Warm RF Cavities for LEReC

Binping Xiao

Collider-Accelerator Department, BNL

May 28, 2015

BROOKHAVEN NATIONAL LABORATORY

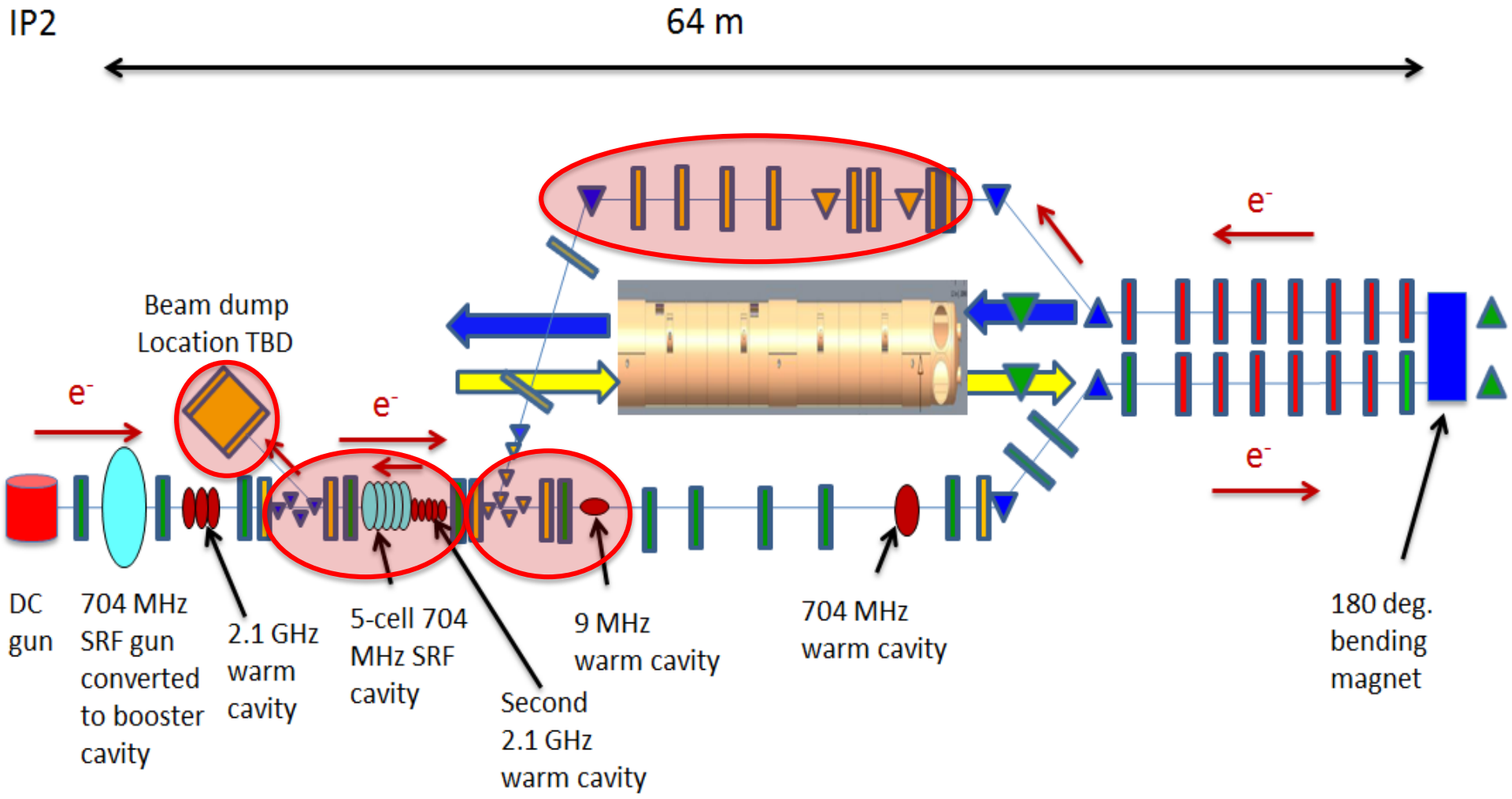
a passion for discovery

