

7. Quality Assurance

EFDA QA rules applicable where appropriate (EFDA-Annex QA- EFDA QA requirements for Suppliers (**EFDA_D_2AN6G6**)).

8. Background Documentation

EFDA 2010 Work Programme (EFDA Steering Committee document (09) 41/3.3.1).

[1] Art 8.2a and 8.2b of the Contract of Association -"a) an additional rate supplementing baseline support and not exceeding a final rate of 40% for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4. b) a rate not exceeding 40 %, for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4."

Annex 1: Summary financial table for Priority Support

Year	*Association*	*Activity*	*Manpower*		*Hardware expenditure*	*Consumables expenditure*	*Other expenditures*	*Total*	*Comments*
			ppy	*k€*	*k€*	*k€*	*k€*	*k€*	
2010	Belgium_ERM-KMS	WP10-TRA-01-02-xx-01/Belgium_ERM-KMS	0.20	15.26	0.00	2.00	0.00	17.26	
	CCFE	WP10-TRA-01-01-xx-02/UKAEA	0.20	23.00	0.00	0.00	0.00	23.00	
	CIEMAT	WP10-TRA-01-01-xx-01/CIEMAT	0.40	36.00	18.00	0.00	0.00	54.00	
	CIEMAT	WP10-TRA-01-02-xx-01/CIEMAT	0.40	36.00	100.00	0.00	0.00	136.00	
	CIEMAT	WP10-TRA-01-03-xx-01/CIEMAT	0.40	36.00	40.00	0.00	0.00	76.00	
	CIEMAT	WP10-TRA-01-05-xx-01/CIEMAT	0.20	18.00	0.00	0.00	0.00	18.00	
	FZJ	WP10-TRA-01-02-xx-01/FZJ	0.30	33.75	0.00	0.00	0.00	33.75	
	HAS	WP10-TRA-01-03-xx-01/HAS	0.30	6.74	50.00	0.00	0.00	56.74	
	IPP	WP10-TRA-01-01-xx-01/IPP	0.20	27.66	0.00	0.00	0.00	27.66	
	IPP	WP10-TRA-01-03-xx-01/IPP	0.50	66.70	0.00	0.00	0.00	66.70	
	IPP	WP10-TRA-01-04-xx-01/IPP	0.20	30.08	0.00	0.00	0.00	30.08	
	RISØ	WP10-TRA-01-03-xx-01/RISO	0.30	26.40	0.00	0.00	0.00	26.40	

	TEKES	WP10-TRA-01-01-xx-02/TEKES	0.20	28.00	0.00	0.00	0.00	28.00	
Total 2010			3.80	383.59	208.00	2.00	0.00	593.59	

Annex 2: Indicative mobility Support [2]

Year	*Association*	*Estimated number of trips*	*Estimated total cost (k€)*	*Comments*
2010	CCFE	5	10.3	Participation in inter machine experiments
	CIEMAT	23	46.0	Participation in fusion devices experiments
	FOM_Rijnhuizen	1	1.0	Participation in Topical Group meetings
	FZJ	9	18.0	Participation in Topical Group meetings
	HAS	25	81.0	Participation in measurements on TEXTOR and on ASDEX Work on ABP measurements at IPP.CR
	IPP	2	2.0	Participation in Topical Group meetings
	IPP.CR	4	4.5	Perform data interpretation at CIEMAT Participation in Topical Group meetings Participation in joint experiments
	MEdC	3	2.7	Participation in Topical Group meetings
	RISØ	1	0.9	Comparison with Experiments at IPP Garching
	TEKES	2	1.0	Participation in Topical Group Meetings
	ÖAW	12	18.0	Participation in AUG and IPP.CR experiments Modelling work at IPP Garching Pedestal Physics studies at IPP Garching
	Total	87	185.4	

[2] To be included in the Associations annual mobility plan.

EFDA Workprogramme 2010

Transport

TASK AGREEMENT

Chapter 2: Turbulent electron transport: experimental search of turbulence and transport at small scales

WP10-TRA-02

Between:
The EFDA Leader
and the following Associates

- Belgium_ULB
- CCFE
- CEA
- CIEMAT
- ENEA_CNR
- FZJ
- IPP
- IST

Index

1. Introduction

Ion transport in a wide range of operation scenarios can qualitatively be explained by theory-based models. Transport in other channels, in particular the electron transport, are not understood with the same level of confidence. From a theoretical point of view, two instabilities contribute: large ion scale (ITG/TEM) and smaller electron scale (ETG) instabilities, as well as the interplay of these scales (this is a great challenge for both diagnostics and simulations). In addition, magnetic instabilities like microtearing or Alfvenic modes could also provide a channel of electron heat transport in high beta scenarios. This topic is particularly relevant when electron heating dominates as eventually in ITER burning plasmas or ECRH dominated scenarios.

2. Objectives

Electron transport studies in various heating schemes and magnetic geometries.

Feasibility studies of plasma diagnostics for high k instabilities.

Interplay between high k and low k instabilities.

Use of existing diagnostics and development of new systems for small-scale fluctuations.

Characterization of plasma conditions which exceed or not the predicted linear ETG thresholds.

Numerical simulations of multi-scale turbulence and transport, which include kinetic effects at realistic mass ratio, relevant for comparisons with the experimental measurements.

3. Work Description and Breakdown

3.1 Structure

The Electron Transport Group Chair is the coordinator of the task.

WP10-TRA-02-01

H&CD mix effect on Electron transport

Perform experiments and analysis of experiments performed in view of understanding the role of H&CD mix on electron transport.

WP10-TRA-02-02

Diagnostics for high-k and low-k instabilities

Perform feasibility studies of plasma diagnostics for high-k and low-k instabilities

WP10-TRA-02-03

ETG threshold

Perform experiments and analysis of experiments to identify plasma conditions which exceed or not the predicted linear ETG thresholds.

WP10-TRA-02-04

Simulation of multi-scale transport

Perform simulations of multi-scale transport

Develop simulation tools of turbulence and transport to characterize the role of small scales turbulence on electron transport.

3.2 Work Breakdown and involvement of Associations

The work breakdown and involvement of the Associates which results from the call from participation and the assessment conducted by the EFDA-CSU and the Transport Topical Group is given in Table 3.1

Table 3.1: Work Breakdown

Year	*Work Description*	*Associate*	*Manpower Baseline Support (ppy)*	*Manpower Priority Support (ppy)*	*Hardware, Cons., Other Expenditure Priority Support (kEuros)*
2010	**WP10-TRA-02-04-xx-01/Belgium_ULB** Simulation of multi-scale transport Development of a modelling approach based on a scale separation technique for gyrokinetic simulations using the local version of the GENE code, developed in IPP Garching. These simulations are going to be performed on the HPC-FF in Juelich in the framework of the project "Filtered Gyrokinetic Simulations" that has been approved by the HPC-FF Board.	Belgium_ULB	0.50	0.20	0.00
	WP10-TRA-02-02-xx-01/UKAEA Diagnostics for high-k and low-k instabilities Installation and commissioning of the 2D BES turbulence imaging system onto MAST in collaboration with RMKI (HAS). Development of synthetic BES diagnostic for comparison of simulated 2D density fluctuation data from turbulence codes with observations. Feasibility study for phase-contrast-imaging (PCI) system for characterisation of high-k density turbulence based on existing CO2 interferometer using 2D detector loaned from NIFS Japan, including calculations of achievable SNR, k-range, conceptual design and costing.	CCFE	0.55	0.00	0.00
	WP10-TRA-02-03-xx-01/UKAEA ETG threshold Execute dedicated experiments on MAST to determine scalings of energy transport	CCFE	0.50	0.00	0.00

