

Microwave Power Products, Inc.

MW CLASS GYROTRON DEVELOPMENT AT MPP

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OUTLINE

❖ BACKGROUND

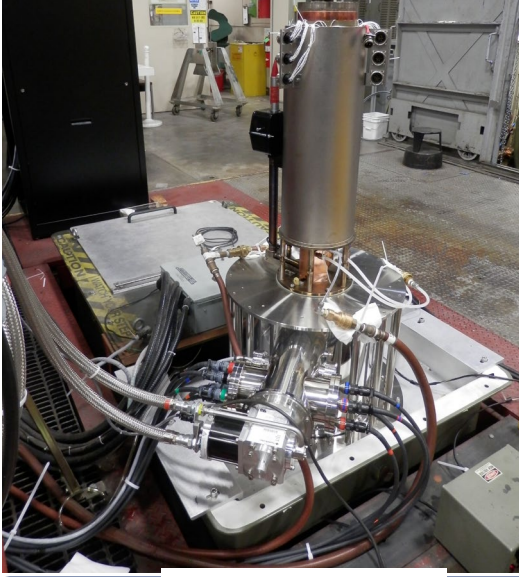
❖ CURRENT HIGH-POWER GYROTRON DEVELOPMENTS

- 70/105 GHz DUAL FREQUENCY 600 kW CW FOR MPEX
- 105 GHz FOR GEOTHERMAL DRILLING

❖ SUMMARY

OVER 300 GYROTRONS SHIPPED SINCE 1977

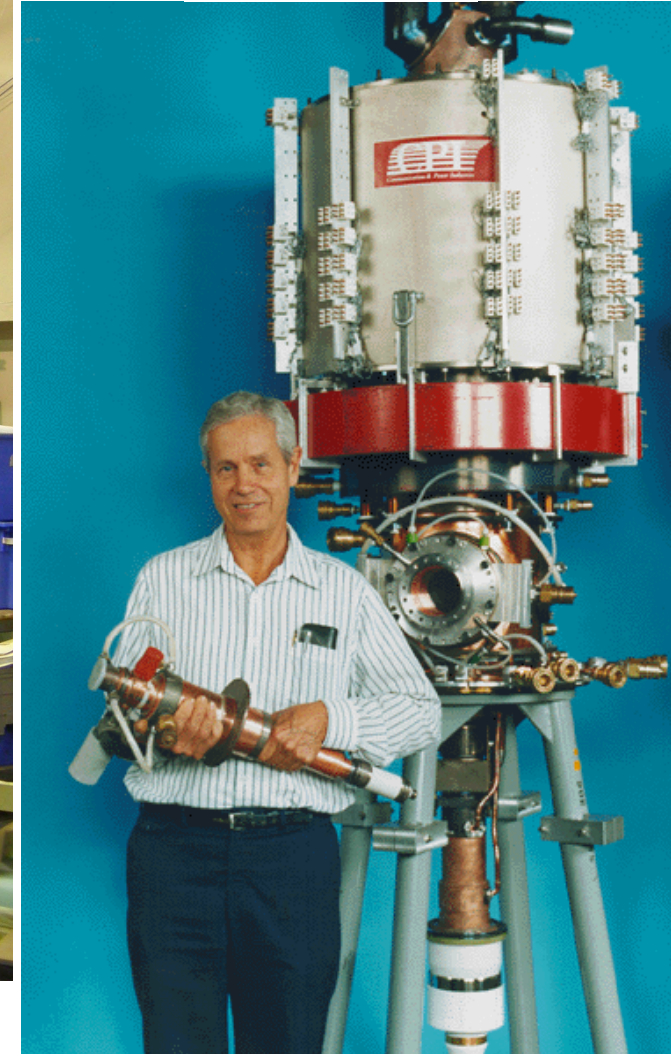
92–100 GHz 50 kW GyroTWT



117.5 GHz 1.8 MW



110 GHz 1 MW



110 GHz 1.2 MW

170 GHz 1 MW



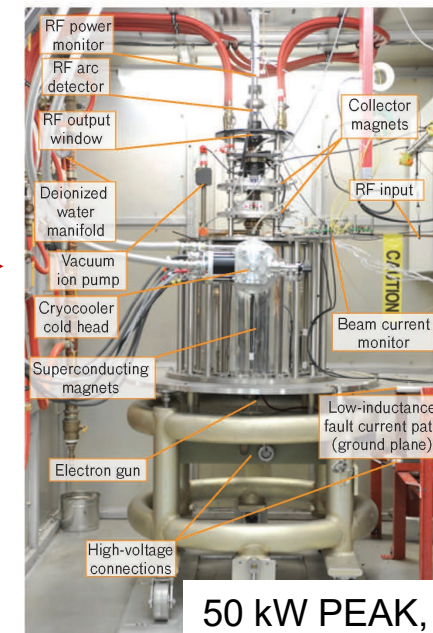
527 GHz 50 W



MPP GYROTRONS

- ❖ FREQUENCIES: 28 GHz – 800 GHz
- ❖ POWER LEVELS: 10 kW – 1.8 MW
- ❖ APPLICATIONS
 - FUSION
 - GEOTHERMAL DRILLING
 - NON-LETHAL WEAPONS
 - SPECTROSCOPY
 - RADAR
 - MICROWAVE THERMAL LAUNCH
 - INDUSTRIAL HEATING