U.S. DEPARTMENT OF ENERGY | Office of Science

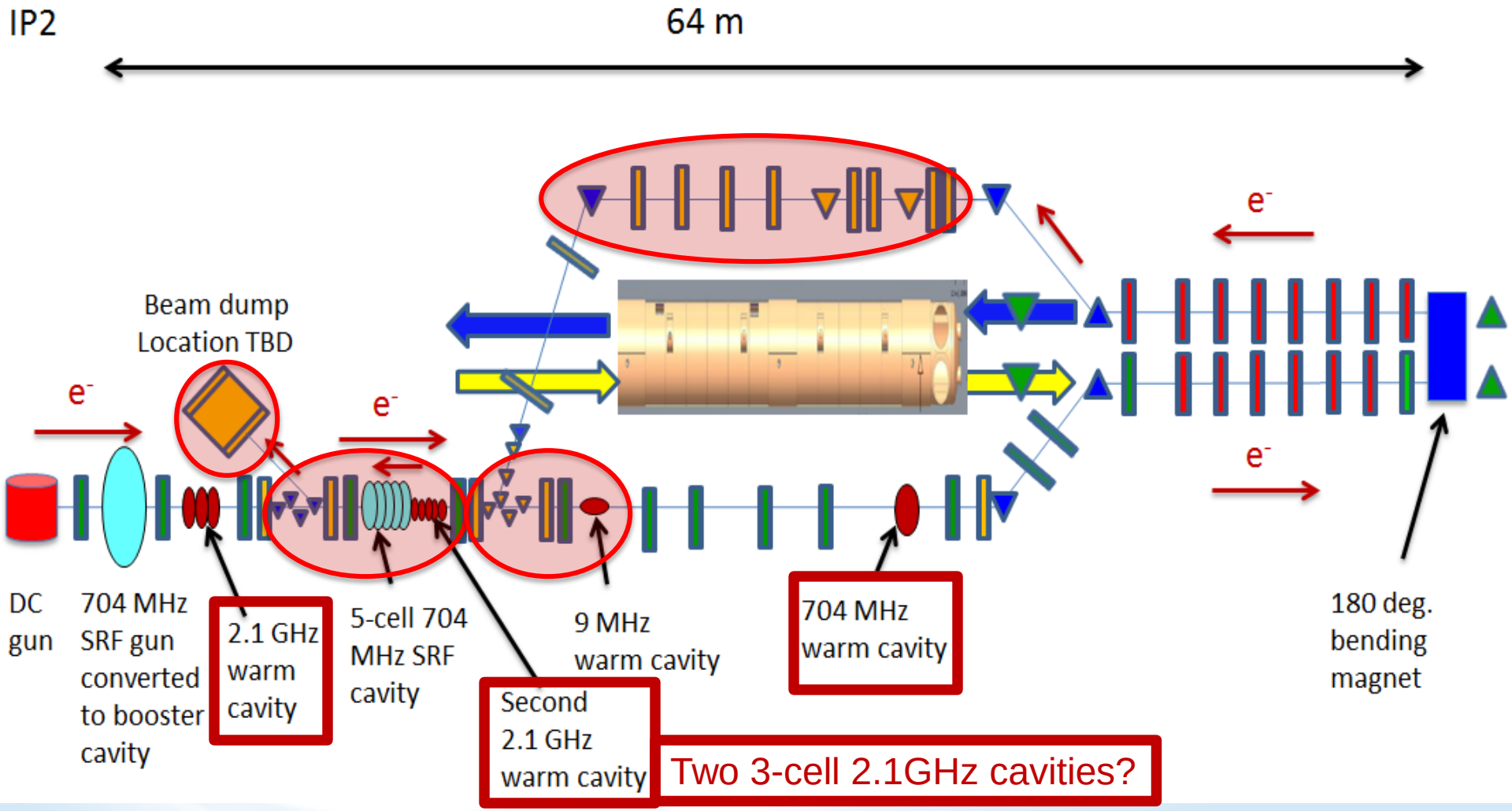
Outline

- Layout of the LEReC linac
- Description of warm RF systems:
  - 704 MHz warm RF cavity
  - 2.1 GHz warm RF cavity
- Summary

