

# RF STRUCTURES FOR X-RAY FREE ELECTRON LASER AT FREIA

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# Layout of RF Structures

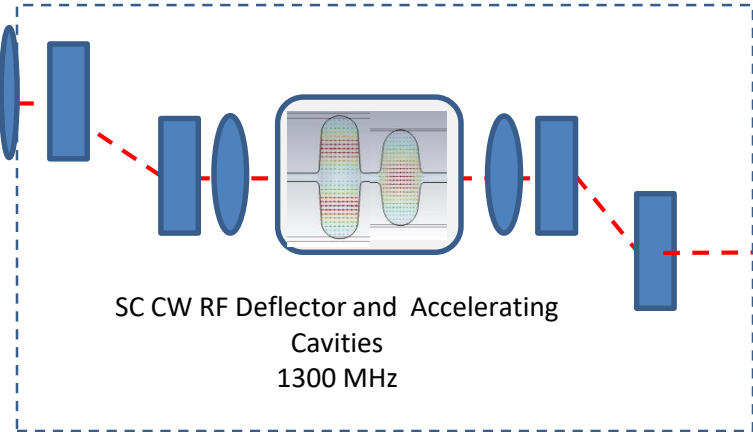
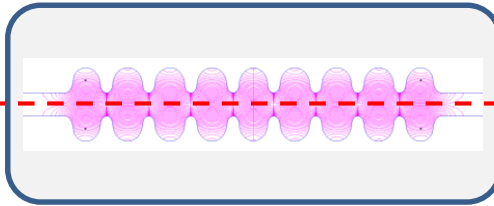
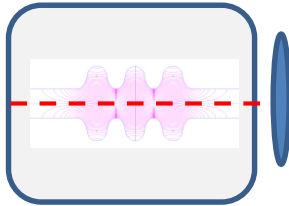
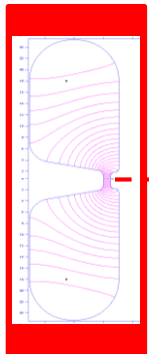
Room Temperature  
CW RF Photo-Gun  
325 MHz

SC CW 3 Cell Booster  
1300 MHz =  $4 \times 325$  MHz

SC CW 9 Cell Accelerating Structure  
1300 MHz

Emittance Exchanger

SC CW RF Deflector and Accelerating  
Cavities  
1300 MHz



# ROOM TEMPERATURE RF Photo Gun Cavity, 325 MHz

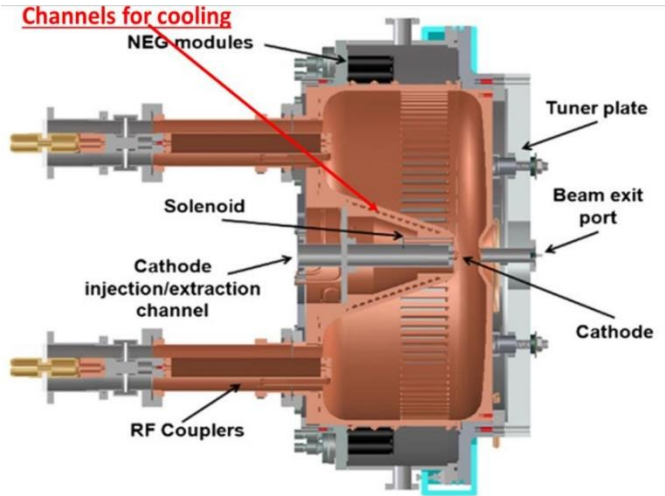
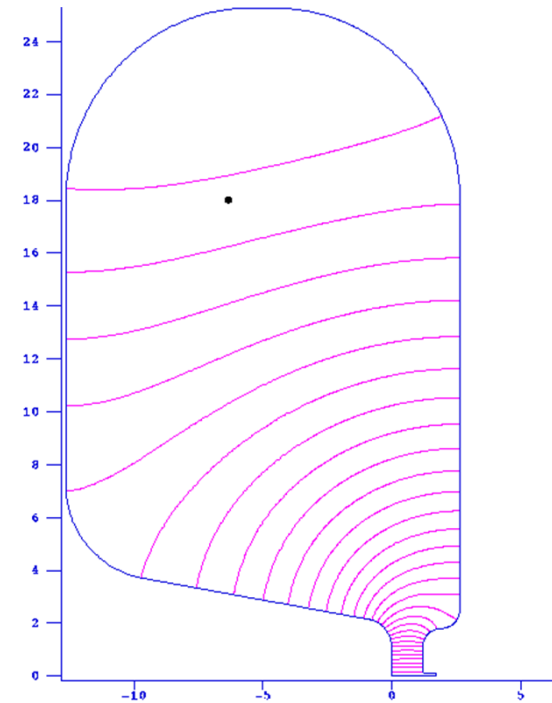
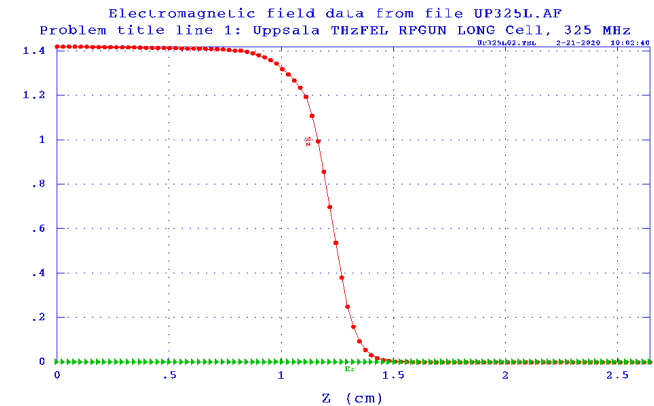