95 GHz, 100 kW, CW



50 kW PEAK, 30% DU, 92 – 100 GHz

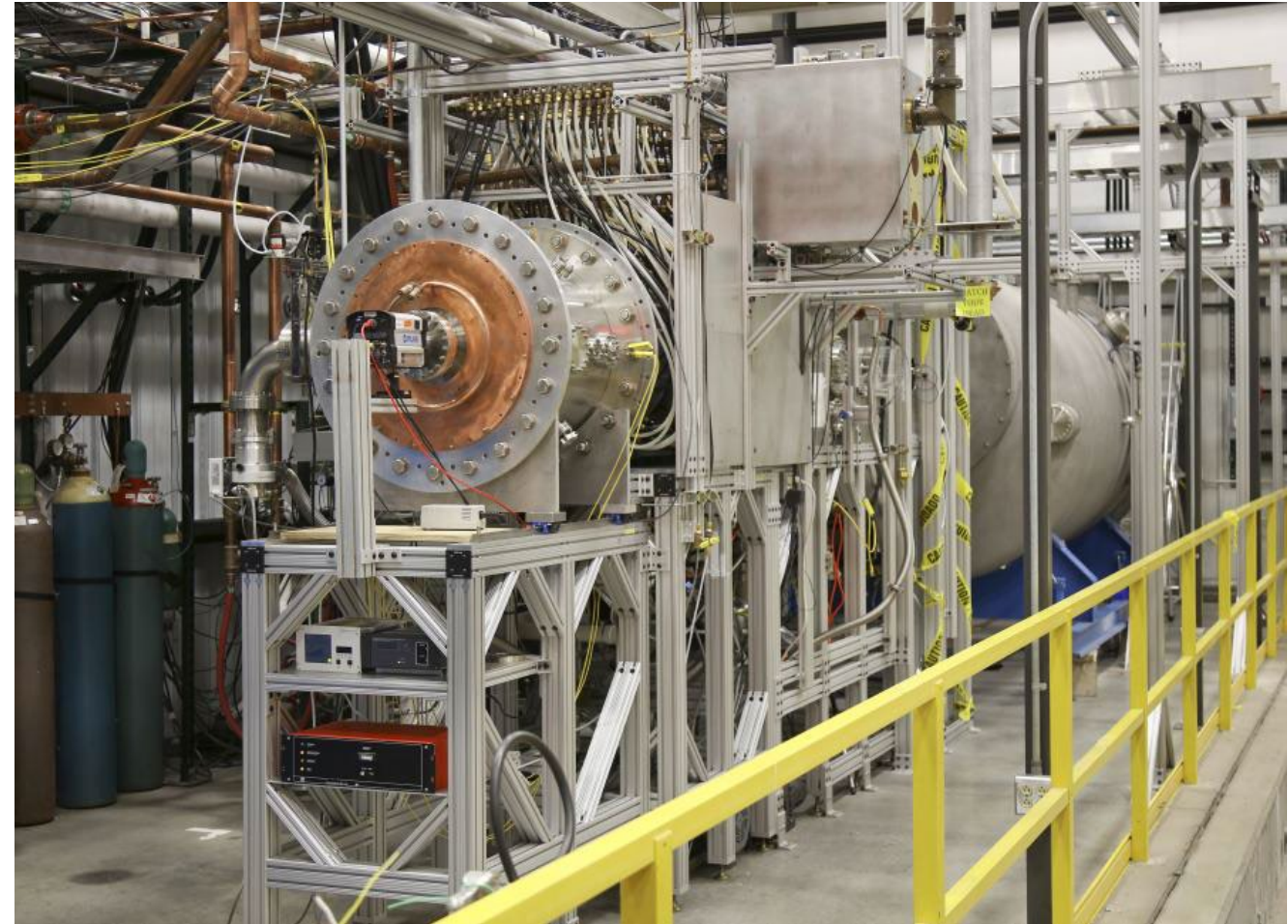


OUTLINE

- ❖ BRIEF VARIAN/CPI/MPP GYROTRON HISTORY
- ❖ CURRENT GYROTRON DEVELOPMENT
 - 70/105 GHz 600 kW CW FOR ORNL MPEX
 - 105 GHz FOR GEOTHERMAL DRILLING
- ❖ SUMMARY

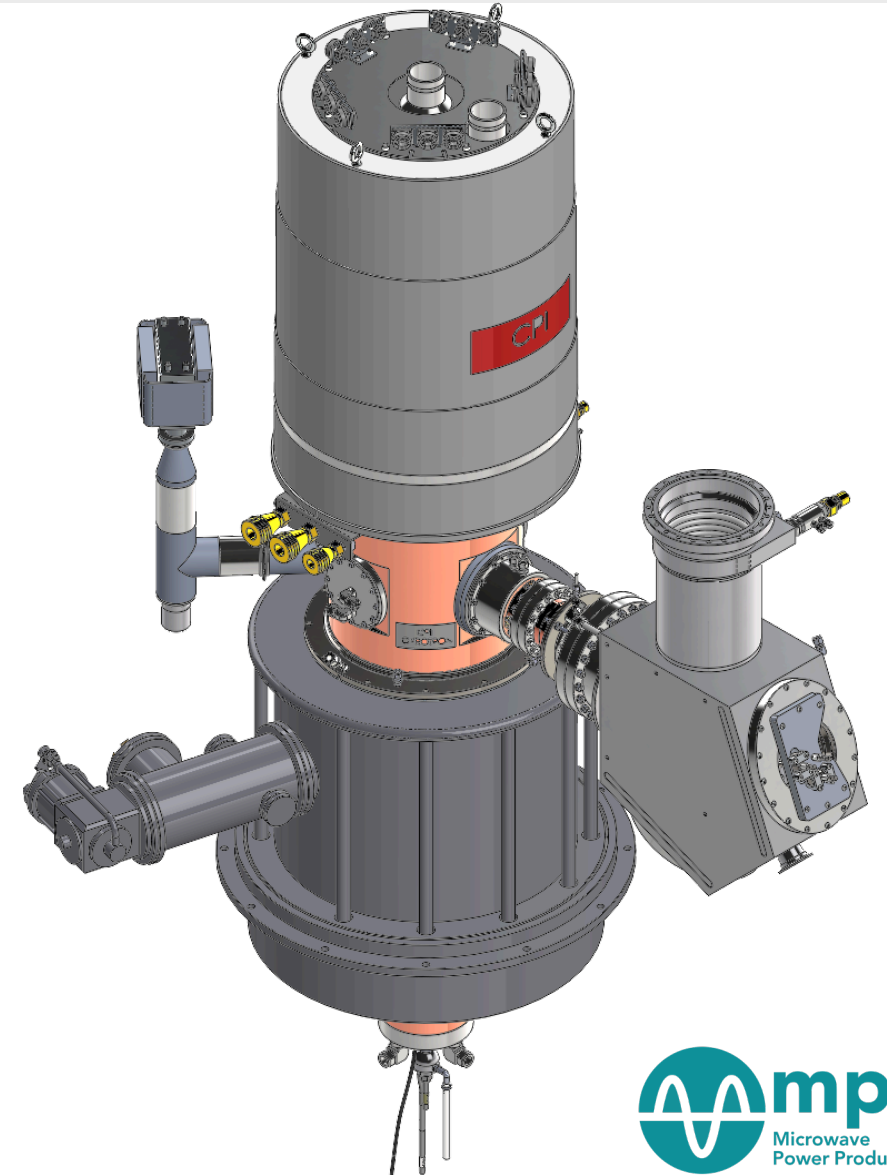
ORNL MPEX PROGRAM

- Material Plasma Exposure eXperiment (MPEX)
- LINEAR PLASMA DEVICE
- DESIGNED TO RECREATE FUSION REACTOR EDGE CONDITIONS
- TEST MATERIALS FOR
 - ❑ HEAT HANDLING
 - ❑ PARTICLE FLUXES

