Numerical Study of Very High-Order Volume Modes as Possible Alternatives to the $TE_{34,19}$ Operating Mode of the KIT 2MW-170 GHz Coaxial Cavity Gyrotron

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ABSTRACT

Gyrotrons are utilized as millimeter (mm)-wave sources for electron cyclotron resonance heating and electron current drive in nuclear fusion experiments. They are currently the only devices, which are capable to produce multi-megawatt RF output powers at the necessary frequencies (140 – 200 GHz). At KIT, in pursuit to develop gyrotrons for a future DEMO (**Demo**nstration Power Plant), the extreme volume mode $TE_{25,22}$ is being investigated as a secondary alternative to the currently proposed $TE_{34,19}$ operating mode. With its requirement for a reduced electron beam radius, it is expected that the $TE_{25,22}$ mode will allow a more compact gyrotron design, particularly a smaller diameter of the gyrotron shaft. Utilizing the EURIDICE code-package [1] and previously published results [2] a numerical study of different cavity designs and operating parameters has been carried out. The coaxial cavity design has been optimized to satisfy the thermal constrains and to improve the mode stability. Compared to the $TE_{34,19}$ mode, the $TE_{25,22}$ mode shows an increased mm-wave output power. The thermal load on the cavity walls is similar to that for the $TE_{34,19}$ mode and it can be managed with existing cooling technologies [3]. Steps to physically implement and test the gyrotron design will be discussed in the presentation. In addition, a simulation of operation at 204 GHz will also be shown.

Acknowledgement

Parts of the simulations were performed on the EUROfusion High Performance Computer (Marconi-Fusion).

References

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