FIG. 1. APEX VHF gun cross section with main components.

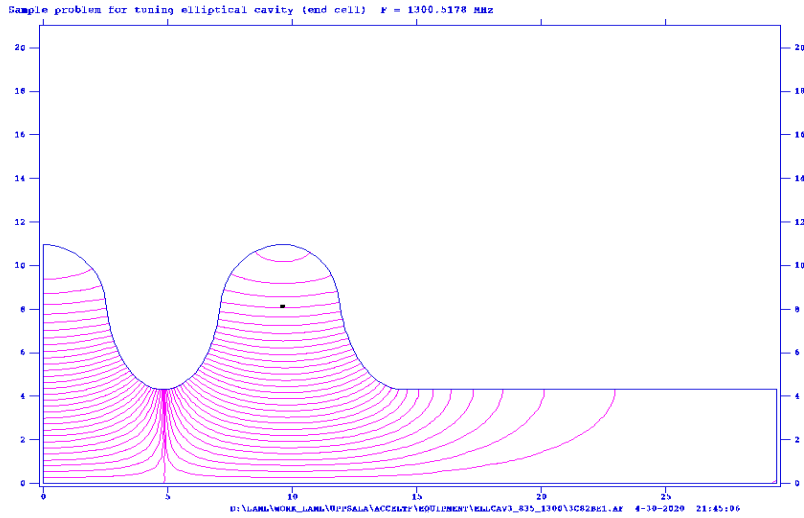
Advanced Photo-injector EXperiment , 186 MHz, at the Lawrence Berkeley National Laboratory



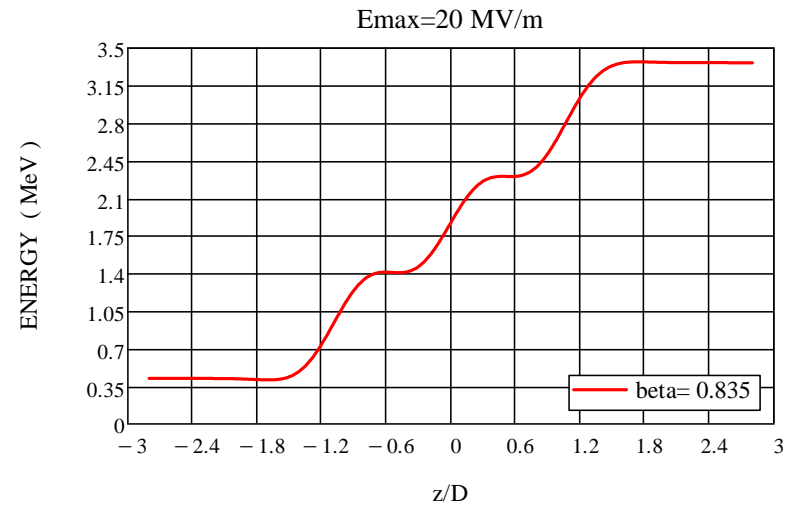
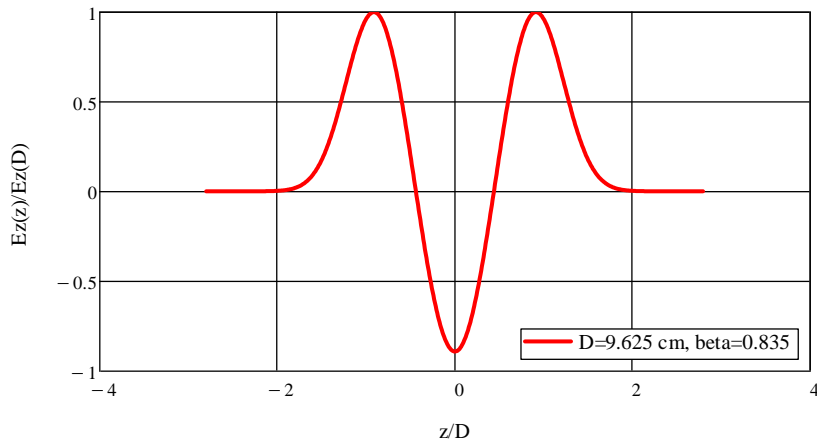
PARAMETERS	VALUE
Quality, $Q_0$	34646.5
Shunt Impedance, $Z_{sh}$	483 M $\Omega$ /m
Electric field at Cathode	35 MV/m
Stored energy	0.364 J
Power Dissipation, $P_{diss}$	21.4 kW
Energy Gain, $V_{acc}$	419 keV
Max. Power Density on Wall	48 W/cm <sup>2</sup>