LEReC layout



LEReC layout

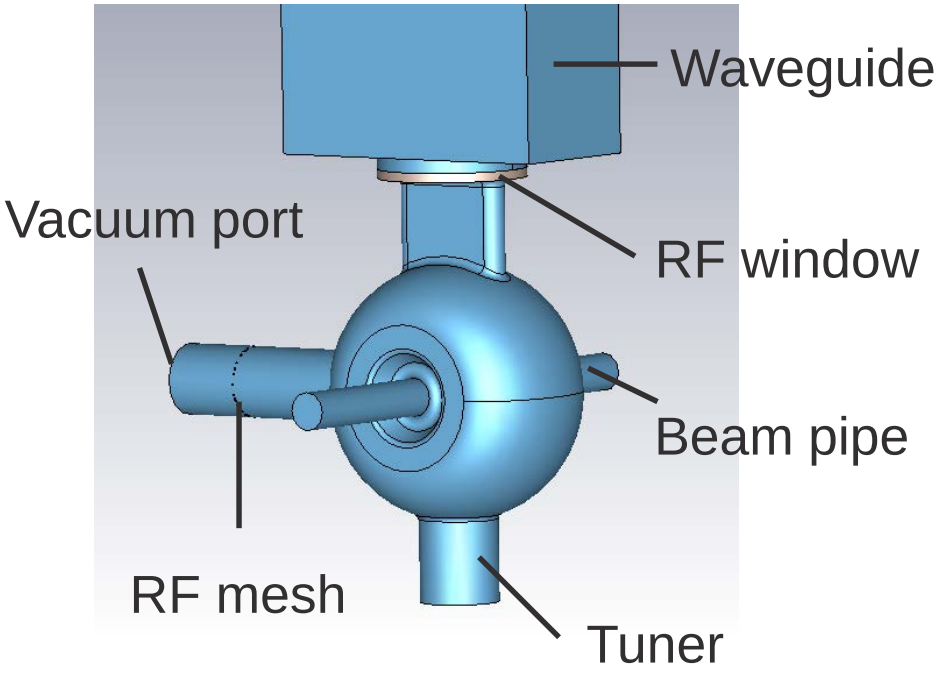


Parameters

Frequency	703.567 MHz	2.1107 GHz
Beam pipe ID [inch]	1.875	1.37
# of cells	1	3
Voltage [kV]	430	200
R/Q [Ohm]	247	480
G [Ohm]	235	170
Q0	25900*	14100
Pcav [kW]	28.9	5.92
RF power [kW]	50	10

