Demonstration of a THz Pulse Gyrotron

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***Abstract*— We present initial results of testing of a pulse gyrotron to produce powers up to 10 kW peak and 10 W average at frequencies from 600 GHz to 2 THz. The gyrotron uses a pulse magnet to generate fields to 40 Tesla.**

CALABAZAS Creek Research, Inc. (CCR) is developing a gyrotron producing up to 5 kW pulse power at various frequencies from about 600 GHz to 2 THz. The operating mode at 1 THz is TE15,4. The magnetic field is 37.6 Tesla. This is provided by a pulsed magnet operated with a repetition frequency of about 2.3 Hz. By reducing the magnetic field, lower order modes can be excited. Frequencies to 2 THz will be generated using the second harmonic. The development program includes the design of the electron gun, cavity, magnet and its power supply, output structure and output window. The characteristics of the gyrotron are summarized in Table 1.

TABLE 1. GYROTRON DESIGN PARAMETERS

Pulse power	5 kW
Average power	10 W
Pulse width	~ 1- 550 microseconds
Frequency	600 GHz – 2 THz
Voltage	30 kV
Current	1 A

A conceptual model of the gyrotron is shown in Figure 1. The pulse solenoid is shown in Figure 2. The magnet is wound from foil to maximize the extraction of heat. Thermo-mechanical modeling showed that the magnet can be run with a ~ 1 ms pulse at 2.2 Hz. Stresses induced by the magnetic fields are about 2/3 of yield values.

Results of simulations of the gun are shown in Figure 3, and a mechanical layout of the experimental apparatus is shown in Figure 4. Particular care was taken by choice of materials and minimization of wall thicknesses to minimize eddy currents generated by the pulsed magnetic field. The magnet and cavity are in a liquid nitrogen bath to minimize ohmic losses.

The gyrotron is being fabricated. Testing of the magnet is planned to start in July, 2008, and initial operation of the gyrotron will start later in early fall. Results of the experiments will be reported at the conference.

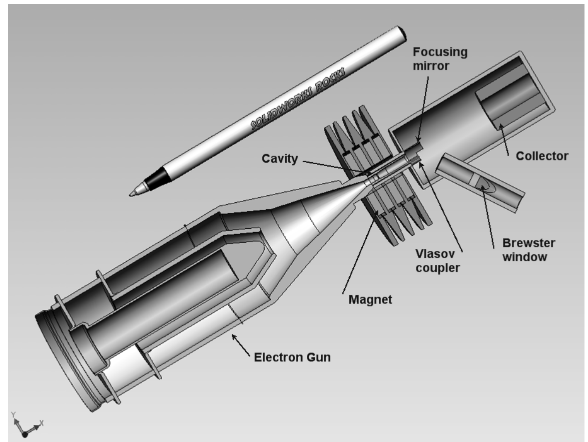

Figure 1. Initial solid model of the CCR Thz gyrotron.

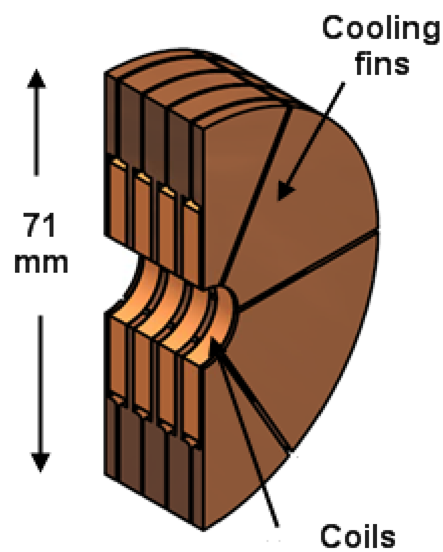

Figure 2. Solenoid

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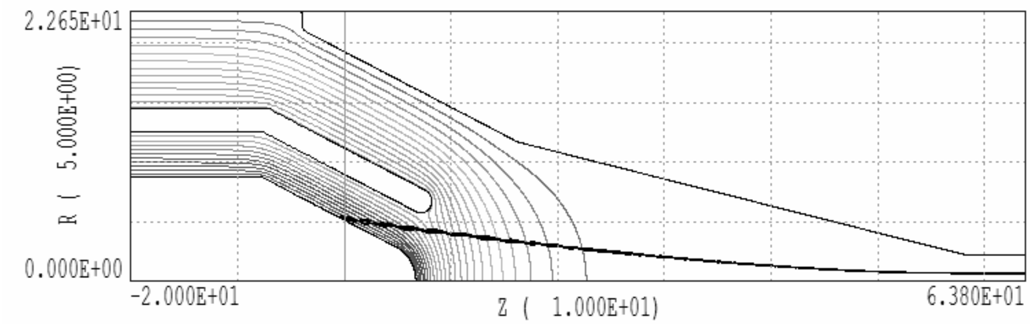

Figure 3. Magnetron Injection Gun for the THz gyrotron. Dimensions are in mm.