# SC CW 3 Cell BOOSTER 1300 MHz, $v_{ph}=0.835$

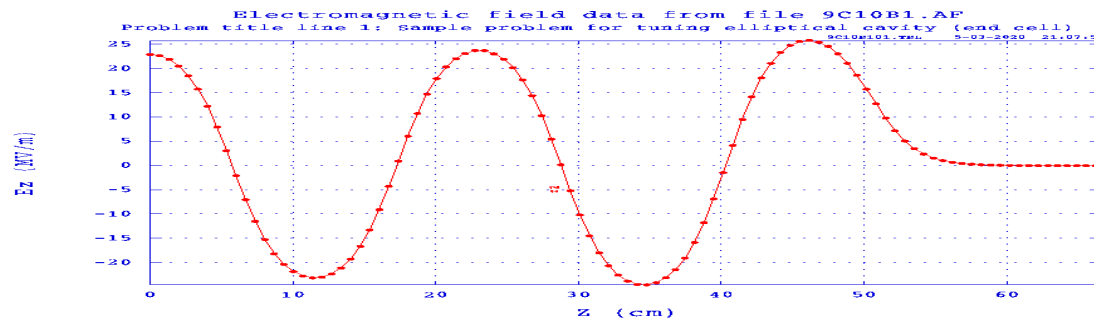
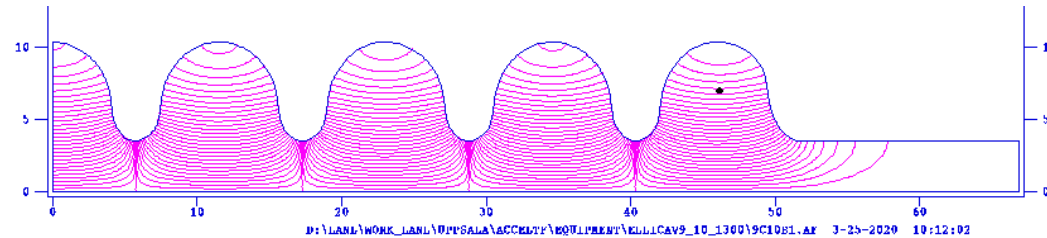


PARAMETERS	VALUE
Quality, $Q_0$	6.8813E+09
$r/Q_0$	52 $\Omega$
Max Electric field on axis	20 MV/m
Stored energy	72 mJ
Power Dissipation, $P_{diss}$	0.8 W
Energy Gain, $V_{acc}$	2.5 MeV
Max. Power Density on Wall	2.3 mW/cm <sup>2</sup>