	(mainly electrons) on main dimensionless parameters such as n*, q, b, etc. Analyse data and determine whether ETG modes can explain the electron heat transport or whether other instabilities (micro-tearing, Alfven waves) could be dominant. Possible involvement in experimental studies of electron transport on NSTX (depending on 2010 run schedule), including ETG threshold and muti-scale transport using diagnostics for low- and high-k turbulence (2D BES and micro-wave scattering). Execute local gyro-kinetic simulations of electron heat transport, including non-linear simulations of ETG turbulence and micro-tearing modes, including the effect of ExB flow shear, for comparisons with observations.				
	WP10-TRA-02-04-xx-01/UKAEA Simulation of multi-scale transport Basic work to improve on core algorithms that are used at the heart of local gyrokinetic solvers, with the objective of enhancing the scalability with number of processors of high resolution simulations that require very large grid sizes. Local GK simulations will also be performed to study electron heat transport in MAST, looking in particular at ETG turbulence and microtearing instabilities. The influence of sheared equilibrium flows will also be investigated. This work will be performed in collaboration with IST.	CCFE	0.50	0.00	0.00
	WP10-TRA-02-02-xx-01/CEA Experimental search of ETG modes Perform experiments on Tore Supra using different ICRH electron heating schemes changing the additional power and the ETG threshold (heating scheme, (FWEH, 2nd harmonic…), H concentration, magnetic shear, Zeff …). In parallel, experiments will be performed on AUG trying to provoke ETG at the plasma edge with off-axis ECH and to study this impact on the frequency spectra measured at high k with the Doppler system. Comparison aiming at validating the observations and possible discrimination of	CEA	0.00	0.40	0.00

	driving instabilities.				
	WP10-TRA-02-02-xx-02/CEA Feasibility of high k measurements using vertical Doppler reflectometry on Tore Supra Perform feasibility study of high k measurement up to krhos=7, using the implantation and the control system of the DREVE project (vertical channel, installed end 2009, supported by the EFDA call WP08-TGS-01-06), and implementing a D-band channel in X-mode borrowed on the correlation reflectometer installed on Tore Supra. This will require to adapt this latter system but not to develop a new diagnostic from scratch (horn + adaptation on the antenna, couplers). This study should be done in the second half of 2010, the first half of the campaign will be devoted to the study of long range correlation with the O mode DREVE system.	CEA	0.00	0.50	10.00
	WP10-TRA-02-04-xx-01/CEA Linear and nonlinear gyrokinetic ETG modelling Perform simulations using GENE and Kinezero of multi-scale transport for Tore Supra discharges in which high-wavenumber, high-frequency modes drifting in the electron diamagnetic direction are detected by the Doppler reflectometer diagnostic. Work performed in close collaboration with experimentalists at IPP and at CEA Cadarache.	CEA	0.10	0.00	0.00
	WP10-TRA-02-02-xx-01/CIEMAT/BS Diagnostics for high-k and low-k instabilities Perform a feasibility study for a second Doppler reflectometer able to measure high-k at higher plasma densities.	CIEMAT	0.30	0.00	0.00
	WP10-TRA-02-01-xx-01/ENEA_CNR H&CD mix effect on Electron transport Comparison and synergy with Te modulation experiments on different devices.	ENEA_CNR	0.10	0.00	0.00
	WP10-TRA-02-01-xx-01/FZJ H&CD mix effect on Electron transport Data analysis of experiments done lately on TEXTOR to study degradation of electron energy confinement at ECRH.	FZJ	0.10	0.00	0.00

	WP10-TRA-02-02-xx-01/FZJ Diagnostics for high-k and low-k instabilities Measurements of higher fluctuation frequencies will available after installation of a second CMOS camera in the diagnostic system. The camera is available, but further work will be done for its installation, alignment and adaptation of the software.	FZJ	0.25	0.00	0.00
	WP10-TRA-02-01-xx-01/IPP H-modes with dominant ECRH heating Preparation of H-mode experiments with dominant Electron Cyclotron Resonance (ECR) heating making use of the new ECRH system on ASDEX Upgrade.	IPP	0.00	0.20	0.00
	WP10-TRA-02-03-xx-01/IPP ETG threshold - role of density turbulence spectrum Investigation of the density turbulence k-spectrum behaviour at high k_perp rho_s > 2 across the plasma mid-radius to edge using the suite of Doppler reflectometer diagnostics. In parallel, comparative experiments will be performed on Tore Supra using a similar Doppler refl. system with the aim of validating the Doppler reflectometry measurements and data analysis techniques.	IPP	0.00	0.20	0.00
	WP10-TRA-02-04-xx-01/IPP Linear and non-linear gyrokinetic ETG modelling Perform simulations using GENE and Kinezero of multi-scale transport for Tore Supra discharges in which high-wavenumber, high-frequency modes drifting in the electron diamagnetic direction are detected by the Doppler reflectometer diagnostic. Work performed in close collaboration with experimentalists at IPP and at CEA Cadarache.	IPP	0.00	0.40	0.00
	WP10-TRA-02-04-xx-02/IST Simulation of multi-scale transport Study the coupled ITG/ETG multiscale system in the presence of bulk plasma rotation: • dependence of the saturated level on the level of equilibrium shear flow, • search for an hysteresis, • interaction between ITG and the ETG modes.	IST	0.00	0.33	2.00

	For these numerical studies the gyrokinetic (GK) code GS2 will be used (some time is already allocation on the HPC-FF Juelich to perform multiscale transport studies).				
	Total		2.90	2.23	12.00

3.3 JET related activities

No JET experiments are foreseen to be implemented under this Task. However, should JET carry experiments in this area, a close coordination with the JET Task Forces will be sought.

3.4 Publications

4. Scientific and Technical Reports

4.1 Progress Reports

At the end of each calendar year, the Task Agreement Coordinator shall present his reports on activities under the Task Agreement to the EFDA Leader for his approval. These reports shall integrate the progress made by each Association on each activity, and they shall indicate the level of achievement of the objectives, the situation of the activities, the allocation of resources and recommendations for the next year when applicable. The EURATOM financial contribution will be made through the usual procedures for baseline support through the Contract of Association.

4.2 Report of achievements under Priority Support (final report and, when appropriate, intermediate reports)

Achievement of Priority Support deliverables will be reported separately to the EFDA Leader. A final report (and intermediate reports marking substantial progress in the achievement of deliverables, if the EFDA Leader so requests) shall be prepared by the Task Coordinator and submitted to the EFDA Leader. If part of or all the activities carried out relate to JET, the Associate Leader for JET will be involved in clearing the report. These reports shall include specific sub-sections for each of the Associations involved. They shall document the degree to which the deliverables in Table 4.1 have been achieved, and shall include a breakdown of expenditure for each Association, under the headings of Annex 1. The EURATOM financial contribution will be made after approval by the EFDA Leader of these reports.

Table 4.1: Task Deliverables

Activity	*Association*	*Priority Support Deliverables*	*Due Date*
WP10-TRA-02-01-xx-	IPP	Report on experiments performed on	31. Dec 2010

01/IPP		AUG.	
WP10-TRA-02-02-xx-01/CEA	CEA	Report on experiments performed on Tore-Supra and comparison with results obtained on AUG.	31. Dec 2010
WP10-TRA-02-02-xx-02/CEA	CEA	Report on a feasibility study of high k turbulence measurements.	31. Dec 2010
WP10-TRA-02-03-xx-01/IPP	IPP	Report on high-k turbulence measurements on AUG.	31. Dec 2010
WP10-TRA-02-04-xx-01/IPP	IPP	Report on GENE and Kinezero simulations.	31. Dec 2010
WP10-TRA-02-04-xx-02/Belgium_ULB	Belgium_ULB	Report on gyrokinetic simulations with GENE.	31. Dec 2010
WP10-TRA-02-04-xx-02/IST	IST	Report on the coupling of turbulence with plasma rotation.	31. Dec 2010

4.3 Milestones

- Mid 2010 Activity Meetings: Collection and discussion of results obtained from the evaluation of theoretical work and experiments performed in 2009 and early 2010.
- End second trimester 2010 Annual meeting of the EU Transport Topical Group: coordinated presentation of the results from the theoretical work and experimental campaigns in 2010.
- December 2010 Final report sent to EFDA-CSU.

5. Priority Support Expenditure Forecast

The forecast of the total expenditures eligible for priority support in this Task Agreement is **326.580 kEuro**. A full breakdown of forecast of expenditures is given in Annex 1. The Community financial contribution will be up to a maximum of **67.716 kEuro** under Art. 8.2a and 8.2b of the Contract of Association.

For exchange of scientists between the involved Associations details of the forecast of expenditure under the Mobility Agreement is shown in Annex 2. This data shall be included in the annual Mobility Plan of the Associations [3].

[3] Art 8.2a and 8.2b of the Contract of Association -"a) an additional rate supplementing baseline support and not exceeding a final rate of 40% for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4. b) a rate not exceeding 40 %, for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4."

6. Intellectual Property

The Associates shall identify, in the Task Agreement reports, all information relevant from the Intellectual Property Rights point of view. Guidelines regarding the content of this IPR chapter are given in the EFDA Explanatory Note to the Associates of 28 November 2007 (IPR report (art.5) final).