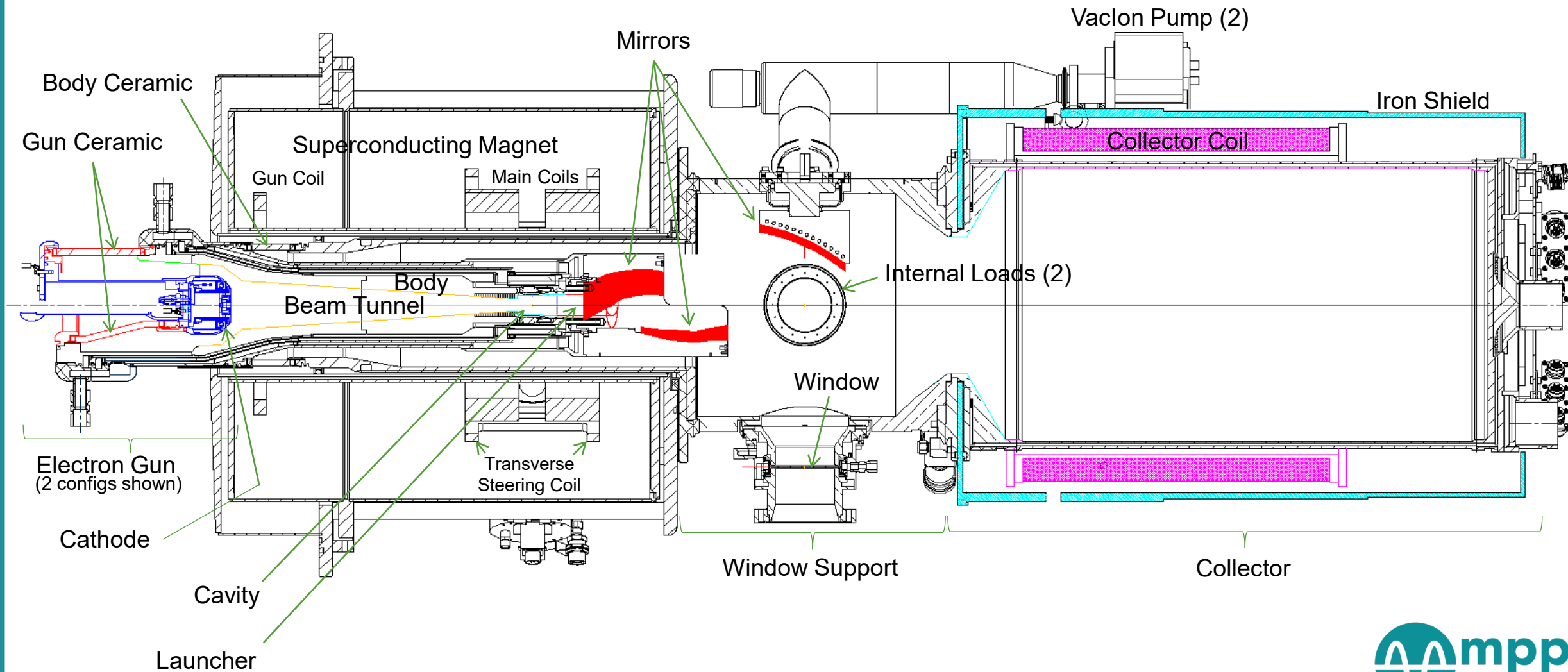


600 kW CW 70/105 GHz GYROTRON

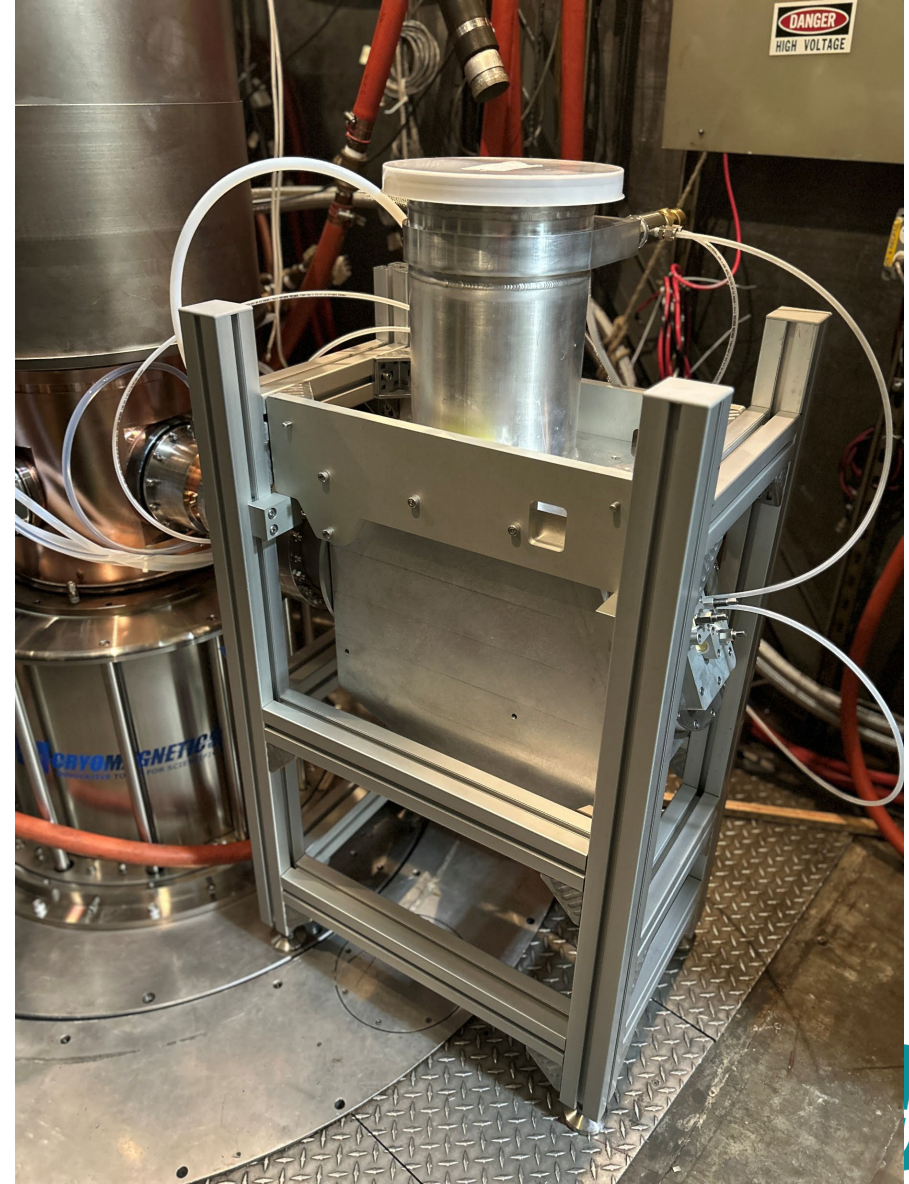
	70 GHz	105 GHz
MODE	TE _{11,3}	TE _{14,5}
Q	644	1504
FREQUENCY	70.07 GHz	105.28 GHz
BODY-TO-CATHODE VOLTAGE	82 kV	75 kV
CATHODE-TO-COLLECTOR VOLTAGE	63 kV	61 kV
CATHODE CURRENT	25 A	25 A
MAGNETIC FIELD	27.5 kG	40.8 kG
OUTPUT MODE	TEM00	TEM00



