

2.1 GHz Warm RF Cavity for LEReC

Binping Xiao

Collider-Accelerator Department, BNL

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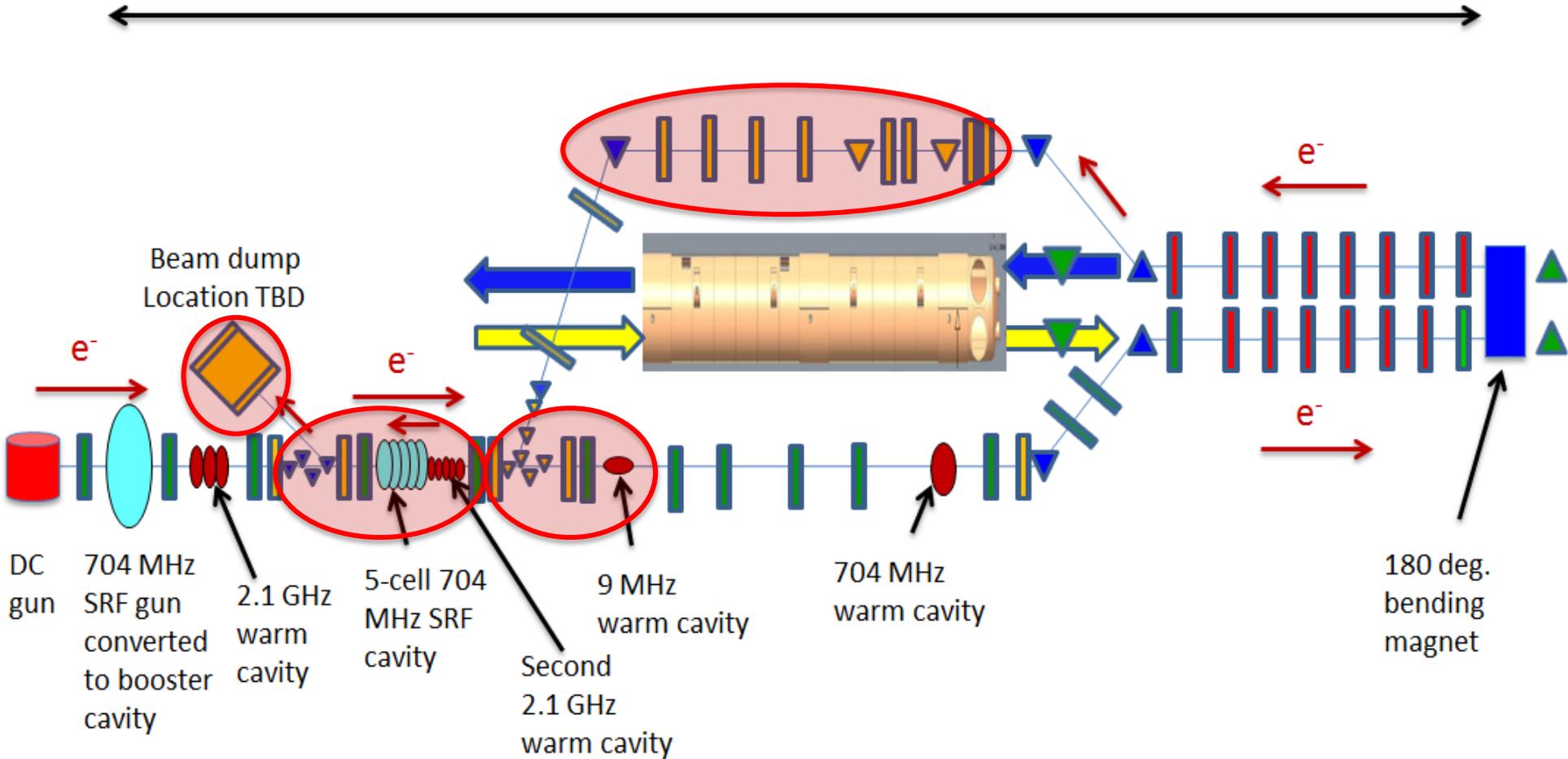
Outline