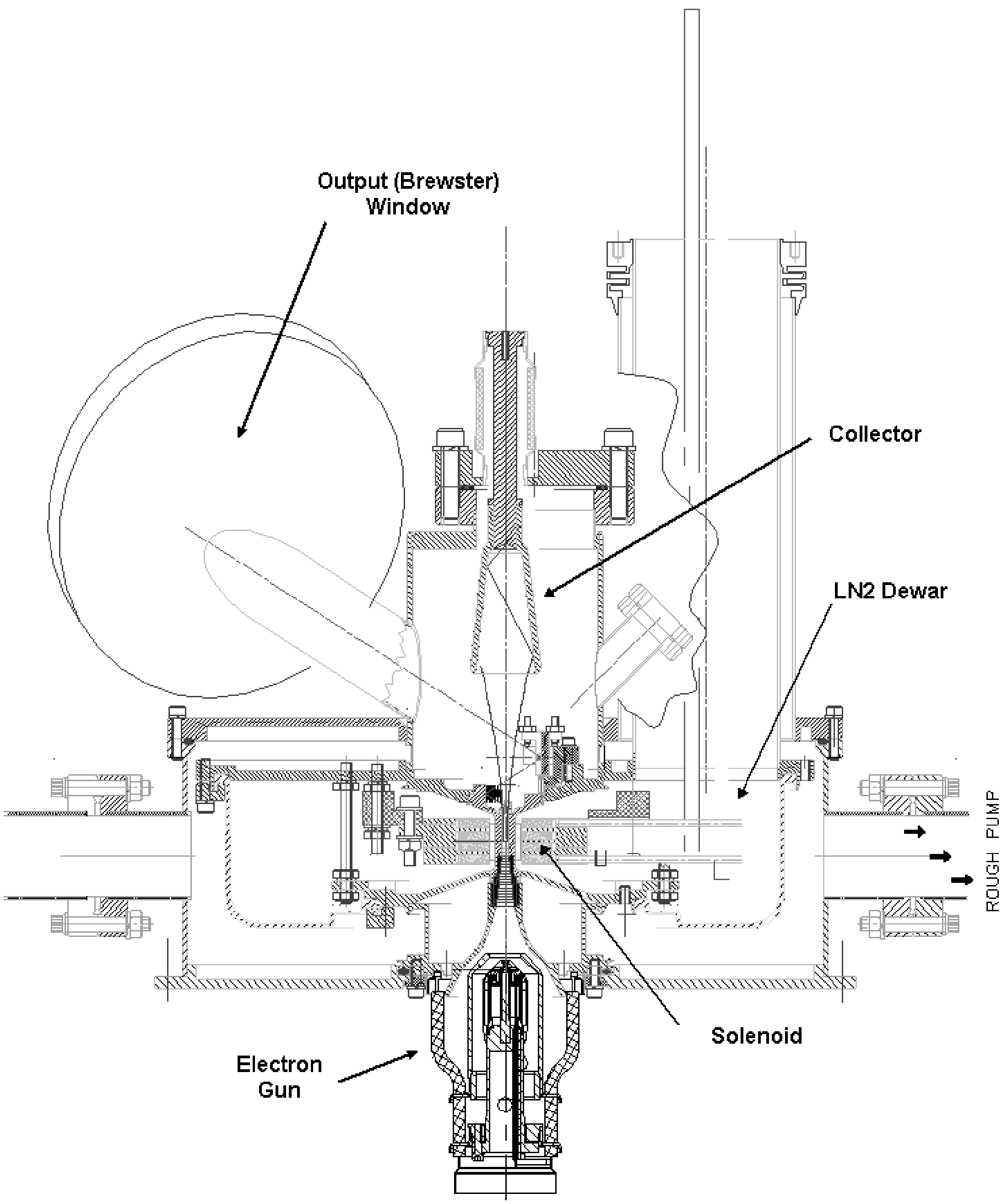

Figure 4. Mechanical layout of the gyrotron.

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