7. Quality Assurance

EFDA QA rules applicable where appropriate (EFDA-Annex QA- EFDA QA requirements for Suppliers (**EFDA_D_2AN6G6**)).

8. Background Documentation

EFDA 2010 Work Programme (EFDA Steering Committee document (09) 41/3.3.1).

Annex 1: Summary financial table for Priority Support

Year	*Association*	*Activity*	*Manpower*		*Hardware expenditure*	*Consumables expenditure*	*Other expenditures*	*Total*	*Comments*
			ppy	*k€*	*k€*	*k€*	*k€*	*k€*	
2010	Belgium_ULB	WP10-TRA-02-04-xx-02/Belgium_ULB	0.20	7.20	0.00	0.00	0.00	7.20	
	CEA	WP10-TRA-02-02-xx-01/CEA	0.40	68.40	0.00	0.00	0.00	68.40	
	CEA	WP10-TRA-02-02-xx-02/CEA	0.50	85.50	10.00	0.00	0.00	95.50	
	IPP	WP10-TRA-02-01-xx-01/IPP	0.20	29.71	0.00	0.00	0.00	29.71	
	IPP	WP10-TRA-02-03-xx-01/IPP	0.20	27.66	0.00	0.00	0.00	27.66	
	IPP	WP10-TRA-02-04-xx-01/IPP	0.40	48.59	0.00	0.00	0.00	48.59	
	IST	WP10-TRA-02-04-xx-02/IST	0.33	47.52	2.00	0.00	0.00	49.52	
Total 2010			2.23	314.58	12.00	0.00	0.00	326.58	

Annex 2: Indicative mobility Support [4]

Year	*Association*	*Estimated number of trips*	*Estimated total cost (k€)*	*Comments*
2010	Belgium_ULB	4	6.0	Collaboration on GENE code at IPP Garching
	CCFE	4	14.6	Participation in experiments on PCI/CRPP Participation in experiments on NSTX at PPPL. Participation in simulations at IST
	CEA	4	5.0	Participation in Topical Group meetings participation in experiments on Asdex
	CIEMAT	1	3.0	Participation in fusion devices experiments
	ENEA_CNR	1	0.6	Participation in Topical Group meetings
	IPP	6	5.5	Participation in Topical Group meetings
	IST	3	4.0	Simulation work at CCFE
	Total	23	38.7	

[4] To be included in the Associations annual mobility plan.

EFDA Workprogramme 2010

Transport

TASK AGREEMENT

Chapter 3: Particle and impurity transport in standard and advanced tokamak scenarios

WP10-TRA-03

Between:
The EFDA Leader
and the following Associates

- CEA
- Hellenic Republic
- MEdC
- VR

Index

1. Introduction

The present understanding of impurity sources and accumulation is still insufficient to predict the behaviour of elements over the wide Z range from He to W. More intense comparison between theory and experiments is needed amongst different devices: scaling of transport with Z (to discriminate between turbulent and neoclassical transport in the core); experimental tracking of the ITG to TEM transition (anomalous convection expected to depend on the type of turbulence); impurity accumulation studies in regimes with ITBs; interplay between turbulence in the SOL and edge with impurity and particle source.

2. Objectives

Continuation and extension of the study the impurity transport (in combination with fluctuation measurements, when experimentally feasible) from standard to advanced tokamak scenarios, with particular focus on the behaviour of electrons, light and heavy impurities in the presence of an ITB. These studies are of particular interest in scenarios were a large fraction of non-inductive current is achieved. The physics of impurity transport is an important subject of research at JET and may well gain impetus in the future experimental campaigns exploiting the new ITER-like wall.

3. Work Description and Breakdown

3.1 Structure

The Impurity Transport Group Chair is the coordinator of the task.

WP10-TRA-03-01

Experiments on impurity transport

Coordinated experiments on impurity transport to validate the paradigm of the ITG / TEM / ETG theory, by performing impurity transport measurements, profile measurements and fluctuations.

WP10-TRA-03-02

Internal heat transport barrier

Explore experimentally the behaviour of the electron density profile and impurity transport before, during and after internal heat transport barriers with different strength and at different temperature ratios.

WP10-TRA-03-03

Central electron heating and plasma dynamics

Impact of central electron heating, as expected in ITER alpha heated discharges, on the strength of the barrier, on both electron and ion temperatures as well as on particle and impurity densities

3.2 Work Breakdown and involvement of Associations

The work breakdown and involvement of the Associates which results from the call from participation and the assessment conducted by the EFDA-CSU and the Topical Group is given in Table 3.1

Table 3.1: Work Breakdown

Year	*Work Description*	*Associate*	*Manpower Baseline Support (ppy)*	*Manpower Priority Support (ppy)*	*Hardware, Cons., Other Expenditure Priority Support (kEuros)*
2010	**WP10-TRA-03-01-xx-01/CEA** Particle and impurity transport in standard and advances tokamak scenarios Experimental studies of turbulent impurity convection and comparison with theoretical modelling	CEA	0.40	0.00	0.00
	WP10-TRA-03-03-xx-01/Greece Test particle simulations of impurity transport On the basis of test particle transport in MHD fields, a one-dimensional, Fokker-Planck type particle and impurity transport model will be constructed. Particular focus will be on transport in the presence of an ITB (e.g. impurity accumulation). This activity will be undertaken in collaboration with CEA, Univ. of Marseille.	Hellenic Republic	0.60	0.00	0.00
	WP10-TRA-03-01-xx-01/MEdC Numerical experiments with low dimensional kinetic models of the impurity transport Perform studies of particle transport including impurities with: - statistical properties of the electric field extracted from gyrokinetic simulations without impurity. - stochastic electric field, with given statistical properties, numerically generated.	MEdC	0.20	0.00	0.00

	The simulations will be performed on the 2 and 3 dimensional versions of the gyrokinetic code GYSELA with Landau collision term. The computing facilities from ULB and CEA-Cadarache will be used.				
	WP10-TRA-03-03-xx-01/MEdC Impact of central electron heating on both electron and ion temperatures, and on particle and impurity densities Improvements in analytical description of power density deposition profile of ICRH for diverse species obtained previously will be used to describe the variation of the density of particles, both electrons and ions, due to turbulence in presence of radio frequency heating. The analysis of the dispersion equation of ITG instability for a multi-species plasma with a radio-frequency heating (ECRH and ICRH) will be continued both by analytic and numeric way. The modification of particle and impurity densities due to both turbulent transport and influence of the radio-frequency heating will be described.	MEdC	0.30	0.00	0.00
	WP10-TRA-03-03-xx-02/VR Quasilinear impurity transport in ITER-relevant scenarios Development of a semi-analytical GYrokinetic IMpurity transport model for Electro-Static turbulence (GYIMES) based on an approximate solution of the gyrokinetic equation. Compare the results of GYIMES with numerical gyrokinetic codes (GYRO and GENE) and the Weiland quasilinear fluid model. Report on the dependence of the direction of the convection of impurities on various parameters such as impurity charge, density, background temperature and density gradients, impact of radio frequency heating, and on comparison with experimental measurements.	VR	0.60	0.00	0.00

	Total		2.10	0.00	0.00

3.3 JET related activities

No JET experiments are foreseen to be implemented under this Task. However, should JET carry experiments in this area, a close coordination with the JET Task Forces will be sought.

3.3 Publications

4. Scientific and Technical Reports

4.1 Progress Reports

At the end of each calendar year, and at intermediate times where appropriate, the Task Coordinator shall submit a report on activities under the Task Agreement to the EFDA Leader for his approval. These reports shall integrate the progress made by each Association on each activity, and they shall indicate the level of achievement of the objectives, the situation of the activities, the allocation of resources and recommendations for the next year when applicable. The EURATOM financial contribution will be made through the usual procedures for baseline support through the Contract of Association.

4.2 Report of achievements under Priority Support (final report and, when appropriate, intermediate reports)

This Task Agreement contains no priority support activities.

4.3 Milestones

- Mid 2010 Activity Meetings: Collection and discussion of results obtained from the evaluation of theoretical work and experiments performed in 2009 and early 2010.
- End second trimester 2010 Annual meeting of the EU Transport Topical Group: coordinated presentation of the results from the theoretical work and experimental campaigns in 2010.
- December 2010 Final report sent to EFDA-CSU.

5. Priority Support Expenditure Forecast

This Task Agreement contains no priority support activities.

