FAST SWITCHING OF HIGH-POWER MILLIMETRE WAVES BETWEEN TWO LAUNCHERS: CONCEPTS, NUMERICAL INVESTIGATIONS AND FIRST EXPERIMENTS.

W. Kasparek[1], M. Petelin[2], V. Erckmann[3], D. Shchegolkov[2], A. Bruschi[4], S. Cirant[4], M. Thumm[5], B. Plaum[1], M. Grünert[1], M. Malthaner[1], ECRH groups at IPP Greifswald[3], FZK Karlsruhe[5], and IPF Stuttgart[1].

[1]Institut für Plasmaforschung, Universität Stuttgart, 70569 Stuttgart, Germany
[2]Institute of Applied Physics, RAS, 603600 Nizhny Novgorod, Russia
[3]MPI für Plasmaphysik (IPP), EURATOM Association, 17491 Greifswald, Germany
[4]Istituto di Fisica del Plasma, EURATOM-ENEA-CNR, 20125 Milano, Italy
[5]Forschungszentrum Karlsruhe, EURATOM Association, IHM, 76021 Karlsruhe, Germany

e-mail: walter.kasparek@ipf.uni-stuttgart.de

Neoclassical tearing modes (NTMs) in tokamaks can be stabilized by electron cyclotron resonance current drive at the corresponding resonant flux surface [1]. Especially for the case where the width of the power deposition profile exceeds the width of the island, ECCD in the O-point of the island only gives highest efficiency for NTM stabilization, which requires modulation of the launched EC power synchronously with the rotating islands.

Up to now, synchronous current drive is performed by power modulation of the gyrotron, with the disadvantages that (i) half of the installed power is not used, (ii) the collector of the gyrotrons can be thermally overloaded, and (iii) fast switching of MW-powers can result in severe electromagnetic interference. An alternative for power modulation could be switching of the millimetre waves between two launchers directing the beam to poloidal or toroidal planes, which are 180° apart from each other with respect to the phase of the NTM. Here, the power is switched synchronously with the island rotation by a fast directional switch (FADIS). This device is based on a small frequency-shift keying of the gyrotron (some tens of MHz), and a narrow-band diplexer, which directs an input beam to one of the two output channels [2]. Note that besides NTM stabilization, the device can be used to share the installed EC power between different types of launchers or different applications (e.g. in ITER, midplane / upper launcher), whichever is given priority during a plasma discharge.

The diplexer can be realized as a quasi-optical interferometer with grating splitters, as a waveguide interferometer or resonator with 3dB-hybrids based on oversized rectangular corrugated waveguide, or, in the most compact form, as a quasi-optical cavity (ring resonator) with corrugated mirrors.

In the paper, various concepts for fast directional switches are discussed. Calculations and low-power measurements of prototypes are presented. Requirements and techniques for frequency control of the gyrotrons are discussed, and the results of preliminary frequency modulation experiments are shown. Finally, the preparations and plans for a high-power test of a resonant diplexer in the beam duct of the ECRH system for W7-X are discussed.

References

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