

2008/9 Work Programme  
Recommendation Proposal

Title: Experimental simulation of non-linear burning plasma dynamics in the Advanced Scenarios for steady-state operation

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Category:

Physics			
	Modelling development & support needs	P-Mod	x
	Requests towards EU experimental program	P-Exp	x
Technology			
	Conceptual design study needs	T-Design	
	R&D needs	T-R&D	
	Requests towards/from EU fusion devices	T-Device	

Link(s) with EFDA missions: Under conditions of strong self-heating by alpha particles, new couplings between plasma phenomena will occur. Such couplings are intrinsically non-linear, and will substantially complicate the problem of maintaining a steady-state scenario at high Q. For example, the pressure profile determines the fusion reactivity and hence alpha particle heating profile, yet the heating profile feeds back directly on the pressure profile, which in turn affects the bootstrap current profile and hence, through the influence on confinement and stability, produces a further indirect influence on the pressure profile. The direct effects of alpha particle heating can be simulated in a number of important respects using ICRH driven in proportion to a real-time 'substitute' for the DT reactivity. A key further feature in this proposal is to combine the simulated alpha heating with a component of the LHCD, driven in such a way as to simulate the effect of bootstrap current computed from the real-time profiles and scaled to maintain appropriately chosen dimensionless parameters at values appropriate to the corresponding ITER/reactor scenario.

Link(s) with EFDA structure:

EU-ITM-TF    EU-PWI-TF    TG-Diag    TG-MHD    TG-Transp

Corresponding tasks (**baseline support/priority support**):

Task description	Duration estimate	Resource estimate	Expected deliverable
Preparation (modelling, diagnostics, RT network development)	1 year	0.5ppy 0.5ppy	Confirmation of validity of scheme and detailed experiment definition.
Experimental simulation of advanced scenario self-heated plasma	1 year	0.5ppy 0.5ppy (including analysis) + machine time (TBA)	Publication-quality report highlighting key issues for controllability of burning SS scenario

Comments:

**The present task calls for a dedicated working group in charge of producing the relevant modelling and experimental proposal(s), as well as preparing and running the experiment(s).**

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***The Chairman***

**Such experiments have been performed in JET for the ELMy H-mode, but never in the Advanced Scenarios. It has been shown that such experiments have a number of important limitations, especially concerning the applicability of the fast-ion parameters when other quantities are scaled to maintain the most important dimensionless parameters relative to the reactor scenario being simulated. However, the proposed scheme including the simulated bootstrap current effects will give an important early indication of the tractability of the control problem in the face of a whole new set of non-linear couplings similar (if not strictly identical) to those in a SS ITER/reactor scenario.**