Design of a 670 GHz Extended Interaction Klystron*

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The development of terahertz power amplifiers presents significant new challenges as it brings into focus design, fabrication, and measurement issues that are not important factors at lower frequencies. We will describe our design approach to meet these challenges with particular emphasis on a 0.67 THz Extended-Interaction Klystron (EIK) [1].

One of the key design challenges is beam formation, which is dominated by the beam spread caused by the cathode temperature. Using MICHELLE [*NRL/SAIC*], we have successfully developed an electron gun design that yields a nominal 96 mA, 25 kV, 116 μm diameter, thermal beam with no interception. This beam size allows the feasibility that the gun can be employed in future amplifiers up to 1.03 THz.

Based on the beam parameters, a 9-cavity, 0.7" in length, 670 GHz EIK circuit has been designed using MAGIC-3D [*ATK-Mission Research*]. This initial design indicates that a 1.5 W peak power (with minimum of 500 mW across a 7.1 GHz band) and 25 dB gain can be achieved at a constant input power of 5 mW. At this power level, the circuit has yet reached saturation and is capable of higher output power assuming higher drive power is available.

Due to the extremely low electronic efficiency in the THz regime, a novel depressed collector has also been designed to improve overall amplifier efficiency. Based on MICHELLE, this collector can recover 99% of the DC beam power, and no primaries or secondaries are reflected to the circuit

More detailed description of the gun, circuit, and collector designs will be presented at the conference.

1. Chernin, D. et al., "Extended Interaction Klystrons for Terahertz Power Amplifiers," *Int. Vac. Elect. Conf.*, Monterey, CA, April 22-24, 2010, to be published.

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