- Layout of the LEReC linac
- Description of 2.1 GHz warm RF system
- Summary

LEReC layout

IP2

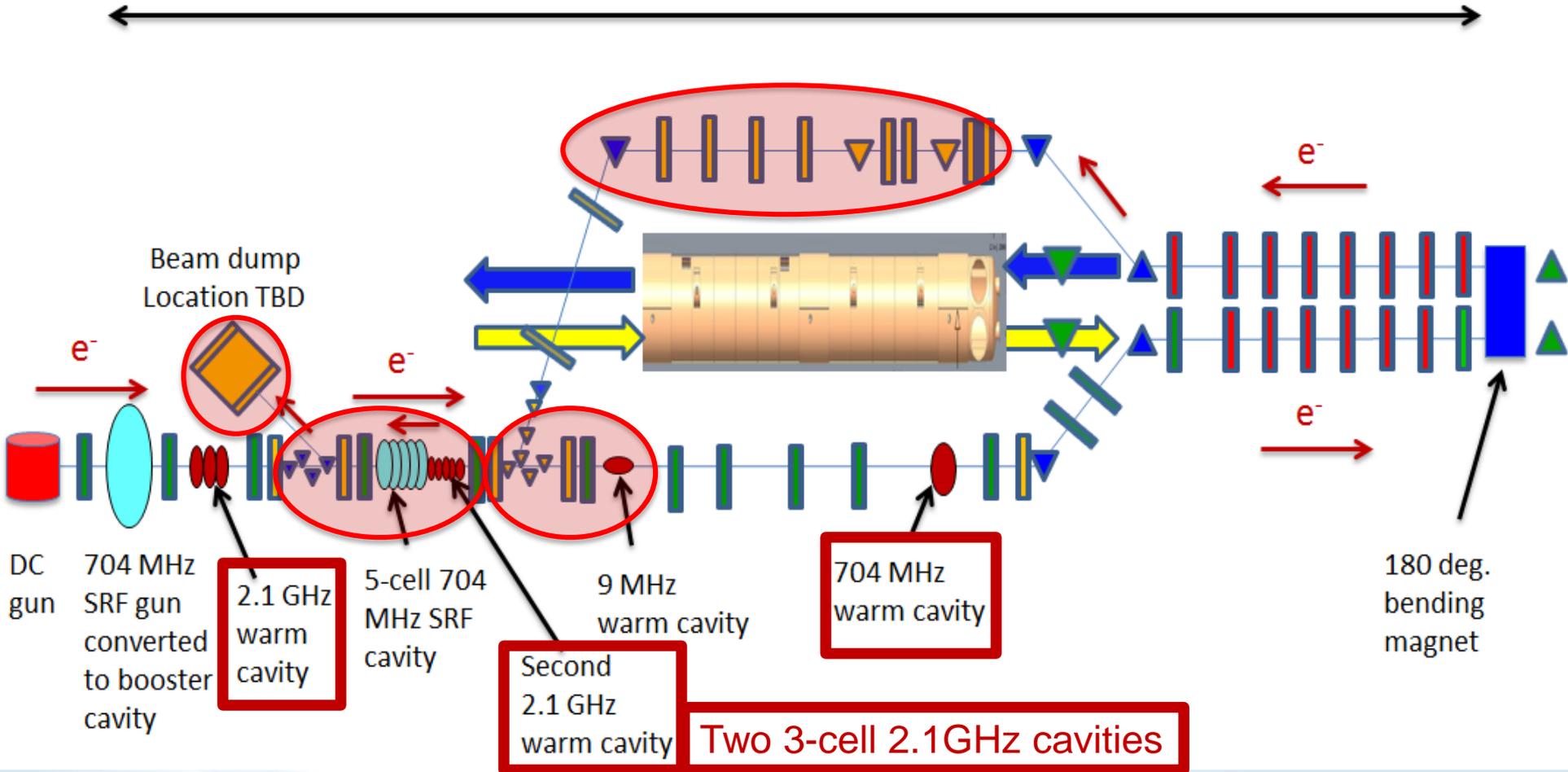
64 m



LEReC layout

IP2

64 m

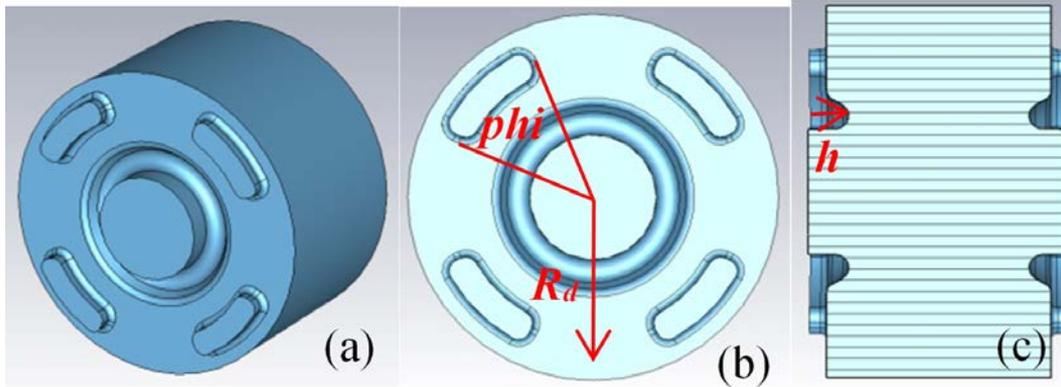


Parameters

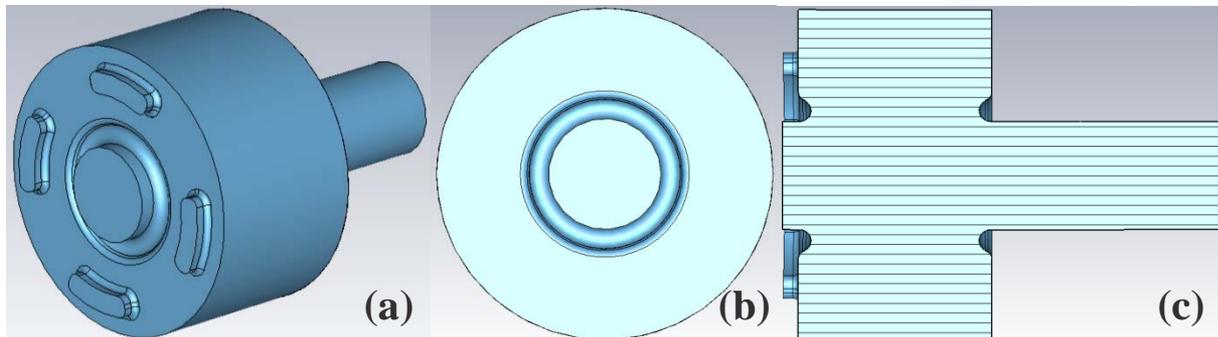
	Phase I	Phase II
Frequency	2.1107 GHz	
Beam pipe ID [inch]	1.37	
