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DEVELOPMENT OF MULTIMEGAWATT GYROTRONS AT FORSCHUNGSZENTRUM KARLSRUHE*

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The main activities at Forschungszentrum Karlsruhe are related to the development and installation of a 10 MW, continuously operated electron-cyclotron-heating system at 140 GHz for the stellarator W7-X at IPP Greifswald (with CRPP Lausanne, IPF Stuttgart and Thales Electron Devices). The prototype gyrotron yielded an output power of 890 kW for three minutes (limitation by power supply) and 539 kW for 939s (limited by gyrotron pressure). The reasons for not achieving completely the specified output power and pulse length are understood. To overcome the limitations, the gyrotron design has slightly been modified. A better quality assurance of the cathode emitter ring for homogeneous electron emission is being performed and the ion getter pumps are placed outside of the gyrotron. The series tubes will be equipped with these modifications. The first series tube has been tested in short pulse operation and the output power of 1 MW at the specified electron beam current of 40 A could be achieved. The results of short and the presently performed long-pulse operation will be reported.

The fabrication phase of an industrial CW operated coaxial-cavity gyrotron with an output power of 2 MW has started between Forschungszentrum, CRPP Lausanne, HUT Helsinki and Thales Electron Devices. The gyrotron will be operated in the $TE_{34,19}$ mode at 170 GHz. To verify experimentally the design of components esp. the design of the electron gun, the quasi-optical mode converter, the amount and suppression of the RF-stray radiation, the present 165 GHz coaxial-cavity gyrotron has been redesigned and modified for 170 GHz. An output power of 1.15 MW could be achieved. The experimentally found mode competition with the $TE_{33,19}$ mode (not predicted by theory), limited the generation of higher output powers. The reason for this mode is caused by a slight misalignment of the magnetic field. Further experiments are foreseen and the results will be reported.

Multifrequency step-tunable gyrotrons with an output power of 1 MW are needed for controlling plasma instabilities in fusion tokamaks (as ASDEX Upgrade, IPP Garching). Within a collaboration with the IAP, Nizhny Novgorod, a short-pulse gyrotron is developed at FZK in order to investigate the behaviour of components like quasi-optical mode converters and Brewster windows. The gyrotron operates in the $TE_{22,8}$ mode at 140 GHz, in the $TE_{17,6}$ mode at 105 GHz and others in between. The latest design results of the Brewster window, experimental results of cold and of gyrotron measurements will be presented.

*Paper will be presented by B. Piosczyk