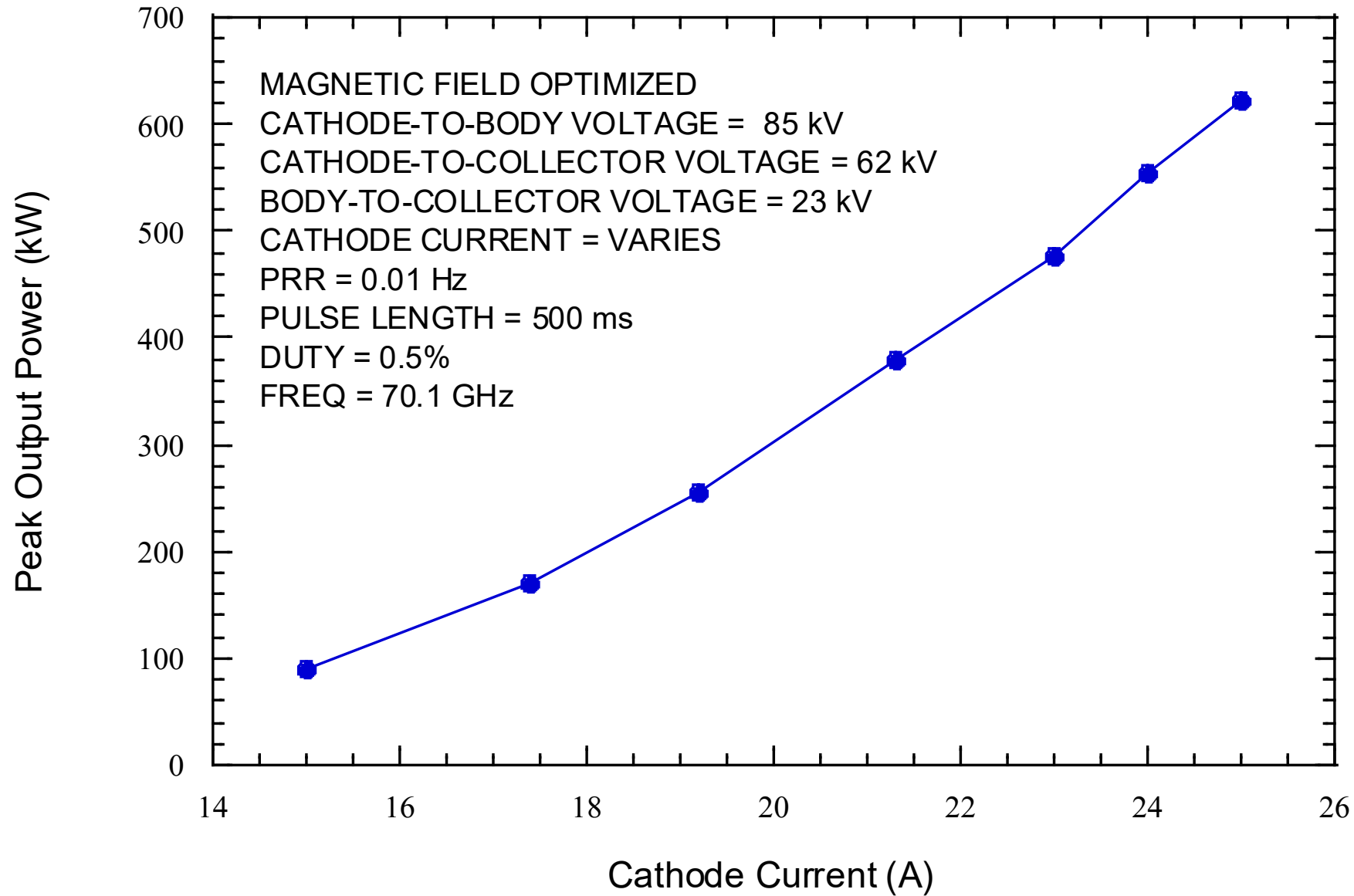
70/105 GHz GYROTRON LAYOUT



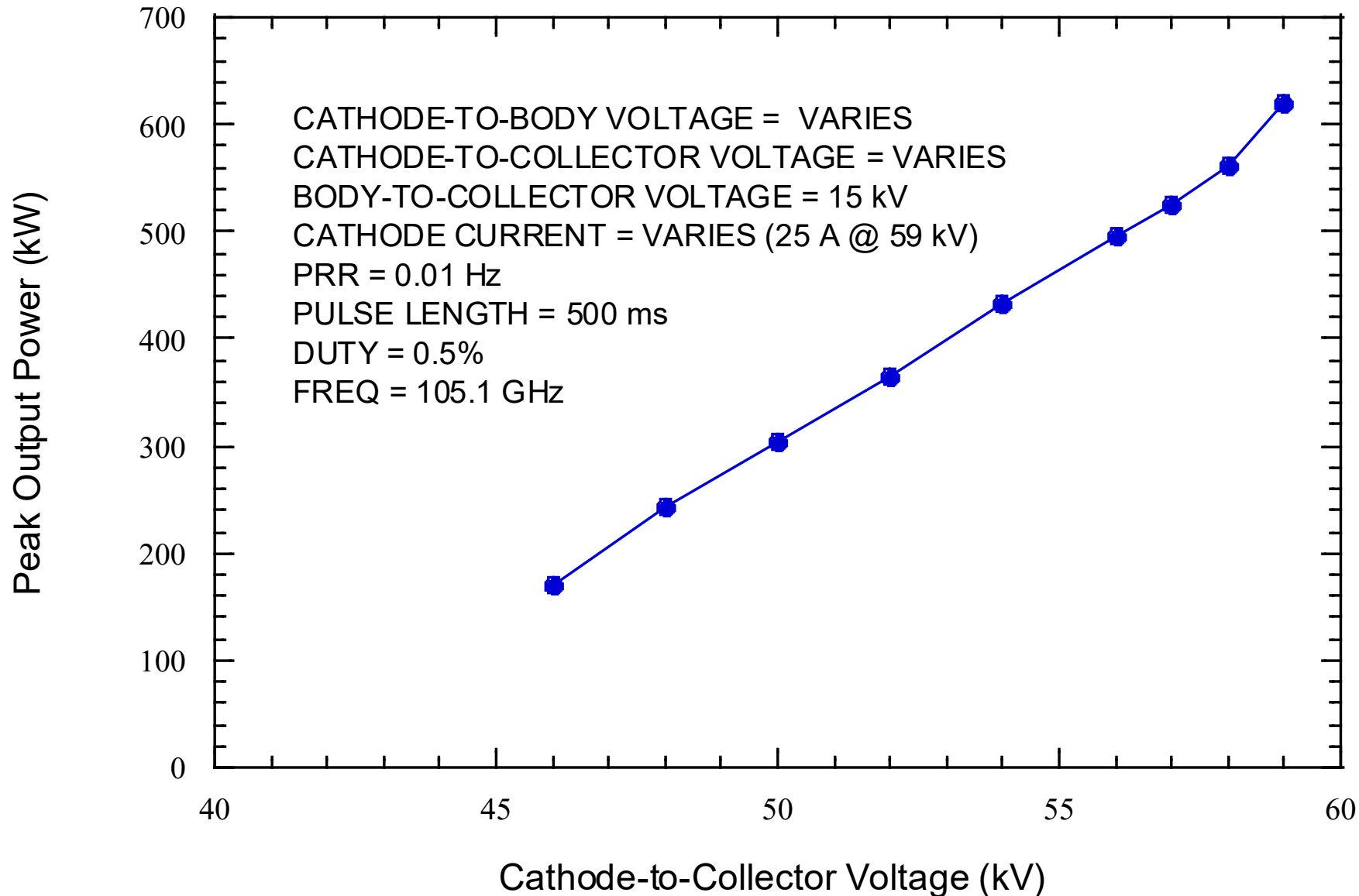
600 kW 70/105 GHz GYROTRON



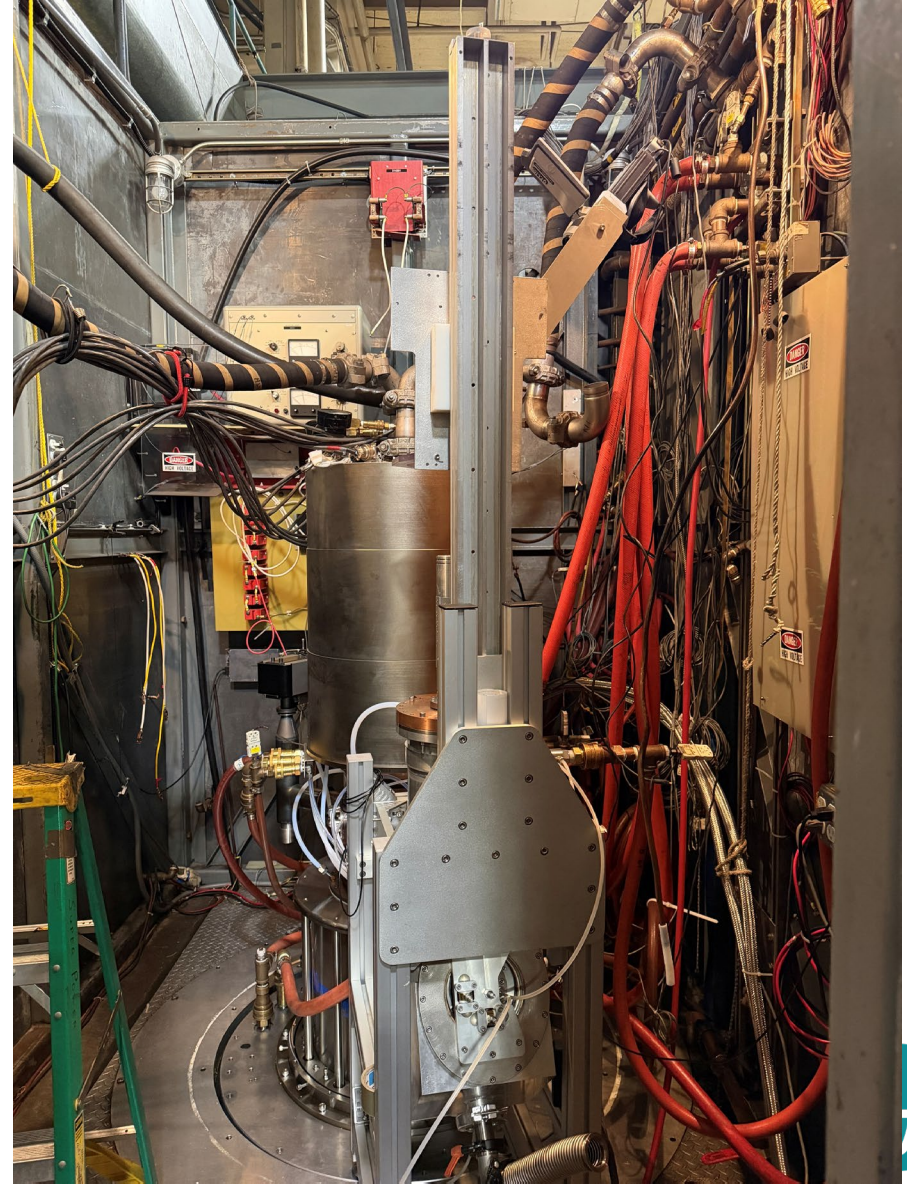
POUT VS BEAM CURRENT @ 70 GHZ



POUT VS CATH-TO-COLL VOLTAGE @ 105 GHz

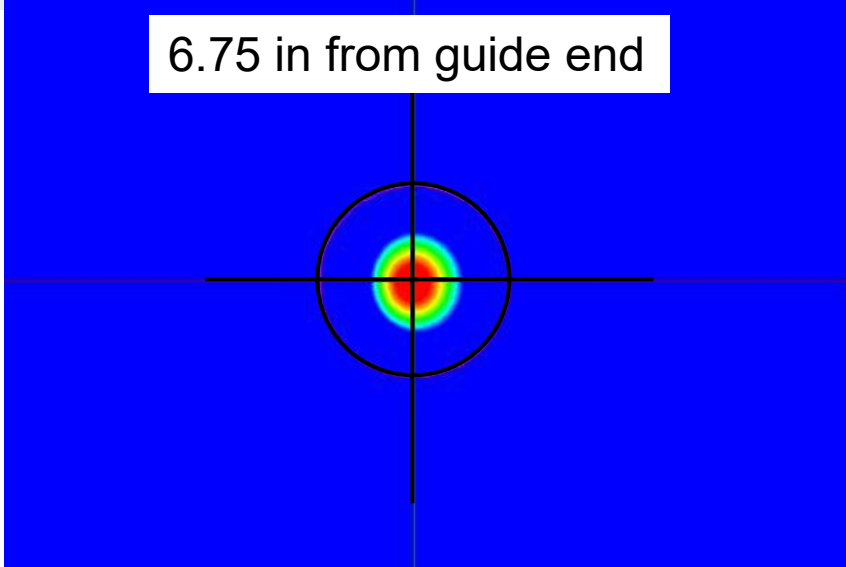