# of cells	3	
Voltage [kV]	200	250
R/Q [Ohm]	480	
G [Ohm]	170	
Q0	14100	
Pcav [kW]	5.92	9.25
RF power [kW]	10	12 or 15?

2.1 GHz warm cavity: cell design

The 2.1 GHz bare cell: (a) perspective view; (b) front view; (c) side view.

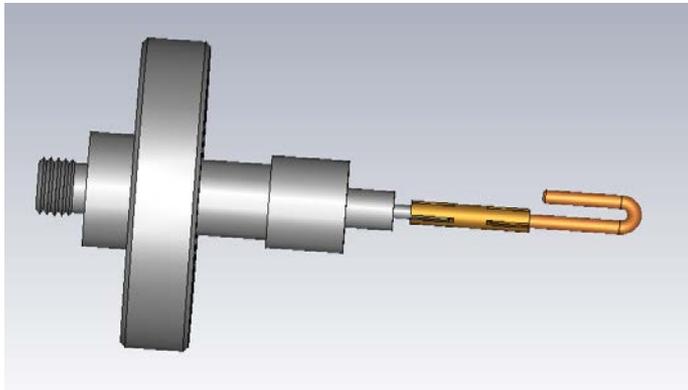


Cavity end cell (a) perspective view (b) front view (c) side view.