*After considering 1.3 factor on surface resistance due to roughness

704 MHz warm cavity

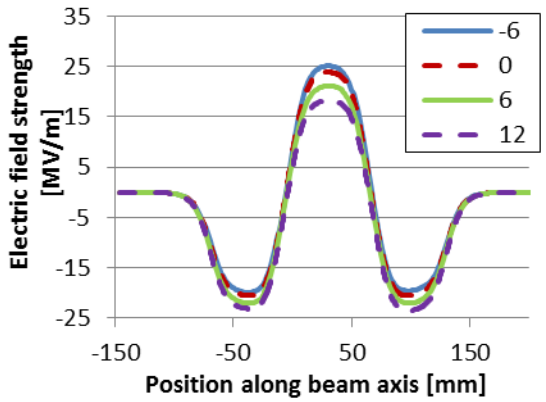


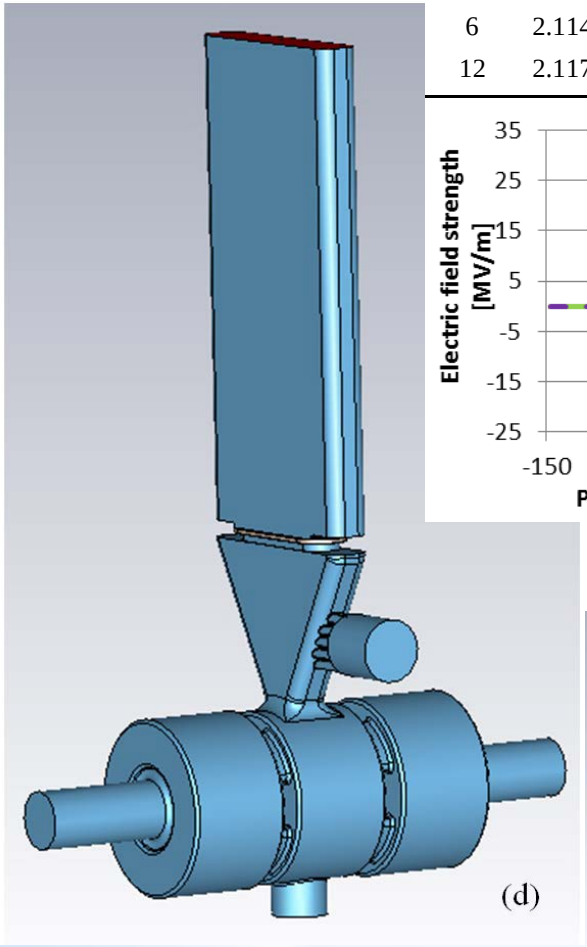
L_t [mm]	f [MHz]	Q_0/1.3	FPC Q_{ext}	R/Q at β=1 [Ω]
-9	703.02	26414	26434	247.89
0	703.58	26023	26063	247.48
9	704.69	25392	25794	247.03
18	706.03	24645	25278	246.47

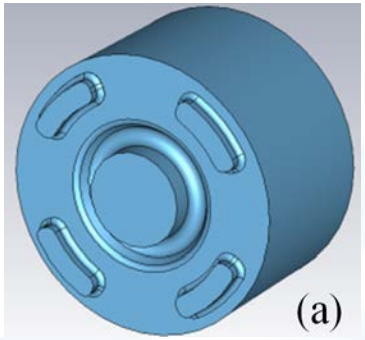
- We borrow design of some components from the 714 MHz cavity developed at LBNL for the NLC damping ring.
- We use an elliptical shape to maximize the shunt impedance.
- We plan to use an RF window originally design for the NLC damping ring cavity at LBNL and further developed at JLab.
- There will be a plunger-type frequency tuners.
- Three ports need to be added: vacuum port and gauge/arc detector port near RF window, pickup port.
- RF window will be moved further away from the cavity to reduce the charge on the ceramic surface from beam.

2.1 GHz warm cavity

L_t [mm]	f [GHz]	Q_0/1.3	Q_{ext}	R/Q at β=1 [Ω]
-6	2.1100058	10861	9910	484.18
0	2.1115363	10872	10948	487.57
6	2.1145674	10907	13588	488.06
12	2.1172592	10996	17872	480.26







- We plan to use a CEBAF-type RF window.
- There will be a plunger-type frequency tuner on the center cell.
- One ion pump (connect to beam pipe with a Tee) will be maintaining the cavity vacuum and one small pump will be located near the RF window.
- A gauge/arc detector port near RF window and a pickup port is designed (not shown here).
- RF window will be moved further away from the cavity to reduce the charge on the ceramic surface from beam.
- This design considered 1.3 enhance factor on surface resistance, recent communications with industry suggested that a much better surface finish can be achieved to suppress this factor, FPC port will be re-optimized.

Summary

- There will be two warm RF systems in LEReC: 704 MHz and 2.1 GHz cavities.
- RF designs are close to final, small changes are needed based on recent feedbacks from R. Rimmer and industry. Mechanical designs are in progress. The cavities can be fabricated by industry.

Thank you!