INFRARED IMAGES FROM WAVEGUIDE

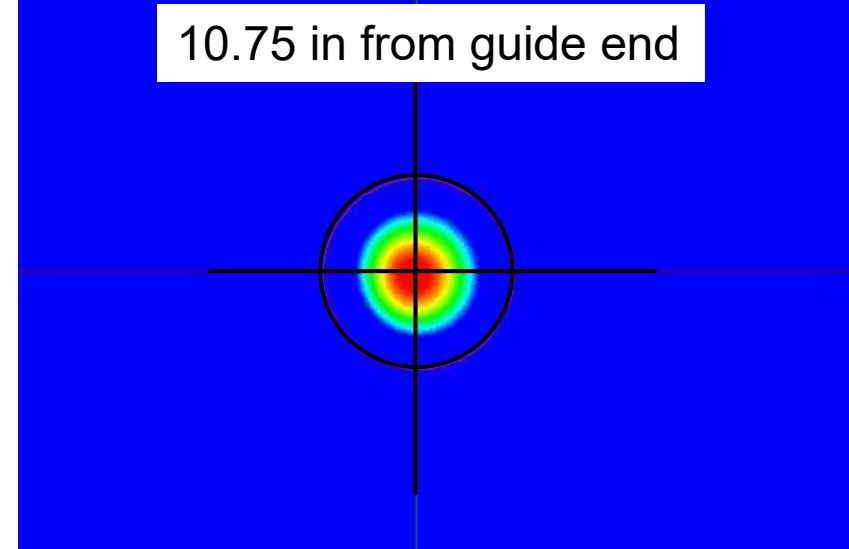


IR IMAGES AT TC1 70 GHz

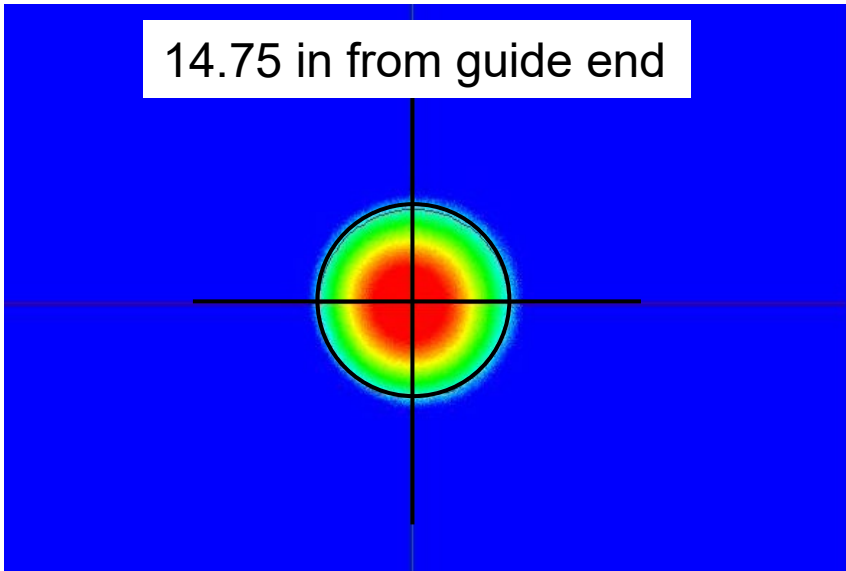
6.75 in from guide end



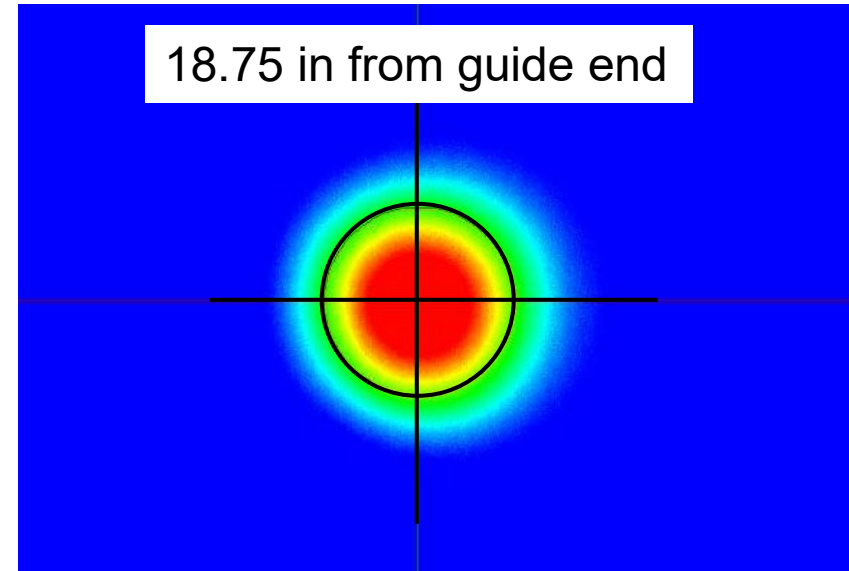
10.75 in from guide end



14.75 in from guide end

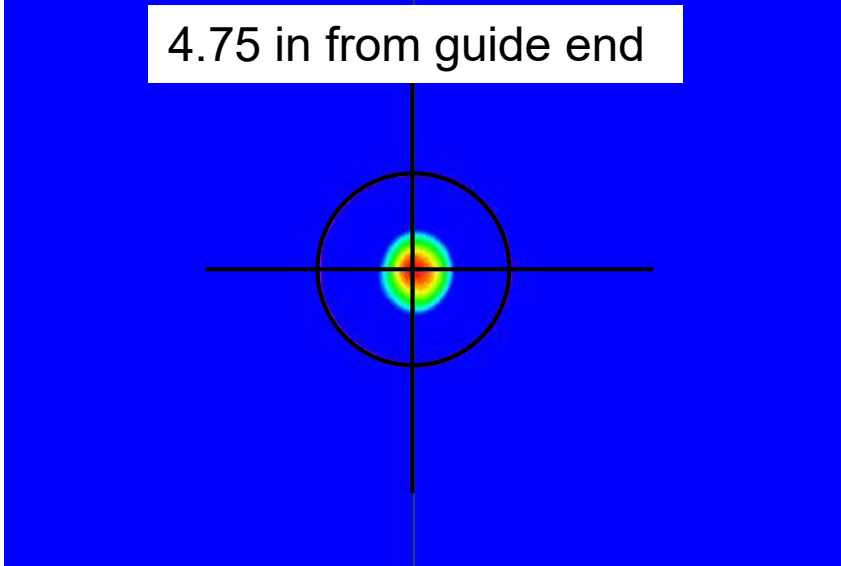


18.75 in from guide end