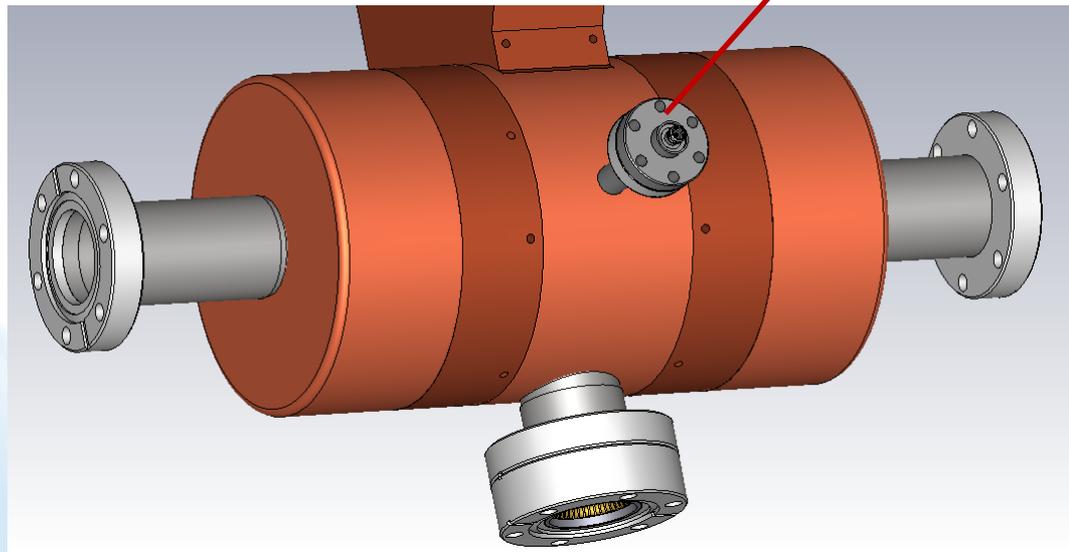
2.1 GHz warm cavity: coupler design

(top) pickup coupler; (bottom) location of pickup coupler.

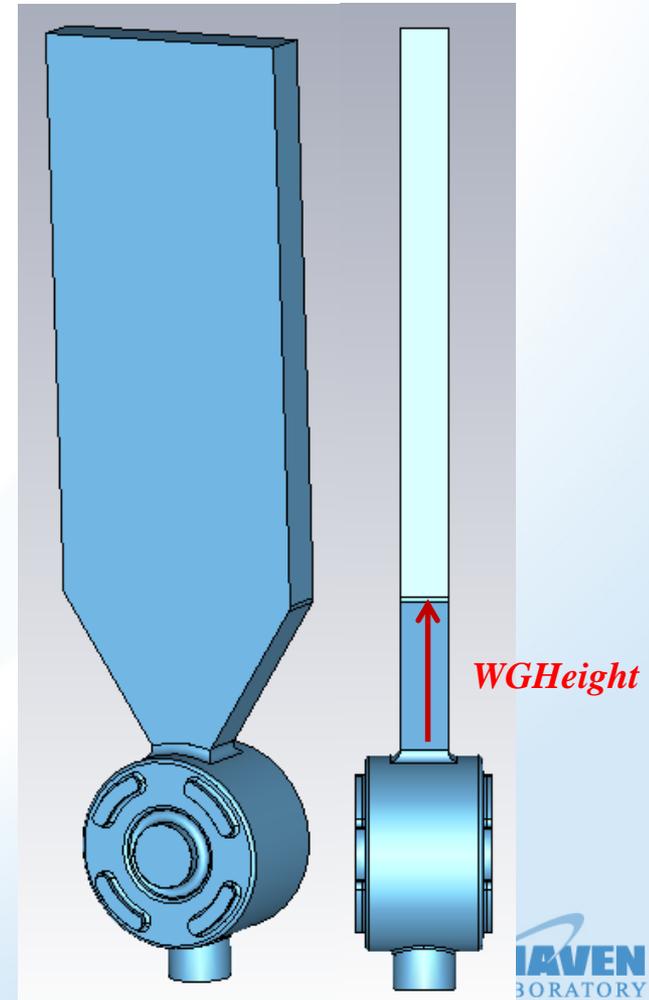


To provide $10^8 Q_{\text{ext}}$ and 1W power at 200kV.

