TECHNICAL DEVELOPMENTS AT THE KIT GYROTRON TEST FACILITY

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Three different types of gyrotrons are currently under investigation at IHM. The development of the 1 MW 140 GHz CW gyrotron for the stellarator W7-X at IPP Greifswald has been completed back in 2002, but during the series production-run (7 tubes) problems have been encountered with parasitic beam tunnel oscillations, which have limited the output power of several gyrotrons. Those tubes consequently have failed the acceptance tests. This necessitated new investigations in the behavior of the beam tunnel, which were performed on the two other gyrotrons which are also being developed at KIT (namely the frequency step tunable gyrotron for 105 – 143 GHz and the 170 GHz / 2 MW coaxial-cavity pre-prototype gyrotron for ITER). These two gyrotrons are merely capable of short pulses (several milliseconds), but have the flexibility of being opened, modified and closed a large number of times and without great cost, due to their flanged modular construction. A modified design of the beam tunnel has been proposed and tested and this has eliminated all the parasitic beam tunnel oscillations. Tests on both these KIT-gyrotrons have given sufficient confidence in the re-designed beam tunnel in order to continue with the series production of the W7-X gyrotrons. The same changes will also be incorporated in the next coaxial-cavity 2 MW ITER gyrotron prototype.

During the entire testing phase of the 1 MW CW gyrotron at KIT the available test loads which have to absorb and dissipate the millimeter-wave beam energy, have sooner or later failed (3 different types of loads so far). In order to continue testing of gyrotrons, KIT was thus forced to develop its own loads and this development is still ongoing. One re-designed load based on an aluminum cylinder coated with a TiO_2/Al_2O_3-mixture has so far performed well and has been used during commissioning and acceptance of a W7-X series gyrotron (SN3), which was accepted at a limited output power of 710 kW during a sequence of 3 minute pulses. Nevertheless, a new load based on a robust, uncoated stainless steel design is also being developed as a backup solution. A preliminary, un-cooled mockup-load has undergone first tests up to 4 s at approx. 620 kW. The decision to build a water-cooled version of this load has now been taken.

A superconducting magnet capable of rapid field changes (4.15 to 5.67 T) for the frequency-step-tunable gyrotron has been procured and tested together with the relevant power supplies and will be installed at the gyrotron test facility at KIT shortly. Its maximum magnetic field is 7.2 T.

The paper will give an overview of the test results achieved during these developments.

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