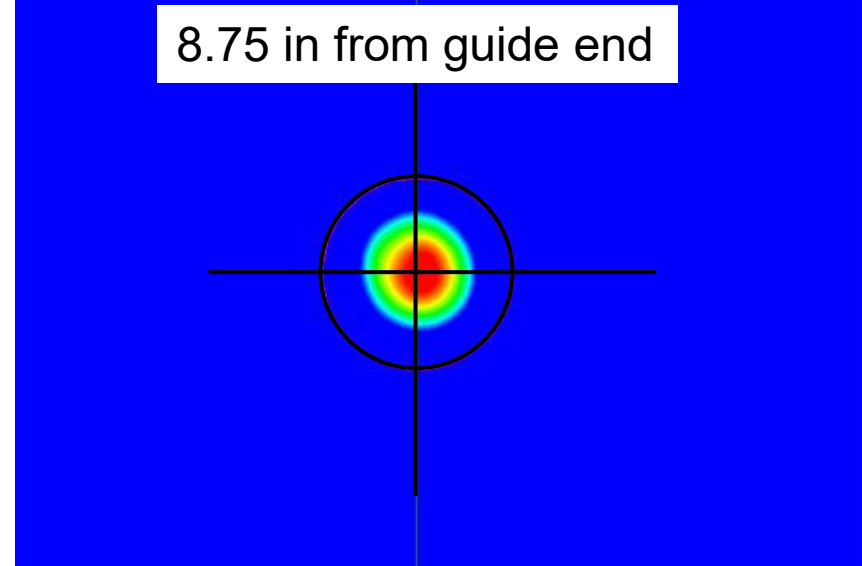


IR IMAGES AT TC2 105 GHz

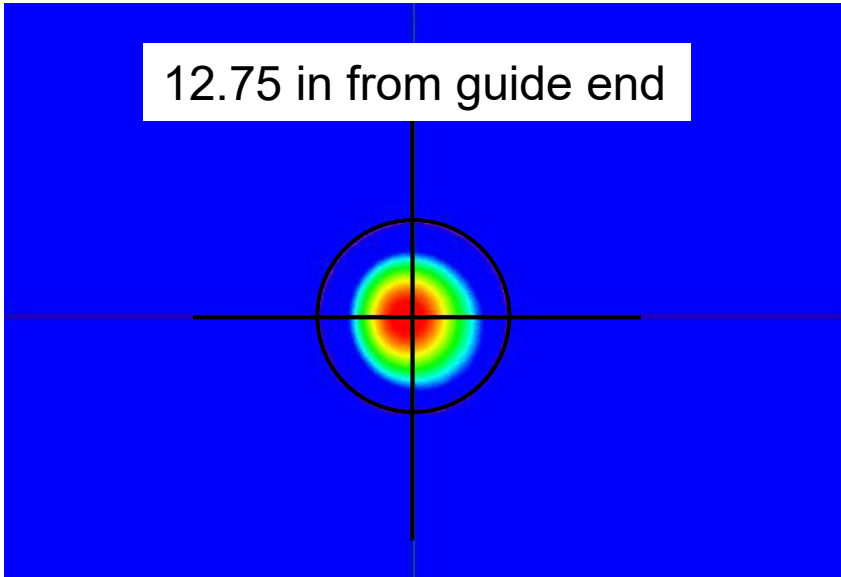
4.75 in from guide end



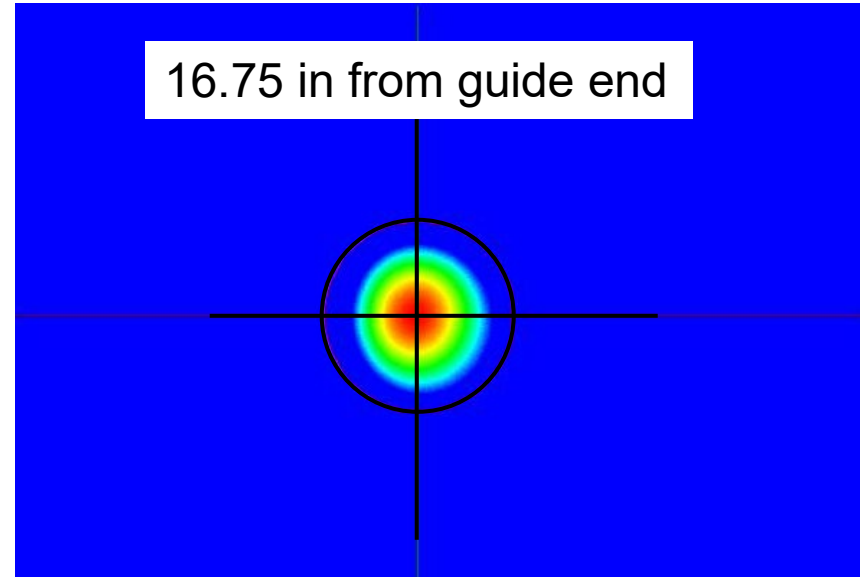
8.75 in from guide end



12.75 in from guide end



16.75 in from guide end



GYROTRONS SHIPPED TO ORNL (9/25 AND 5/26)