Pickup coupler



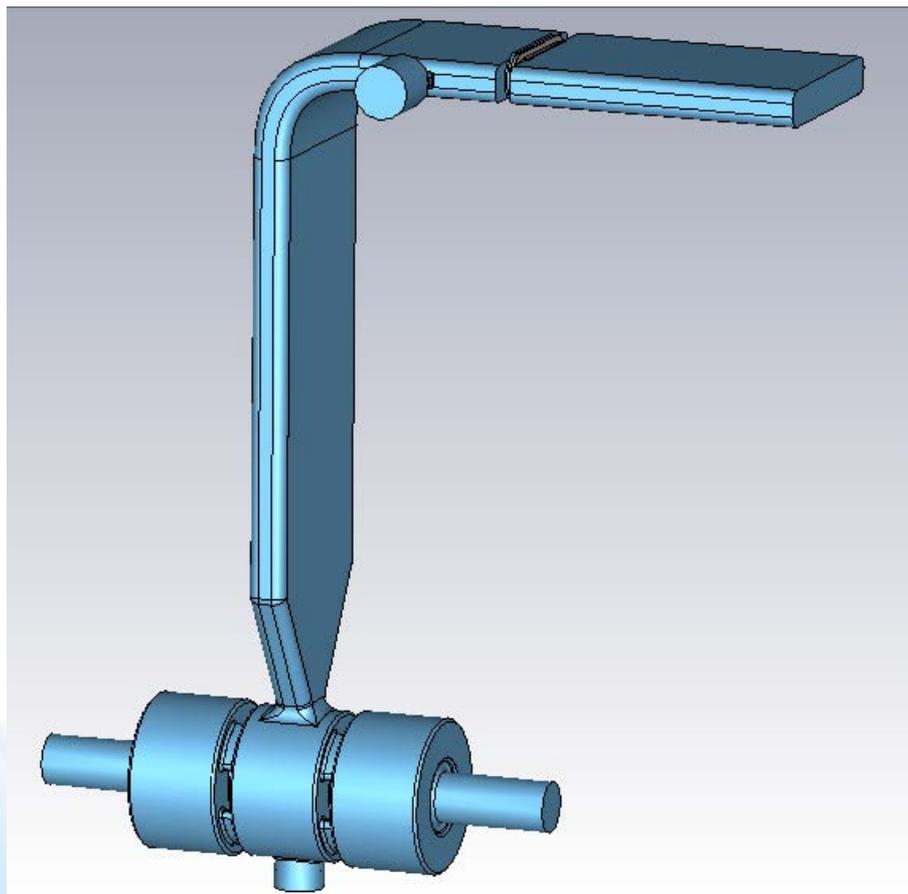
Center cell with the FPC and tuner: (left) perspective view; (right) side view.



2.1 GHz warm cavity: 3cell

Parameters for 3-cell cavity (length unit in mm).

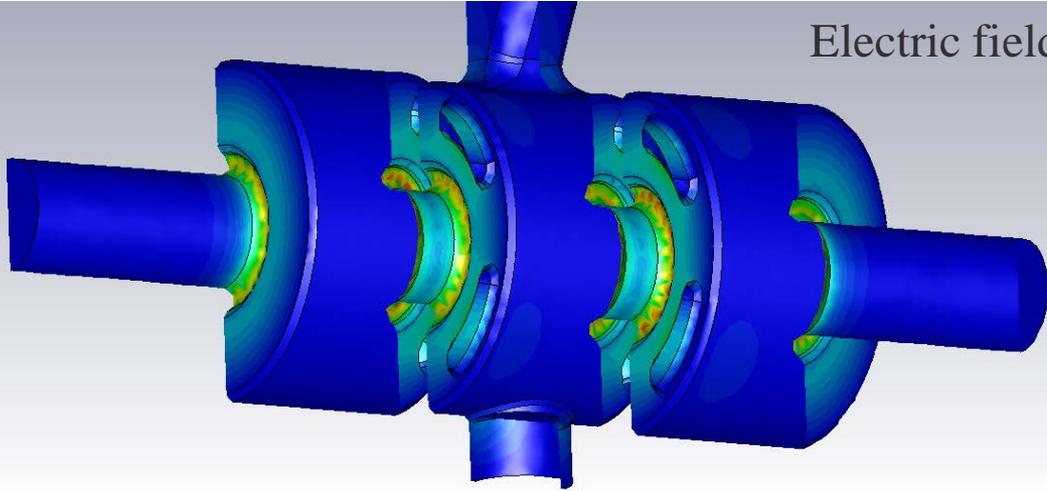
ϕ [degree]	h	R_{d_e}	R_{d_c}	WGHeight
50	4	52.578	50.8508	87