$$L=3D=3 \times 9.625 \text{ cm} = 28.875 \text{ cm}$$

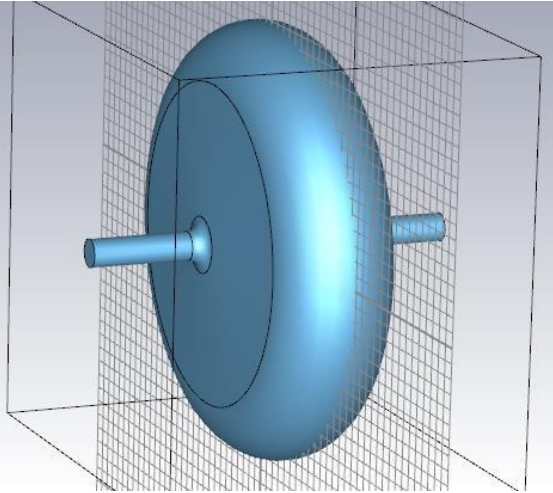
# SC 9 CELL TESLA CAVITY, 1300 MHz



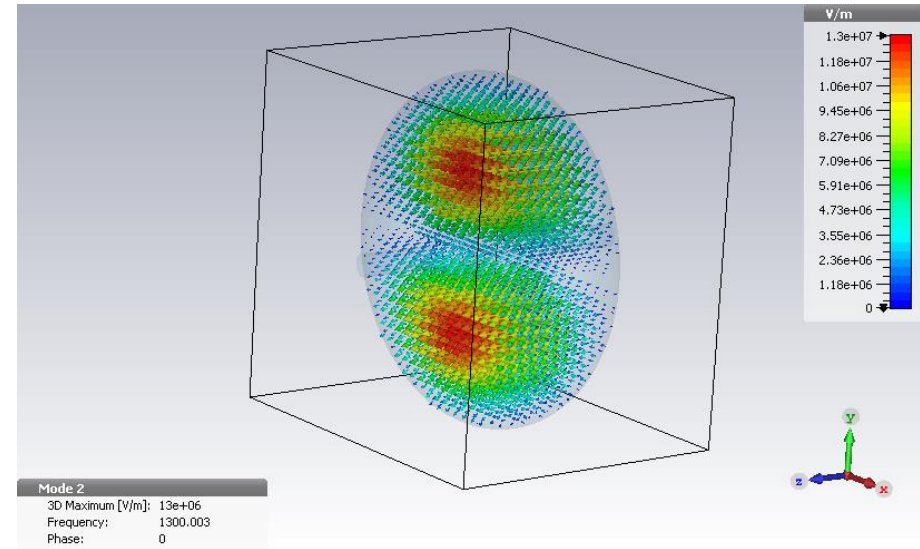
PARAMETERS	VALUE
Quality, $Q_0$	1.3293E+10
$r/Q_0$	510 $\Omega$
Electric field on crest	10 MV/m
Stored energy	1.2 J
Power Dissipation, $P_{diss}$	6.3 W
Energy Gain, $V_{acc}$	10 MeV
Max. Power Density on Wall	0.36 mW/cm <sup>2</sup>