READY TO SHIP



INSTALLED AT MPEX

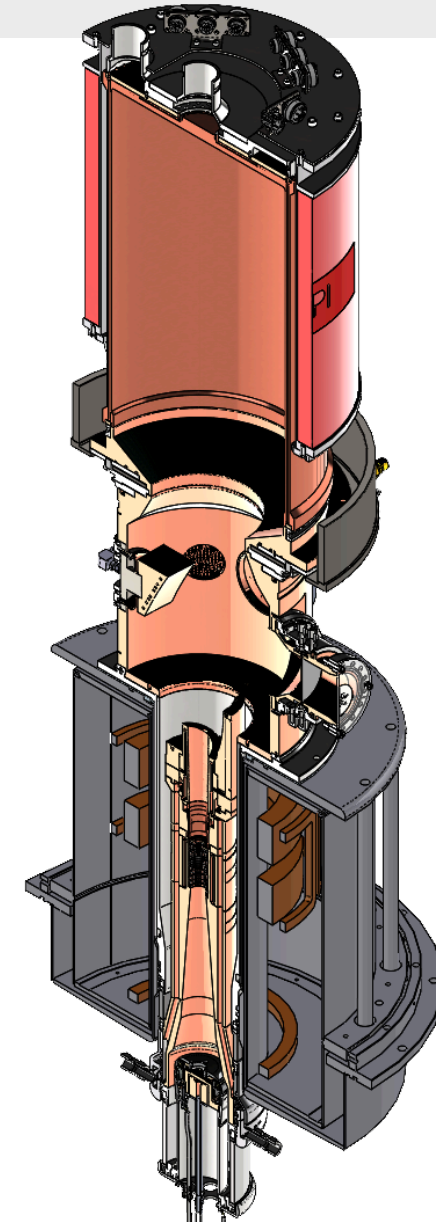
GEO THERMAL DRILLING

- GOAL: DRILL 10 – 20 km TO ACCESS GEOTHERMAL ENERGY
- USE 100 kW – 1 MW POWER LEVEL CW GYROTRONS AT 95 – 110 GHz
- REPURPOSE COAL POWER PLANTS