For exchange of scientists between the involved Associations details of the forecast of expenditure under the Mobility Agreement is shown in Annex 2. This data shall be included in the annual Mobility Plan of the Associations [5].

6. Intellectual Property

The Associates shall identify, in the Task Agreement reports, all information relevant from the Intellectual Property Rights point of view. Guidelines regarding the content of this IPR chapter are given in the EFDA Explanatory Note to the Associates of 28 November 2007 (IPR report (art.5) final).

7. Quality Assurance

EFDA QA rules applicable where appropriate (EFDA-Annex QA- EFDA QA requirements for Suppliers (**EFDA_D_2AN6G6**)).

8. Background Documentation

EFDA 2010 Work Programme (EFDA Steering Committee document (09) 41/3.3.1).

[5] Art 8.2a and 8.2b of the Contract of Association -"a) an additional rate supplementing baseline support and not exceeding a final rate of 40% for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4. b) a rate not exceeding 40 %, for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4."

Annex 1: Summary financial table for Priority Support

Year	*Association*	*Activity*	*Manpower*		*Hardware expenditure*	*Consumables expenditure*	*Other expenditures*	*Total*	*Comments*
			ppy	*k€*	*k€*	*k€*	*k€*	*k€*	

Annex 2: Indicative mobility Support [6]

Year	*Association*	*Estimated number of trips*	*Estimated total cost (k€)*	*Comments*
2010	CEA	2	3.0	Participation in experiments on ASDEX and at Frascati
	Hellenic Republic	3	8.3	Participation in the use of EMEDGE3D at CEA (Marseille) Participation in simulations at MEdC (Craiova)
	MEdC	3	13.6	Participation in simulations at ULB, VR (Chalmers) and CEA
	VR	2	4.0	Participation in simulations at IPP Greifswald
	Total	10	28.9	

[6] To be included in the Associations annual mobility plan.

EFDA Workprogramme 2010

Transport

TASK AGREEMENT

Chapter 4: Role of neoclassical and turbulent mechanisms in plasma rotation

WP10-TRA-04

Between:
The EFDA Leader
and the following Associates

- Belgium_ERM-KMS
- CCFE
- CEA
- ENEA_RFX
- FZJ
- IPP
- IST
- RISØ
- TEKES
- VR

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1. Introduction

Sheared rotation can lead to quenching of turbulence and a subsequent improvement in confinement. Toroidal rotation also increases stability against pressure limiting resistive wall modes. Transport of toroidal / poloidal momentum remains less understood than heat or particle transport. Extrapolating reliably toroidal rotation, in magnitude and profile shape to future tokamaks, such as ITER, remains a challenge, as neither momentum transport nor sources are known precisely and toroidal rotation driven by momentum from neutral beam injection (NBI) will be limited. It is essential to study the other mechanisms which can drive and transport plasma rotation (plasma turbulence, fast particles and neoclassical mechanisms).

2. Objectives

The work programme 2008/09 should lead to improved diagnostic capabilities for rotation measurements. The workprogramme 2010 and the following ones shall develop this research activity taking advantage of the new diagnostics capability.

3. Work Description and Breakdown

3.1 Structure

The Plasma Rotation Group Chair is the coordinator of the task.

WP10-TRA-04-01

Diagnostics for plasma rotation

Develop diagnostics allowing systematic comparisons between experimental measurements of rotation with neoclassical and turbulent mechanisms (L-, H- and improved confinement modes).

WP10-TRA-04-02

Experiments and theory of plasma rotation

Perform systematic comparisons between experimental measurements of rotation with neoclassical and turbulent mechanisms (L-, H- and improved confinement modes).

3.2 Work Breakdown and involvement of Associations

The work breakdown and involvement of the Associates which results from the call from participation and the assessment conducted by the EFDA-CSU and the Transport Topical Group is given in Table 3.1

Table 3.1: Work Breakdown

Year	*Work Description*	*Associate*	*Manpower Baseline Support (ppy)*	*Manpower Priority Support (ppy)*	*Hardware, Cons., Other Expenditure Priority Support (kEuros)*
2010	**WP10-TRA-04-01-xx-01/Belgium_ERM-KMS** Diagnostics for plasma rotation Building a new combined Mach and turbulence probe system.	Belgium_ERM-KMS	0.50	0.20	0.00
	WP10-TRA-04-02-xx-01/Belgium_ERM-KMS Experiments and theory of plasma rotation Analysis of experimental data measured by CXRS diagnostic under different regimes (L, H-mode, RMP, ICRH plasmas) to evaluate plasma rotation values for a comparison with neoclassic predictions. Comparison of the measured turbulence rotation with neoclassical calculations. Study of 'spontaneous rotation' in plasmas without external momentum input (ITER relevant task) in continuation of the previous study on this subject at TEXTOR.	Belgium_ERM-KMS	0.70	0.00	0.00
	WP10-TRA-04-01-xx-01/UKAEA Diagnostics for plasma rotation Improvements to CXRS system for measurement of core rotation. Optimisation of edge CXRS system for edge ion temperature measurements. Improvements to E-CELESTE for edge rotation measurements.	CCFE	0.30	0.00	0.00
	WP10-TRA-04-02-xx-01/UKAEA Experiments and theory of plasma rotation	CCFE	0.21	0.00	0.00

	Comparisons of poloidal rotation with neo-classical theory. Measurement of rotation in up/down shifted SND plasmas with short NBI beam blips. Comparison with theory of neo-classical poloidal rotation damping. Studies of NTV breaking due to applied RMPs.				
	WP10-TRA-04-02-xx-01/CEA Ripple and fast particle effects on plasma rotation with no external momentum input, and comparison with existing theories including ripple Experimental investigation of the ripple effect (the ripple can be varied from 0.8 to 7% in Tore Supra) on plasma rotation and comparison with theories. Experimental investigation of fast particle effect (electrons and ions) on plasma rotation and comparison with theories.	CEA	0.50	0.00	0.00
	WP10-TRA-04-02-xx-02/CEA Experimental study of the coupling between SOL and edge flows Continuation of the experimental study of the coupling between SOL and edge flows.	CEA	0.50	0.00	0.00
	WP10-TRA-04-02-xx-01/ENEA_RFX Parallel and perpendicular flow in the edge region of RFX-mod and relationship with magnetic topology Investigation will be performed on the momentum transfer between parallel and perpendicular direction, focusing on the relationship with the existing magnetic islands which populates the external region of RFX-mod.	ENEA_RFX	0.17	0.00	0.00
	WP10-TRA-04-02-xx-01/FZJ Experiments and theory of plasma rotation Measurement of plasma rotation on TEXTOR and comparison with neoclassical calculations.	FZJ	0.20	0.00	0.00
	WP10-TRA-04-01-xx-01/IPP Diagnostics for plasma rotation - CXRS Modification of the CER spectrometer to improve optimal matching, radial coverage and time integration. More detailed CXRS profiles should result.	IPP	0.00	0.25	0.00
	WP10-TRA-04-01-xx-01/IST	IST	0.00	0.20	0.00

	Diagnostics for plasma rotation Measurement of the parallel and perpendicular rotation in the ISTTOK edge plasma and comparison with the neoclassical predictions. Study of the dynamical coupling between parallel flows and turbulent transport using multi-pin probes. Measurement of the electrostatic Reynolds Stress and evaluation of its contribution to the poloidal flows generation.				
	WP10-TRA-04-01-xx-01/RISO Diagnostics for plasma rotation Perform feasibility study to assess the potential of CTS as a plasma rotation diagnostic. The reliability of the measurements and its bounds will be investigated under a number of different operating scenarios at AUG. Analyze potential improvements required to develop the CTS system towards regular rotation velocity measurements.	RISØ	0.30	0.00	0.00
	WP10-TRA-04-02-xx-01/TEKES/BS Experiments and theory of plasma rotation ELMFIRE is proposed to provide the gyrokinetic theory prediction for the toroidal and poloidal rotation for comparison with the experimental measurements. The objective is to identify the relevant mechanisms behind the rotation and the mechanisms affecting its evolution, and for constructing appropriate scalings and analytical models for the comparison with the experimental observation.	TEKES	0.10	0.00	0.00
	WP10-TRA-04-02-xx-01/VR Predictive simulations of poloidal and toroidal rotation Predictive transport simulations (including rotation, transport barriers, ...) and comparisons with experimental data collected by the Transport Topical Group.	VR	0.50	0.20	0.00
	Total		3.98	0.85	0.00

3.3 JET related activities

No JET experiments are foreseen to be implemented under this Task. However, should JET carry experiments in this area, a close coordination with the JET Task Forces will be sought.