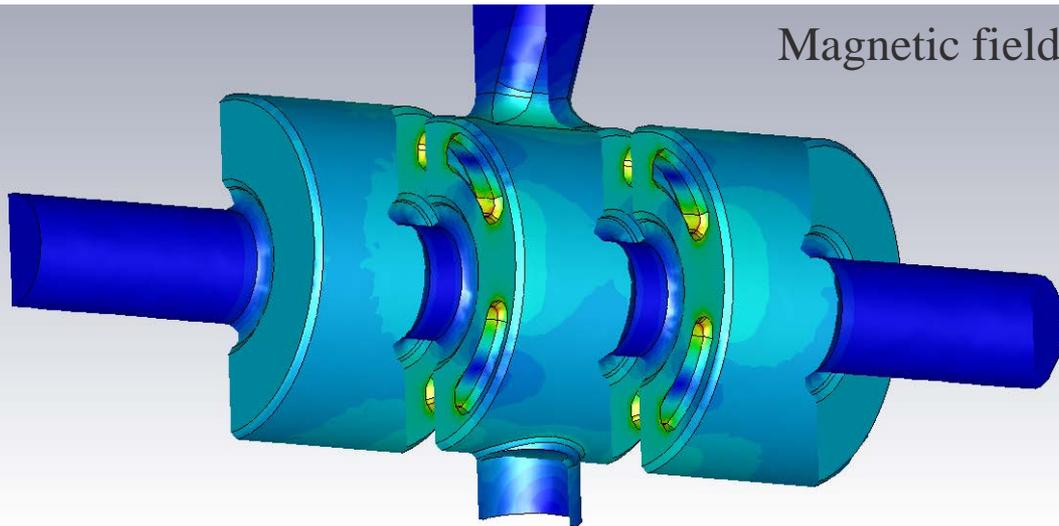
- Machining accuracy 0.001”.
- 50 degree coupling slot is chosen for the balance between coupling and shunt impedance for 3-cell.
- 4mm nose cone is chosen to maximize the shunt impedance.
- Radii of center cell and end cells are optimized for field flatness and resonance frequency at 0 tuner insertion.
- A gauge/arc detector port near RF window and a pickup port is designed (not shown here). A vacuum port near RF window is designed.
- JLab530 RF window (TiN coated) is placed far away from the cavity with an L-shaped waveguide to reduce the charge on the ceramic surface from beam.

2.1 GHz warm cavity: EM field

Electric field



Magnetic field



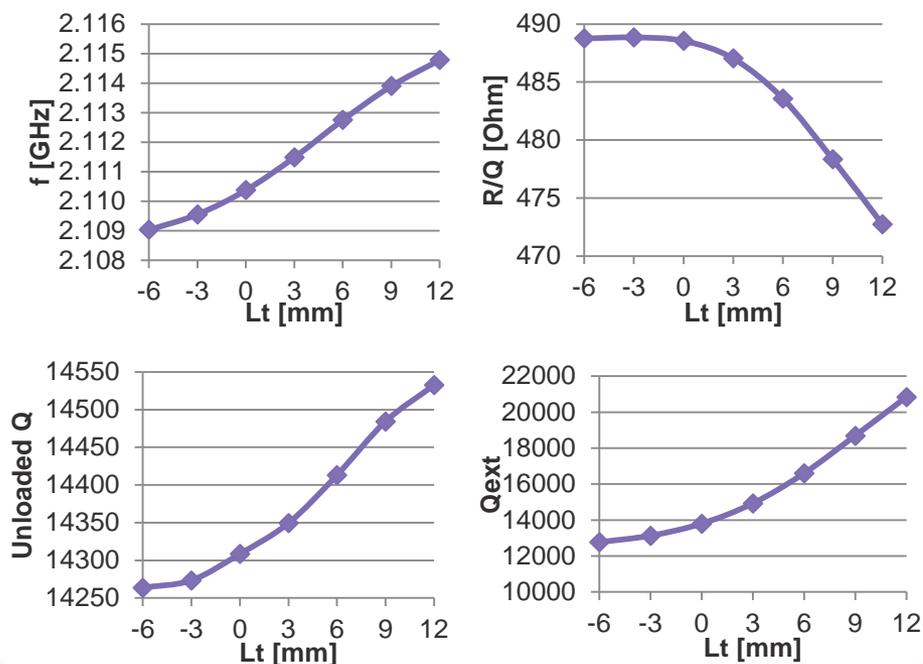
For 200 kV:

