

## RECENT STATUS OF GYROTRON RESEARCH AND DEVELOPMENT AT KIT AS PART OF THE EUROPEAN FUSION GYROTRON PROGRAM

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### ABSTRACT

Electron cyclotron resonance heating and current drive (ECRH&CD) are the main auxiliary methods to support steady state operation of two major plasma fusion experiments, namely the stellarator Wendelstein 7-X (W7-X) in Greifswald, Germany, which officially started operation in February 2016 and the International Thermonuclear Experimental Reactor ITER, currently under construction at Cadarache, France. Gyrotrons are the unique RF sources which meet the extraordinary requirements of those applications: RF output power in the MW range, operating frequencies up to 170 GHz, and pulse lengths of several seconds up to continuous wave (CW) operation are already state of the art. Optimum current drive efficiencies for the prospected Demonstration Power Plant DEMO may require even higher frequencies (> 200 GHz), multi-MW levels of output power together with enhanced efficiency, while step-tunability of the RF sources would be favourable for plasma stabilization.

KIT, together with its EU partners, is responsible for the nearly finished construction and assembly of the complete 10 MW ECRH system at W7-X, which significantly contributed to the very successful commissioning of the stellarator. In addition, in the frame of the European Gyrotron Consortium (EGYC) and F4E, KIT is currently testing a 1 MW, 170 GHz CW prototype gyrotron for the EU contribution of the ITER ECRH system. Experiments with a comparable short-pulse tube have already proven good performance and the design of the critical components of the gyrotron has been verified.

As part of the European fusion development consortium EUROfusion, KIT is contributing significantly to the development of gyrotrons which shall fulfil the future requirements of DEMO by doing theoretical studies and experiments.

Within the research and development activities described above, KIT is investing in the development of advanced design tools and components research; to maintain a proper test environment for future gyrotrons the Fusion Long Pulse Gyrotron Laboratory (FULGOR) is under construction at KIT, which among other components will comprise a 10 MW CW power supply.

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