RECENT EXPERIMENTAL RESULTS OF THE 2 MW, 170 GHz EUROPEAN PRE-PROTOTYPE COAXIAL-CAVITY GYROTRON FOR ITER*

S. Illy, J. Flamm[1], G. Gantenbein, J. Jin, S. Kern, B. Piosczyk, T. Rzesnicki, A. Samartsev, A. Schlaich[1] and M. Thumm[1]
Karlsruhe Institute of Technology, Association EURATOM-KIT, Institut für Hochleistungsimpuls- und Mikrowellentechnik (IHM),
[1]*and Institut für Hochfrequenztechnik und Elektronik (IHE), Kaiserstr. 12, D-76131 Karlsruhe, Germany*

A 2 MW, CW, 170 GHz coaxial-cavity gyrotron for electron cyclotron heating and current drive in ITER is under development within an European Gyrotron Consortium (EGYC). To support the development of the industrial CW gyrotron prototype, a short pulse tube (pre-prototype) is used at KIT for experimental verification of the design of critical components, as electron gun, beam tunnel, cavity and quasi-optical (q.o.) RF-output coupler.

Significant progress has been achieved recently due to the following modifications of the gyrotron: (1) An additional normal conducting coil was installed to increase the magnetic flux density up to the nominal value of 6.87 T (originally limited to 6.7 T by the superconducting magnet). (2) The shape of the anode of the electron gun has been adjusted for operation at the nominal acceleration voltage around U_c= 90 kV. (3) A new beam tunnel with irregularly longitudinally corrugated copper rings has been mounted in order to suppress radio frequency parasitic oscillations. (4) In order to be able to operate the gyrotron at additional modes in the frequency range between 130-170 GHz, the gyrotron output window has been replaced by a broadband silicon-nitride Brewster window provided by NIFS. (5) Finally, a new q.o. RF output coupler, based on a launcher optimized with a novel optimization method has been built in.

With these modifications an RF output power of up to 2.2 MW with 30% output efficiency (in non-depressed collector operation) has been obtained at U_c= 93 kV and I_b=80 A in single-mode operation at 170 GHz. The measured values correspond very well with the results of numerical simulations obtained with the KIT multi-mode, self consistent code SELFT. Furthermore, an excellent quality of the RF output beam with ∼96% Gaussian mode content has been achieved by using the new q.o. RF output system.

The Brewster window permitted the operation at lower frequencies: as an example, an RF output power of ∼1.8 MW in the $TE_{28,16}$ mode at 141.3 GHz has been obtained with an efficiency of 26%. In this case, the quality of the RF output beam is still good (Gaussian mode content $>$ 92%), in agreement with simulations.

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