$$L=9D=9 \times 11.53 \text{ cm} = 103.774 \text{ cm}$$

# SC CW RF Deflector of EEX, 1300 MHz



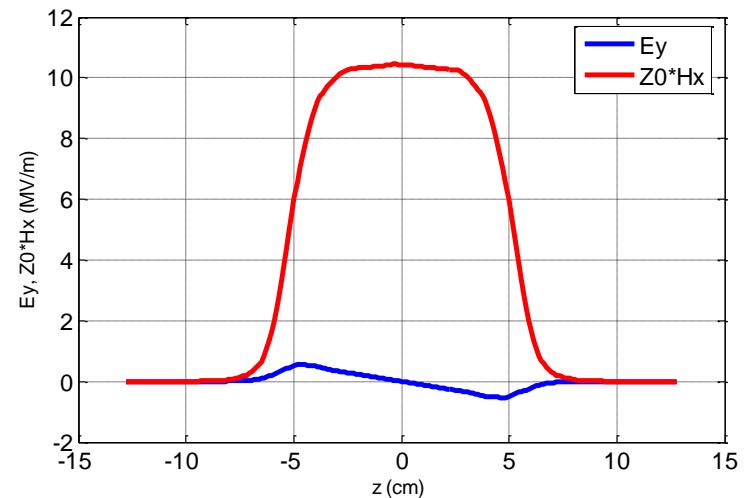
The three-dimensional drawing



Electric field of TM<sub>11</sub> Mode

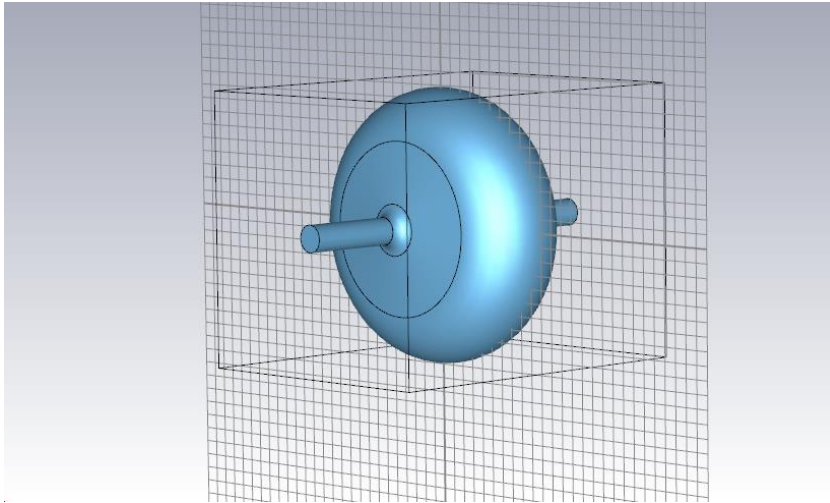
Parameter	Values	Units
Frequency of TM <sub>11</sub> $\pi$ engine modes	1300	MHz
Period, D	11.53	cm
Radius of a cavity, b	14.92	cm
Radius of a beam line tube, a <sub>b</sub>	1.0	cm
Total Length, L (cm)	25	cm

The geometry sizes

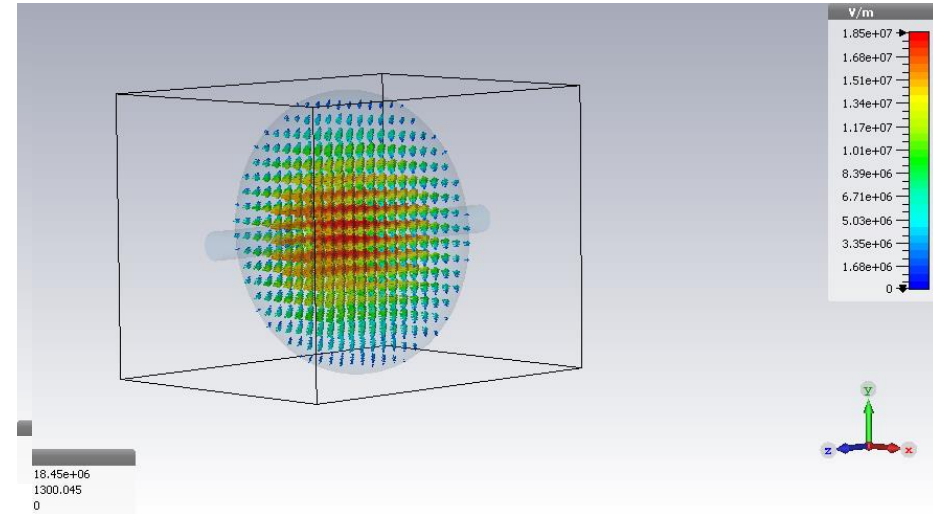


The transverse fields of TM<sub>11</sub> mode along the deflector axis

# SC CW Accelerating Cavity of EEX, 1300 MHz



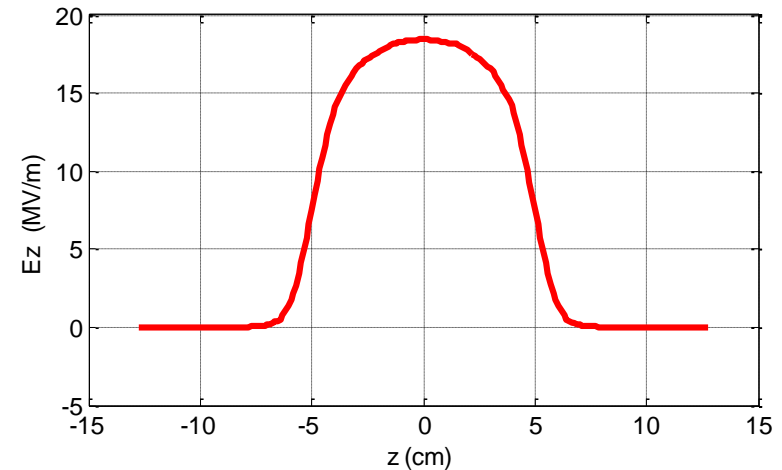
The three-dimensional drawing



Electric field of TM<sub>01</sub> Mode

Parameter	Values	Units
Frequency of TM <sub>01</sub> engine modes	1300	MHz
Period, D	11.53	cm
Radius of a cavity, b	9.908	cm
Radius of a beam line tube, a <sub>b</sub>	1.0	cm
Total Length, L (cm)	25	cm

The geometry sizes



The longitudinal field of TM<sub>01</sub> mode along the deflector axis

**THANK YOU FOR ATTENTION**