# Capabilities of the ITER ECRH/ECCD systems for extended physics application

*G.Ramponi, D.Farina, S.Nowak*

Istituto di Fisica del Plasma
Ass. EURATOM-ENEA-CNR, Milano (Italy)

First Author e-mail: ramponi@ifp.cnr.it

The envisaged functions of the ITER-ECRH systems are: i) core heating to access H-mode and reach conditions for Q≥10 operation; ii) on and off-axis current drive for current profile control and steady state operation; iii) generation of well localized current drive for control of MHD instabilities as Neoclassical Tearing Modes (NTMs), sawteeth, and, possibly, Edge Localized Modes (ELMs). The performance of all the above mentioned tasks in a variety of plasmas requires the ability to drive sufficient and well localized current from the core up to close the plasma edge. Depending on the application, the system will utilize an upper or equatorial launcher to inject EC beams at a fixed frequency f=170 Ghz into the plasma. The GRAY beam tracing code [1] has been extensively used up to now to evaluate, under the EFDA technology task [2,3], the performance of the upper launcher for its main goal of NTM stabilization, by taking into account both the Remote Steering (RS) and the Front Steering (FS) designs. The need of a quite large steering in the poloidal injection angle ($\sim 21^0$) to cope with the expected variation of the radial location of the q=2 and q=3/2 surfaces ($0.65 \leq \rho_p \leq 0.93$) in a number of ITER scenarios relevant for NTMs as well as that of using well focused beams in order to maximize the figure of merit for NTM stabilization have been shown to be crucial items in previous analysis. The FS upper launcher fulfils both these requirements providing a quite good performance for the NTM stabilization task [4]. This work reports an optimization study over launch angles and launching locations compatible with an updated version of the FS upper launcher design (EP upper launcher) [5] as well as a study for the equatorial launcher, to evaluate the joint capabilities of the entire ITER-ECRH system for extended physics application. Calculations for the inductive scenario 2 show that with the extended vertical steering range of the EP upper launcher, well localized current density profiles can be maintained over the radial range $0.4 \leq \rho_p \leq 0.95$. For the equatorial launcher in its current design, effects of second harmonic absorption at toroidal injection angles $\beta < 20^0$ and incomplete power absorption for strongly oblique propagation ($\beta \geq 40^0$) are seen to limit the power deposition and current drive up to $\rho_p \leq 0.55$ .

**References**

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