3.4 Publications

4. Scientific and Technical Reports

4.1 Progress Reports

At the end of each calendar year, the Task Agreement Coordinator shall present his reports on activities under the Task Agreement to the EFDA Leader for his approval. These reports shall integrate the progress made by each Association on each activity, and they shall indicate the level of achievement of the objectives, the situation of the activities, the allocation of resources and recommendations for the next year when applicable. The EURATOM financial contribution will be made through the usual procedures for baseline support through the Contract of Association.

4.2 Report of achievements under Priority Support (final report and, when appropriate, intermediate reports)

Achievement of Priority Support deliverables will be reported separately to the EFDA Leader. A final report (and intermediate reports marking substantial progress in the achievement of deliverables, if the EFDA Leader so requests) shall be prepared by the Task Coordinator and submitted to the EFDA Leader. If part of or all the activities carried out relate to JET, the Associate Leader for JET will be involved in clearing the report. These reports shall include specific sub-sections for each of the Associations involved. They shall document the degree to which the deliverables in Table 4.1 have been achieved, and shall include a breakdown of expenditure for each Association, under the headings of Annex 1. The EURATOM financial contribution will be made after approval by the EFDA Leader of these reports.

Table 4.1: Task Deliverables

Activity	*Association*	*Priority Support Deliverables*	*Due Date*

WP10-TRA-04-01-xx-01/Belgium_ERM-KMS	Belgium_ERM-KMS	Report on build of a turbulence diagnostic system.	31. Dec 2010
WP10-TRA-04-01-xx-01/IPP	IPP	Report on the modification of the CER spectrometer.	31. Dec 2010
WP10-TRA-04-01-xx-01/IST	IST	Report on studies and experiements on ISTTOK related to plasma rotation.	31. Dec 2010
WP10-TRA-04-02-xx-03/VR	VR	Report on predictive simulations.	31. Dec 2010

4.3 Milestones

- Mid 2010 Activity Meetings: Collection and discussion of results obtained from the evaluation of theoretical work and experiments performed in 2009 and early 2010.
- End second trimester 2010 Annual meeting of the EU Transport Topical Group: coordinated presentation of the results from the theoretical work and experimental campaigns in 2010.
- December 2010 Final report sent to EFDA-CSU.

5. Priority Support Expenditure Forecast

The forecast of the total expenditures eligible for priority support in this Task Agreement is **106.250 kEuro**. A full breakdown of forecast of expenditures is given in Annex 1. The Community financial contribution will be up to a maximum of **21.250 kEuro** under Art. 8.2a and 8.2b of the Contract of Association.

For exchange of scientists between the involved Associations details of the forecast of expenditure under the Mobility Agreement is shown in Annex 2. This data shall be included in the annual Mobility Plan of the Associations [7].

6. Intellectual Property

The Associates shall identify, in the Task Agreement reports, all information relevant from the Intellectual Property Rights point of view. Guidelines regarding the content of this IPR chapter are given in the EFDA Explanatory Note to the Associates of 28 November 2007 (IPR report (art.5) final).

[7] Art 8.2a and 8.2b of the Contract of Association -"a) an additional rate supplementing baseline support and not exceeding a final rate of 40% for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4. b) a rate not exceeding 40 %, for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4."

7. Quality Assurance

EFDA QA rules applicable where appropriate (EFDA-Annex QA- EFDA QA requirements for Suppliers (**EFDA_D_2AN6G6**)).

8. Background Documentation

EFDA 2010 Work Programme (EFDA Steering Committee document (09) 41/3.3.1).

Annex 1: Summary financial table for Priority Support

Year	*Association*	*Activity*	*Manpower*		*Hardware expenditure*	*Consumables expenditure*	*Other expenditures*	*Total*	*Comments*
			ppy	*k€*	*k€*	*k€*	*k€*	*k€*	
2010	Belgium_ERM-KMS	WP10-TRA-04-01-xx-01/Belgium_ERM-KMS	0.20	29.65	0.00	0.00	0.00	29.65	
	IPP	WP10-TRA-04-01-xx-01/IPP	0.25	25.43	0.00	0.00	0.00	25.43	
	IST	WP10-TRA-04-01-xx-01/IST	0.20	28.80	0.00	0.00	0.00	28.80	
	VR	WP10-TRA-04-02-xx-03/VR	0.20	22.38	0.00	0.00	0.00	22.38	
Total 2010			0.85	106.25	0.00	0.00	0.00	106.25	

Annex 2: Indicative mobility Support [8]

Year	*Association*	*Estimated number of trips*	*Estimated total cost (k€)*	*Comments*
2010	CEA	5	10.0	Participation in Topical Group meetings Participation in Topical Group meetings on plasma rotation
	IST	1	1.5	Participation in Topical Group meetings
	VR	4	6.0	Participation in comparison experiments
	Total	10	17.5	

[8] To be included in the Associations annual mobility plan.

EFDA Workprogramme 2010

Transport

TASK AGREEMENT

Chapter 5: Statistical properties of edge turbulent transport

WP10-TRA-05

Between:
The EFDA Leader
and the following Associates

- Belgium_ERM-KMS	- ENEA_RFX	- IST	- TEKES
- Belgium_ULB	- Greece_Cyprus	- MEdC	- VR
- CCFE	- Hellenic Republic	- MHEST	- ÖAW
- CIEMAT	- INRNE	- RISØ	
- ENEA_CNR	- IPP.CR	- Swiss Confederation	

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1. Introduction

The impact of power loadings on material surfaces is one of the constraints on the design of future fusion devices such as ITER and DEMO. The deposition of this power is determined by the nature of transport processes at the plasma edge and scrape-off-layer (SOL). It has long been known from Langmuir probe measurements that this transport is turbulent, producing intermittent fluxes of energy and particles. Statistical analysis of these signals has been performed on many fusion devices using increasingly sophisticated methods, finding some similarities to fluid turbulence. Though much information can be extracted from these measurements, they are limited in that they only sample a small region of the plasma. The development of complementary non-invasive diagnostic, which can collect data from a large region of the plasma at high resolution, is a challenge.

2. Objectives

A research project is proposed to understand the processes that determine the edge transport in different confinement regimes and to study how these processes are linked to core transport. Development of improved or new diagnostics as well as physics studies combining diagnostics and statistical techniques in a relevant way will be considered.

3. Work Description and Breakdown

3.1 Structure

The Edge Transport Group Chair is coordinator of the task.

WP10-TRA-05-01

Turbulent structures and intermittency

Investigation of filamentary structures and nature (electrostatic and magnetic), the mechanisms behind their formation and propagation and their role in transporting energy and particles to the wall (L and H-mode regimes).

WP10-TRA-05-02

Diagnostics for edge turbulence

Improving edge plasma diagnostics to characterize edge transport/particle sources to have access to the relevant physics, including the upgrade of edge diagnostics to allow ion temperature and/or plasma potential measurements

WP10-TRA-05-03

Theory and modelling of edge turbulence

Theory and modelling (kinetic and fluid models) of edge turbulence, particle (including impurity and particles sources) transport and ELMs (eg kinetic vs fluid) and comparison with experimental results.

WP10-TRA-05-04

Test particle experiments

Development of test particle approach to study thermal test particles (using gas-puffing and tracer pellets) and the supra-thermal test particles (using fast ion sources).