Peak electric field 3.6 MV/m

Peak magnetic field 14.3 mT

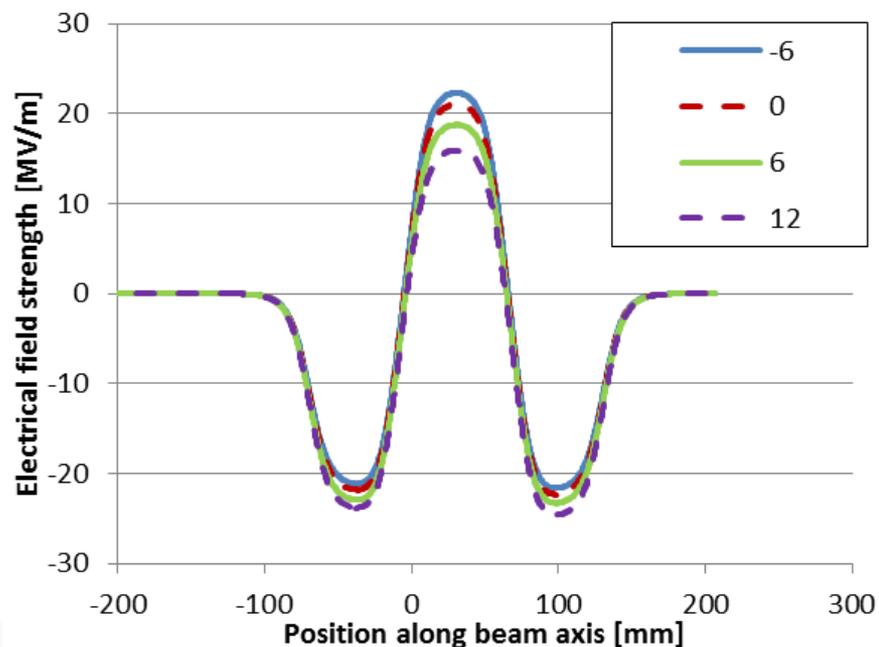
2.1 GHz warm cavity: tuner

Simulation results at different tuners' penetrations: frequency, R/Q at $\beta = 1$, Q_0 after considering 1.3 factor, and the FPC's external Q .



RF performance for different tuner insertion

Lt[mm]	freq [GHz]	Q0	Qext	R/Q [ohm]
-6	2.109027	14264	12771	488.76
0	2.110371	14309	13803	488.55
6	2.112746	14413	16600	483.57
12	2.114779	14533	20850	472.73



Accelerating component of the electric field on beam axis for 3-cell cavity at 1Joule stored energy, with tuner penetrations to be -6, 0, 6, and 12 mm.

Summary

- There will be two warm RF systems in LEReC: 704 MHz and 2.1 GHz cavities.

For the 2.1 GHz warm RF system:

- 3-cell cylindrical cavity with nose cones and coupling slots is designed, and is optimized on shunt impedance.
- FPC, vacuum port and gauge/arc detector port for FPC, tuner and Pickup coupler ($Q_{\text{ext}} 10^8$ to provide $\sim 1\text{W}$ power at 200kV) are designed.
- A vacuum pump will be attached to the cavity using a Tee on one of the beam pipe.
- Cavity is fine tuned for field flatness.
- Cavity performance at different tuners' penetrations is evaluated.
- The 2.1 GHz RF design is finalized.

Thank you!