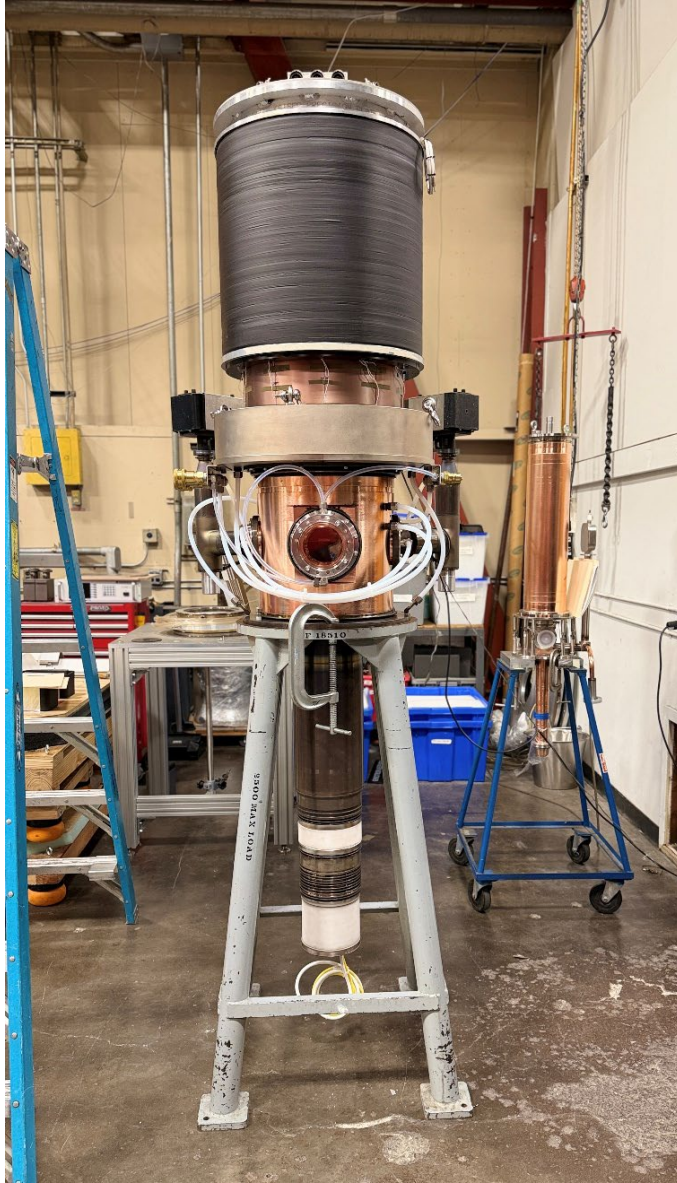


1 MW CW 105 GHz GYROTRON

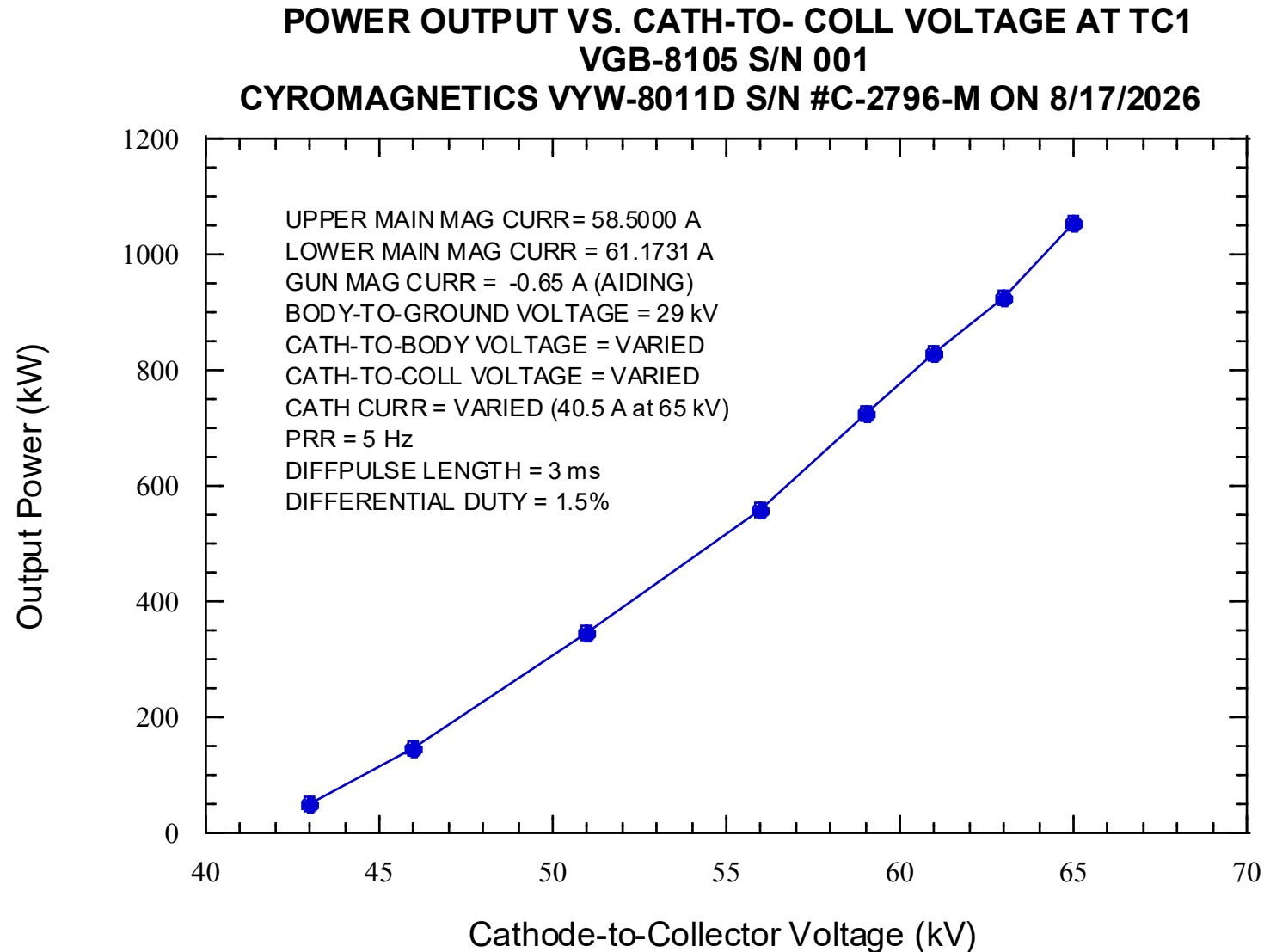
PARAMETER	DESIGN VALUE
MODE	TE _{21,6}
Q	900
FREQUENCY	105.0 GHz
BODY-TO-CATHODE VOLTAGE	94 kV
CATHODE-TO-COLLECTOR VOLTAGE	65 kV
CATHODE CURRENT	40 A
MAGNETIC FIELD	40.8 kG
OUTPUT MODE	TEM00



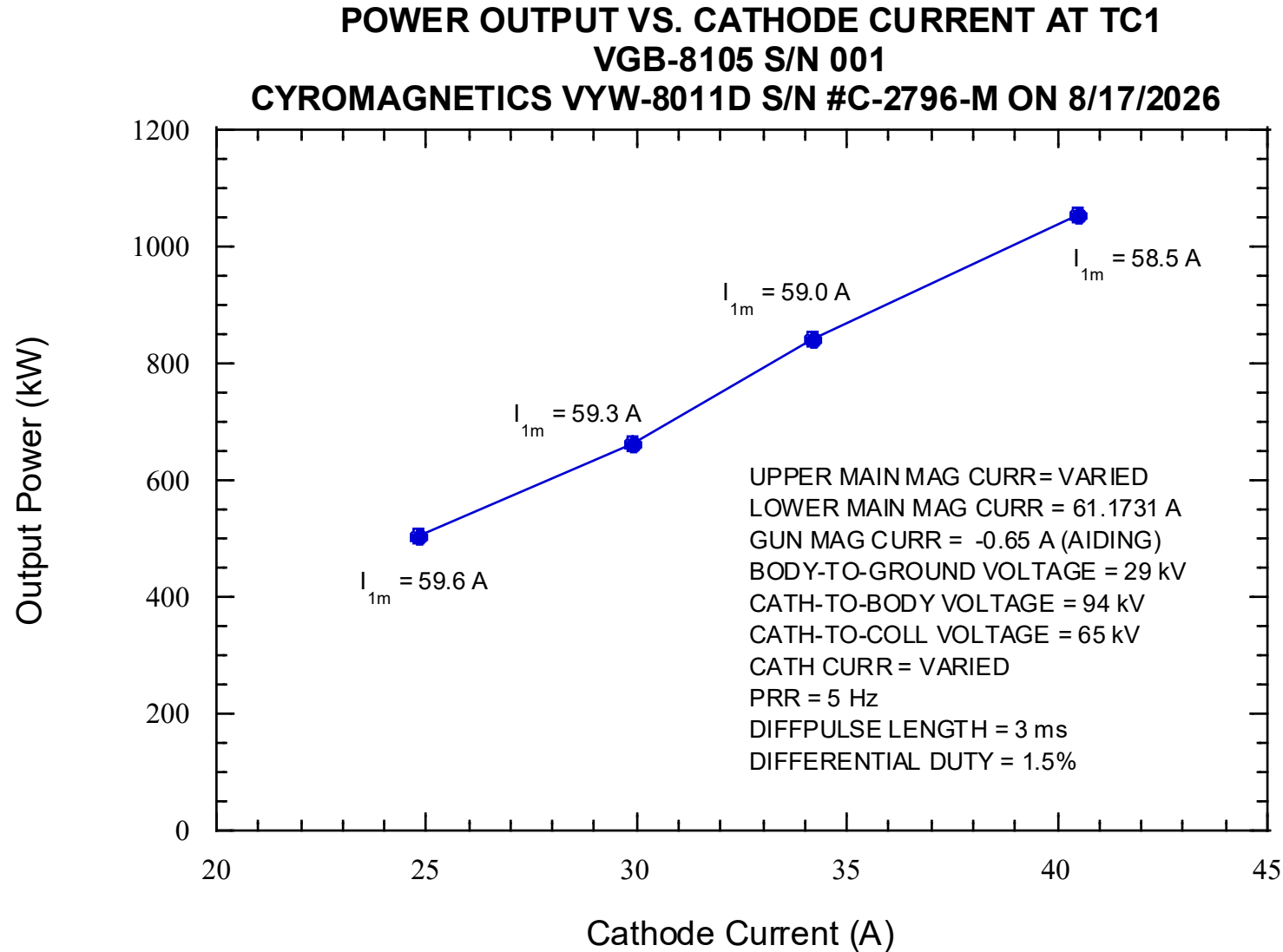
1 MW CW 105 GHz GYROTRON



POWER OUT VS CATHODE VOLTAGE



POWER OUT VS CATHODE CURRENT



OUTLINE

- ❖ BRIEF VARIAN/CPI/MPP GYROTRON HISTORY
- ❖ CURRENT GYROTRON DEVELOPMENT
 - 70/105 GHz 600 kW CW FOR ORNL MPEX
 - 105 GHz FOR GEOTHERMAL DRILLING
- ❖ SUMMARY

SUMMARY

- ❖ DESIGNED, BUILT, DELIVERED TWO 600 kW CW 70/105 GHz GYROTRONS FOR OAK RIDGE NATIONAL LAB MPEX PROGRAM
- ❖ DESIGNED, BUILT, CURRENTLY TESTING 1 MW CW 105 GHz GYROTRON FOR GEOTHERMAL DRILLING
 - ACHIEVED 1 MW OUTPUT POWER AT 105 GHz, SHORT PULSES
 - DEMONSTRATED 1000 SECOND PULSES AT 25 A AND 500 kW OUTPUT POWER
 - SECOND GYROTRON IN PRODUCTION
- ❖ 170 GHz 1 MW CW GYROTRON IN PRODUCTION (NOT FOR ITER)
- ❖ CONTINUING DEVELOPMENT EFFORTS OF NON-FUSION GYROTRON
 - RADAR, SPECTROSCOPY, NON-LETHAL WEAPONS, INDUSTRIAL HEATING, ETC.