LOW POWER TESTS ON THE NEW FRONT STEERING EC LAUNCHER FOR FTU

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Prior to its final installation, a series of tests of the new Electron Cyclotron Resonance Heating Launcher for real time control experiments on FTU was scheduled. In this work we present results of the tests performed at IFP-CNR, aiming at mm-wave characterization of the antenna in its final configuration. The launcher layout is based on a 2 modules, front steering concept [1], with a fast-steerable mirror for each module, symmetric with respect to the equatorial plane of FTU.
The main objectives of the newly proposed system (working frequency f=140 GHz) are the use of ECH&CD for tearing modes stabilization and heating of overdense plasmas (regimes now reachable in FTU), the automatic control of the driven current profile and the Electron Cyclotron-assisted plasma startup. The additional degree of versatility follows from the possibility to inject the EC power in a wide range of positions and angles to reach the multiple goals indicated. The required directivity concerns both poloidal angles, fixed by the need to track in real time the magnetic island position associated to the mode with the injected EC beam (controlling the injection angle with the necessary speed) and toroidal angles as well (fixed by the need to ensure large injection angles to exploit EBW heating schemes).
Mechanical constraints in the small region of the port termination (approximate width 80 mm) limit the dimensions and the possible toroidal and poloidal orientations of the fast-steering mirrors. This determines a boundary that can be described in terms of a reduction of allowed launch angles in the space of parameters, with forbidden combinations of poloidal and toroidal angles. During real-time controlled motion, an independent protection system that takes into account the speed of the steering mirror and its position with respect to the boundary will prevent collisions with the port.
Test programme includes the validation of the parameters range, the protection system, the alignment of the internal mm-wave optics and finally low power measurements to provide beam patterns. Additional tests were also part of the programme to check the performances of the zooming system, realized with a sliding optics included in the launcher, to control the beam dimensions in the plasma.
After installation a final control of mirrors alignment and of the beam shape are foreseen, under vacuum and with the tokamak at liquid nitrogen temperature, using a retractable probe and a RF detector.

[1] A. Bruschi et al., Fusion Science and Technology, **55**, 94-107 (2009).