3.2 Work Breakdown and involvement of Associations

The work breakdown and involvement of the Associates which results from the call from participation and the assessment conducted by the EFDA-CSU and the Transport Topical Group is given in Table 3.1

Table 3.1: Work Breakdown

Year	*Work Description*	*Associate*	*Manpower Baseline Support (ppy)*	*Manpower Priority Support (ppy)*	*Hardware, Cons., Other Expenditure Priority Support (kEuros)*
2010	**WP10-TRA-05-01-xx-01/Belgium_ERM-KMS** Turbulent structures and intermittency Use of a newly-developed diagnostic and a fast camera (gas-puff imaging) system, to detect the two-dimensional (radial and poloidal) structures of the blobby transport at TEXTOR together with Langmuir probe measurements.	Belgium_ERM-KMS	0.40	0.00	0.00
	WP10-TRA-05-02-xx-01/Belgium_ERM-KMS Diagnostics for edge turbulence Build a new plasma diagnostics, i. e., fast camera (gas-puff imaging) system, to observe the 2D turbulent blobby transport at the edge and scrape-off layer (SOL) of TEXTOR. Together with Langmuir probe measurements, perform investigation on the nature of the filamentary structures, their formation, propagation and their role in transporting energy and particles to the wall.	Belgium_ERM-KMS	0.40	0.00	0.00
	WP10-TRA-05-03-xx-01/Belgium_ERM-KMS Theory and modelling of edge turbulence Develop theory in the domain of plasma-turbulence of the blob transport in the SOL and comparison between theory-simulation and experiment. ESEL software will be extended as to include an appropriate damping which mimics the RMP at TEXTOR.	Belgium_ERM-KMS	0.30	0.00	0.00
	WP10-TRA-05-03-xx-01/Belgium_ULB	Belgium_ULB	0.30	0.00	0.00

	Theory and modelling of edge turbulence Generalize spline interpolations to complex grids, e.g. triangular tiling in 2D. Support to other groups wanting to implement algorithms 2 and 3 in other solvers that can generate turbulent fields. Provide support to groups working on Particle-In-Cell codes for test particle transport studies with guiding or real trajectories.				
	WP10-TRA-05-01-xx-01/UKAEA Turbulent structures and intermittency Measurement of edge plasma in MAST using a reciprocating probe in L-mode discharges with and without the application of RMPS. Compare the measured density and flux calculations from models including Tokam 2D.	CCFE	0.30	0.00	0.00
	WP10-TRA-05-02-xx-01/UKAEA Diagnostics for edge turbulence Build a retarding field analyser (RFA) on MAST which will be located on the mid-plane reciprocating probe. Install a similar RFA in the divertor to allow for a direct measurement of the ion temperature at the target.	CCFE	0.60	0.00	0.00
	WP10-TRA-05-01-xx-01/CIEMAT/BS Turbulent structures and intermittency Perform experiments on plasma filament in the TJ-II stellarator including: • Development of plasma diagnostics to characterize edge current filaments on TJ-II (in collaboration with Padova and IPP-Prage teams). • Characterization of the statistical properties of plasma filaments using fast cameras and electromagnetic probes in the TJ-II stellarator: role of electric fields, plasma density (beta effects) and edge plasma bifurcations. Topological characterization of turbulent structures using numerical simulations (EUTERPE).	CIEMAT	0.39	0.00	0.00

	WP10-TRA-05-02-xx-01/CIEMAT Diagnostics for edge turbulence Implementation of a standard Ti diagnostic in TJ-II RFA in collaboration with the ISTOK team.	CIEMAT	0.20	0.20	0.00
	WP10-TRA-05-04-xx-01/CIEMAT/BS Test particle experiments The feasibility to apply the experimental test particle approach based on edge gas puffing and a high speed camera will be studied at TJ-II.	CIEMAT	0.21	0.00	0.00
	WP10-TRA-05-04-xx-01/ENEA_CNR Turbulence structures imaging and modeling in magnetized basic configurations plasma. Use the imaging system develop at TORPEX to perform turbulence studies on GyM. Development of turbulence models to describe detected structures.	ENEA_CNR	0.20	0.00	0.00
	WP10-TRA-05-01-xx-01/ENEA_RFX Filamentary current structures in the SOL of Asdex Upgrade ASDEX Upgrade data will be completed with wall mounted probes in forward interpretative modelling of filamentary structures. The work will be done in close collaboration with IPP Garching, RISO national laboratory, University of Innsbruck	ENEA_RFX	0.20	0.00	0.00
	WP10-TRA-05-01-xx-02/ENEA_RFX Drift and interchange filamentary structures in the edge region of RFX-mod Experimental activities will be performed with the present tools of diagnostic to analyze the possible transition between different regimes. Perform a scan in plasma density to analyze the turbulence characteristics at different values of plasma collisionality in the case of lithization of RFX-mod first wall.	ENEA_RFX	0.30	0.00	0.00
	WP10-TRA-05-01-xx-03/ENEA_RFX Current filaments in the edge and Scrape Off Layer of different magnetic configuration	ENEA_RFX	0.25	0.00	0.00

	Build of a new electromagnetic probes for direct measurements of the current density and of the vorticity associated to turbulent structures. The activity will be done in collaboration with CIEMAT-Madrid and IPP-Prague				
	WP10-TRA-05-01-xx-04/ENEA_RFX Intermittent structures in L-mode and inter-ELM regimes A detailed analysis of electromagnetic intermittent structures as detected in the SOL of AUG will be performed. Evaluation of intermittent character will be performed based on multi-fractal analysis. Comparison between L-mode and inter-ELM regimes will be done.	ENEA_RFX	0.15	0.00	0.00
	WP10-TRA-05-01-xx-01/Cyprus Application of Dispersed Phase Structure Dimensioanlity (DPSD) concept to Edge Turbulence Simulations of particle transport in sheared MHD turbulence in order to validate the applicability of the DPSD concept to particle transport in high Re_m MHD turbulence. If this initial assessment is successful, perform investigations of the methodology that must be followed so that the DPSD concept can be incorporated within mutliphysics codes used for the simulation of plasma and edge turbulence. The initial assessment and roadmap for further development will be completed within 2010, while integration with multiphysics codes will be undertaken in the following years.	Greece_Cyprus	0.30	0.00	0.00
	WP10-TRA-05-03-xx-01/Cyprus Theory and modelling of edge turbulence Use SOLPS and EDGE2D-NIMBUS codes for a better characterization of the edge plasma properties that mainly are correlated with turbulence and particle transport.	Greece_Cyprus	0.30	0.00	0.00
	WP10-TRA-05-03-xx-01/Greece Modelling edge turbulence with the resistive MHD code MYDAS2 Further development of the electro-magnetic, resistive MHD code MYDAS2	Hellenic Republic	0.30	0.00	0.00
	WP10-TRA-05-03-xx-02/Greece	Hellenic	0.20	0.00	0.00

	Statistical analysis of edge plasma fluctuations Data for the blob dynamics from a Hasegawa-Wakatani solver will be used in evaluating the PDF associated with the statistics of the blobs in the framework in the recently published work PRL 103, 165001 (2009).	Republic			
	WP10-TRA-05-04-xx-01/Greece Test particle simulations of thermal and super-thermal particles Perform test particle simulations of thermal and super-thermal particles to study how particles and energy are transported to the wall, the statistics of these transport events and of the expected intermittent fluxes. The role of filamentary structures in particle and heat transport will be studied. Apply the relativistic Hamilton-Jacobi tool to study the behaviour of energetic electrons in the mentioned EM fields. In collaboration with CEA, Univ. of Marseille.	Hellenic Republic	0.20	0.00	0.00
	WP10-TRA-05-02-xx-01/Bulgaria Langmuir probe measurements of the plasma potential and EEDF for edge turbulence diagnostics. Measurements of the plasma potential from IV characteristics at different radial positions in COMPASS tokamak. In collaboration with EURATOM-IPP.CR.	INRNE	0.40	0.30	0.00
	WP10-TRA-05-01-xx-01/IPP-CR Turbulent structures and intermittency Design of the filamentary probe for the COMPASS tokamak. Perform the first experiments. In collaboration with RFX-mod, ENEA, Padova and TJ-II, CIEMAT.	IPP.CR	0.58	0.00	0.00
	WP10-TRA-05-02-xx-01/IPP-CR Diagnostics for edge turbulence Measurements of the ion temperature in the edge plasmas (SOL) with low and high temporal resolution (e.g. using improved AUG hardware).	IPP.CR	0.40	0.00	0.00

