CAVITY DESIGN OF A TERAHERTZ-RANGE GYROTRON

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The project's purpose is to design a microwave source of 670 GHz range radiation with enough power to cause breakdown in the air. The device in question will be a gyrotron oscillator and part of the challenge is designing an interaction cavity for this device.

In line with successful experiments with a 170 GHz gyrotron[1], the $TE_{31,8}$ was chosen as the operation mode. The proposed geometry for the cavity can be broken down into 4 regions. First region is the input region, where the wall radius is well below the cut-off for $TE_{31,8}$ mode; second region is the interaction region, the wall radius corresponds to the operation of $TE_{31,8}$ mode; third region is an up-tapered region, the wall radius in this region is approximated by a sine squared function; the final region is the output region with constant radius.

Cavity design studies are performed by using the self-consistent code MAGY[2]. First, we have performed cold cavity simulations with no electron beam when the resonator is only excited by an external source inside the interaction region. For varying length of the interaction region, we calculated the fields and found the cavity dimensions yielding the quality factors in the range from 10^3 to $2 \cdot 10^3$. Next, we studied the interaction processes in such cavities in the presence of an electron beam. Results of these studies will be presented at the conference.

1. K. Sakamoto et al. "Achievement of robust high-efficiency 1MW oscillation in the hard-self-excitation region by 170GHZ continuous-wave gyrotron". Nature Physics, Vol 3 p.411 (2007)

2. M. Botton, Thomas Antonsen, Baruch Levush et al. "MAGY: A Time Depedent Code for Simulation of Slow and Fast Microwave Sources". IEEE Transaction on Plasma Science. Vol. 26 p. 882 (1998)