	Investigation of the electric field and electron temperature fluctuations.				
	WP10-TRA-05-03-xx-01/IPP-CR Modelling of edge electrostatic interchange turbulence using ESEL code Focus on improving the ESEL parallel dynamics using 1D fluid code SOLF1D developed at IPP-Prague	IPP.CR	0.51	0.00	0.00
	WP10-TRA-05-01-xx-01/IST/BS Turbulent structures and intermittency Characterization of the fluctuations statistical properties using multi-pin probes that allow the simultaneous determination of several edge plasma parameters including: floating potential, ion saturation current, turbulent particle flux and parallel flows. Systematic investigations of the statistical properties of the impurities influx measured with photomultipliers tubes. Study of the dynamical link between intermittent events and impurity influx.	IST	0.20	0.00	0.00
	WP10-TRA-05-02-xx-01/IST Diagnostics for edge turbulence Development of fast ion temperature measurements for plasma fluctuations studies using a Retarding Field Energy Analyzer with multi (6-8) collectors DC biased at different potentials. Optimization of an optical diagnostic system to measure with high temporal resolution the fluctuations in the impurity influx based on photomultipliers tubes.	IST	0.20	0.20	0.00
	WP10-TRA-05-01-xx-01/MEdC Study of the turbulent structures and intermittency by stochastic differential equations Stochastic models of the intermittent events of the edge plasma turbulence will be studied. Characterization of the intermittent events and particle transport on the plasma boundary in term of the singularity structure of the stationary probability density function will be performed.	MEdC	0.20	0.00	0.00
	WP10-TRA-05-01-xx-02/MEdC Effects of filamentary structures on impurity and density transport	MEdC	0.30	0.00	0.00

	A test particle approach will be used to study structures and impurity dynamics at the plasma edge.				
	WP10-TRA-05-03-xx-01/MEdC Test particles simulations for impurities in the edge region with focus on particle and heat transport Use the DCT method and test particle simulations to study impurity transport, as well as runaway electrons.	MEdC	0.30	0.00	0.00
	WP10-TRA-05-02-xx-02/MHST_Slovenia Diagnostics for edge turbulence Development of a theoretical model of the spatial dependence of the ion polytropic coefficient in front of a floating electrode in an oblique magnetic field, first for the non-emitting electrode and later also for electron emitting electrode. The related computer simulations and also modelling will be performed in collaboration with ÖAW.	MHEST	0.20	0.00	0.00
	WP10-TRA-05-01-xx-01/RISO/BS Currents in filamentary structures inside and outside the LCFS Experimental data from ASDEX Upgrade; related to ELM filamentary structures, will be disseminated with the help of and compared to numerical code results from HPC-FF codes as TYR. The work will be done in close collaboration with our colleagues from University Innsbruck and ENEA RFX Padua	RISØ	0.30	0.00	0.00
	WP10-TRA-05-01-xx-02/RISO Currents in filamentary structures inside and outside the LCFS Experimental data from ASDEX Upgrade; related to ELM filamentary structures, will be disseminated with the help of and compared to numerical code results from HPC-FF codes as TYR. The work will be done in close collaboration with our colleagues from University Innsbruck and ENEA RFX Padua.	RISØ	0.25	0.00	0.00
	WP10-TRA-05-03-xx-01/RISO	RISØ	0.30	0.30	0.00

	Theory and modelling of edge turbulence A detailed simulation study in turbulence in the edge/SOL region of toroidal magnetically confined plasmas will be performed. Comparison between experimental observations at both ASDEX and COMPASS and numerical simulations of the turbulence and blob dynamics in the edge and SOL. In cooperation with IPP Prague and ÖAW Innsbruck.				
	WP10-TRA-05-04-xx-01/CRPP Fast imaging of plasma turbulence Construction of a flexible system to image plasma in the TORPEX device at the CRPP. Development a framework to interpret data. Investigation of the possibility to conducting similar investigations on devices other than TORPEX, such as for example TJ-K, Gym and Mirabelle.	Swiss Confederation	0.00	0.20	0.00
	WP10-TRA-05-04-xx-02/CRPP Fast ion physics on basic plasma devices Perform experiments on TORPEX related to turbulence effect on supra-thermal ions in magnetized plasma. Possibly perform similar studies on other devices.	Swiss Confederation	0.00	0.10	0.00
	WP10-TRA-05-03-xx-01/TEKES Theory and modelling of edge turbulence It is proposed that ELMFIRE full f gyrokinetic tool will be adjusted for an appropriate experiment chosen by the coordinator of this Task. It is proposed that a specific 1D/2D PIC code at Association ÖAW (University of Innsbruck) is used to provide taylored boundary conditions (sheaths, reflections etc) for the wall/limiter attachment of the SOL plasma. Also, the ELMFIRE extension will provide the required boundary conditions for the ÖAW PIC code at the separatrix, constructing consistency for the simulations. The code is proposed to be used for preliminary 1) study of the SOL flows and SOL equilibrium with the pedestal inside the separatrix, 2) characterization of the turbulence and possible filamentary/large scale structures there.	TEKES	0.00	0.20	0.00
	WP10-TRA-05-03-xx-02/TEKES	TEKES	0.30	0.00	0.00

	Theory and modelling of edge turbulence ELMFIRE full f a gyrokinetic tool will be further developed to incorporate the SOL geometry with an X-point and proper boundary conditions for recycling. A specific 1D/2D PIC code at Association ÖAW (University of Innsbruck) will be used to provide taylored boundary conditions (sheaths, reflections etc) for the wall/limiter attachment of the SOL plasma. The ELMFIRE extension will also provide the required boundary conditions for the ÖAW PIC code at the separatrix, constructing consistency for the simulations. The code will be used for preliminary study of the SOL flows and SOL equilibrium with the pedestal inside the separatrix, and to characterization of the turbulence and possible filamentary/large scale structures.				
	WP10-TRA-05-03/VR/BS Theory and modelling of edge turbulence Investigation of the conditions for triggering an H-mode in detail and also study of the transport in H-mode.	VR	0.20	0.00	0.00
	WP10-TRA-05-01-xx-01/OEAW Turbulent structures and intermittency: Analysis of electromagnetic intermittent structures Detailed analysis of electromagnetic intermittent structures, focusing on the evaluation of statistical properties of inter-ELM (including ELM post cursors) and L-mode blobs. Improved diagnostics such as probes for electric and magnetic signals will be used to obtain data from AUG. Collaboration with IPP, ENEA-RFX, RISÖ.	ÖAW	0.30	0.00	0.00
	WP10-TRA-05-01-xx-02/OEAW/BS Turbulent structures and intermittency: Analysis of electromagnetic intermittent structures Detailed analysis of electromagnetic intermittent structures, focusing on the evaluation of statistical properties of inter-ELM (including ELM post cursors) and L-mode blobs. Improve diagnostics such as probes for electric and magnetic signals to obtain data from AUG.	ÖAW	0.30	0.00	0.00

	Collaboration with IPP, ENEA-RFX, RISÖ.				
	WP10-TRA-05-02-xx-01/OEAW Diagnostics for edge turbulence: Improvement of edge plasma diagnostics for direct measurements of the plasma potential Improvement of edge plasma diagnostics to characterize radial transport by direct measurements of the plasma potential and the ion temperature in AUG and, if possible, COMPASS, using ball pen probes. Investigation and modelling of reliable diagnostics for the plasma potential and the electric field under various magnetic field angles and in complex plasmas (including emissive surfaces) In collaboration with IPP.CR and MHEST.	ÖAW	0.30	0.20	0.00
	WP10-TRA-05-03-xx-01/OEAW Theory and modelling of edge turbulence: Comparative experimental data for edge plasma turbulence Deliver comparative data for theory and modelling of edge turbulence, particle and momentum transport (including blob dynamics) during ELMs and in between ELMs in the SOL by reliable diagnostics for the plasma potential in various tokamaks. Collaboration with IPP, IPP.CR, RISØ.	ÖAW	0.10	0.00	0.00
	WP10-TRA-05-03-xx-02/OEAW Gyrofluid theory and modelling of edge turbulence, transport and ELMs, and comparison with experiments Gyrofluid theory and modelling of edge turbulence, transport and ELMS and comparison with experiments, using the code GEM; cooperation with IPP Garching	ÖAW	0.40	0.00	0.00
	WP10-TRA-05-03-xx-03/OEAW Simulation of plasma transport in the SOL during the ELM Develop and test the boundary condition modules which will couple BIT1 and ELMFIRE at the separatrix and plasma sheath. The updated codes will be used for simulation of the tokamak plasma edge with significantly increased realism. Perform a set of simulations of the tokamak plasma edge and stand-alone modeling of	ÖAW	0.20	0.20	0.00

	the AUG SOL under different conditions with the updated BIT1 code taking into account realistic boundary conditions at the separatrix.				
	Total		11.74	1.90	0.00

3.3 JET related activities

No JET experiments are foreseen to be implemented under this Task. However, should JET carry experiments in this area, a close coordination with the JET Task Forces will be sought in particular if investigation of edge transport and related plasma-wall studies in different confinement regimes (e.g. using combined studies with IR and fast visible diagnostics) is envisaged.

3.4 Publications

4. Scientific and Technical Reports

4.1 Progress Reports

At the end of each calendar year, the Task Agreement Coordinator shall present his reports on activities under the Task Agreement to the EFDA Leader for his approval. These reports shall integrate the progress made by each Association on each activity, and they shall indicate the level of achievement of the objectives, the situation of the activities, the allocation of resources and recommendations for the next year when applicable. The EURATOM financial contribution will be made through the usual procedures for baseline support through the Contract of Association.

4.2 Report of achievements under Priority Support (final report and, when appropriate, intermediate reports)

Achievement of Priority Support deliverables will be reported separately to the EFDA Leader. A final report (and intermediate reports marking substantial progress in the achievement of deliverables, if the EFDA Leader so requests) shall be prepared by the Task Coordinator and submitted to the EFDA Leader. If part of or all the activities carried out relate to JET, the Associate Leader for JET will be involved in clearing the report. These reports shall include specific sub-sections for each of the Associations involved. They shall document the degree to which the deliverables in Table 4.1 have been achieved, and shall include a breakdown of expenditure for each Association, under the headings of Annex 1. The EURATOM financial contribution will be made after approval by the EFDA Leader of these reports.

Table 4.1: Task Deliverables

Activity	*Association*	*Priority Support Deliverables*	*Due Date*

WP10-TRA-05-02-xx-01/CIEMAT	CIEMAT	Report on Ti measurements on TJ-II	31. Dec 2010
WP10-TRA-05-02-xx-01/IST	IST	Report on fast ion temperature measurements.	31. Dec 2010
WP10-TRA-05-02-xx-02/Bulgaria	INRNE	Report on measurements of plasma potential on COMPASS.	31. Dec 2010
WP10-TRA-05-02-xx-02/OEAW	ÖAW	Report on edge diagnostics on AUG and COMPASS.	31. Dec 2010
WP10-TRA-05-03-xx-01/RISO	RISØ	Report on simulations for comparison with AUG and COMPASS measurements of turbulence.	31. Dec 2010
WP10-TRA-05-03-xx-01/TEKES	TEKES	Report on ELMFIRE simulations.	31. Dec 2010
WP10-TRA-05-03-xx-04/OEAW	ÖAW	Report on simulations using BIT1 coupled to ELMFIRE and modelling of AUG SOL conditions.	31. Dec 2010
WP10-TRA-05-04-xx-01/CRPP	Swiss Confederation	Report on image system on TORPEX.	31. Dec 2010
WP10-TRA-05-04-xx-02/CRPP	Swiss Confederation	Report on TORPEX experiments and turbulence measurements.	31. Dec 2010

4.3 Milestones

- Mid 2010 Activity Meetings: Collection and discussion of results obtained from the evaluation of theoretical work and experiments performed in 2009 and early 2010.
- End second trimester 2010 Annual meeting of the EU Transport Topical Group: coordinated presentation of the results from the theoretical work and experimental campaigns in 2010.
- December 2010 Final report sent to EFDA-CSU.

5. Priority Support Expenditure Forecast

The forecast of the total expenditures eligible for priority support in this Task Agreement is **153.095 kEuro**. A full breakdown of forecast of expenditures is given in Annex 1. The Community financial contribution will be up to a maximum of **30.619 kEuro** under Art. 8.2a and 8.2b of the Contract of Association.

For exchange of scientists between the involved Associations details of the forecast of expenditure under the Mobility Agreement is shown in Annex 2. This data shall be included in the annual Mobility Plan of the Associations [9].

[9] Art 8.2a and 8.2b of the Contract of Association -"a) an additional rate supplementing baseline support and not exceeding a final rate of 40% for expenditure on specific co-operative projects, which have been

6. Intellectual Property

The Associates shall identify, in the Task Agreement reports, all information relevant from the Intellectual Property Rights point of view. Guidelines regarding the content of this IPR chapter are given in the EFDA Explanatory Note to the Associates of 28 November 2007 (IPR report (art.5) final).

7. Quality Assurance

EFDA QA rules applicable where appropriate (EFDA-Annex QA- EFDA QA requirements for Suppliers (**EFDA_D_2AN6G6**)).

8. Background Documentation

EFDA 2010 Work Programme (EFDA Steering Committee document (09) 41/3.3.1).

recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4. b) a rate not exceeding 40 %, for expenditure on specific co-operative projects, which have been recommended for or have been awarded priority status by the CCE-FU according to the conditions and the procedures set out in Annex II, part A, Articles II.3 and II.4."

Annex 1: Summary financial table for Priority Support

Year	*Association*	*Activity*	*Manpower*		*Hardware expenditure*	*Consumables expenditure*	*Other expenditures*	*Total*	*Comments*
			ppy	*k€*	*k€*	*k€*	*k€*	*k€*	
2010	CIEMAT	WP10-TRA-05-02-xx-01/CIEMAT	0.20	18.00	0.00	0.00	0.00	18.00	
	INRNE	WP10-TRA-05-02-xx-02/Bulgaria	0.30	6.53	0.00	0.00	0.00	6.53	
	IST	WP10-TRA-05-02-xx-01/IST	0.20	26.10	0.00	0.00	0.00	26.10	
	RISØ	WP10-TRA-05-03-xx-01/RISO	0.30	26.40	0.00	0.00	0.00	26.40	
	Swiss Confederation	WP10-TRA-05-04-xx-01/CRPP	0.20	11.73	0.00	0.00	0.00	11.73	
	Swiss Confederation	WP10-TRA-05-04-xx-02/CRPP	0.10	8.80	0.00	0.00	0.00	8.80	
	TEKES	WP10-TRA-05-03-xx-01/TEKES	0.20	31.00	0.00	0.00	0.00	31.00	
	ÖAW	WP10-TRA-05-02-xx-02/OEAW	0.20	13.33	0.00	0.00	0.00	13.33	
	ÖAW	WP10-TRA-05-03-xx-04/OEAW	0.20	11.20	0.00	0.00	0.00	11.20	
Total 2010			1.90	153.09	0.00	0.00	0.00	153.09	

Annex 2: Indicative mobility Support [10]

Year	*Association*	*Estimated number of trips*	*Estimated total cost (k€)*	*Comments*
2010	Belgium_ERM-KMS	5	0.8	Participation in modelling at DK-RISO DTU
	Belgium_ULB	2	2.0	Participation in modelling activities
	CIEMAT	3	8.0	Participation in fusion devices experiments Participation in joint experiments on LHD / TJ-II
	ENEA_CNR	1	2.3	Participation in diagnostic work at CRPP
	ENEA_RFX	7	11.0	Participation in experiments at IPP Garching Participation in diagnostic work at Ciemat and IPP-Prague
	Greece_Cyprus	4	6.0	Participation in Topical Group meetings
	Hellenic Republic	4	11.2	Participation in modelling at MEdC Craiova Participation in data analysis at CEA Marseille Participation in simulations at MEdC Craiova
	INRNE	4	20.0	Participation in diagnostic work on COMPASS Improvement of the existing electronic system for Langmuir probe measurements in COMPASS edge plasma. Coupling and testing the new electronic cards, build in Bulgaria, for probes with the existing equipment./Prague, CR - IPP.CR Measurements of the Plasma Potential and the Electron Energy Distribution Function in COMPASS tokamak edge plasma./Prague, CR - IPP.CR
	IPP.CR	11	25.6	Participation in experiments on TJ-II Participation in measurements on ASDEX and at Innsbruck University Participation in Topical Group meetings Participation in ESEL workshop Participation in modelling with SOLF1D with ESEL and at Innsbruck

[10] To be included in the Associations annual mobility plan.

	IST	3	4.5	Participation in Topical Group meetings
	MEdC	4	14.9	Participation in simulations at CEA and CNRS Luminy Marseille, France Participation in Topical Group meetings Meeting for Reporting
	MHEST	3	4.5	Participation in modelling at OEAW, IPP Garching and COMPASS Prague
	RISØ	4	4.5	Participation in modelling at ENEA RFX Padua, IPP Garching and Uni. Innsbruck Participation in probe measurements on COMPASS at IPP Prague
	Swiss Confederation	6	9.0	Participation in experiments on Gym at Milan Participation in experiments on TJ-K Stuttgart
	ÖAW	24	28.0	Participation in analysis at IPP, ENEA-RFX and RISÖ Participation in diagnostics work at IPP, IPP.CR and MHEST Participation in modelling at RISØ and IPP Garching Participation in simulations at Helsinki
	Total	85	152.3	