Optimization of the Cell Shape For the LHC 800MHz Crab Cavity

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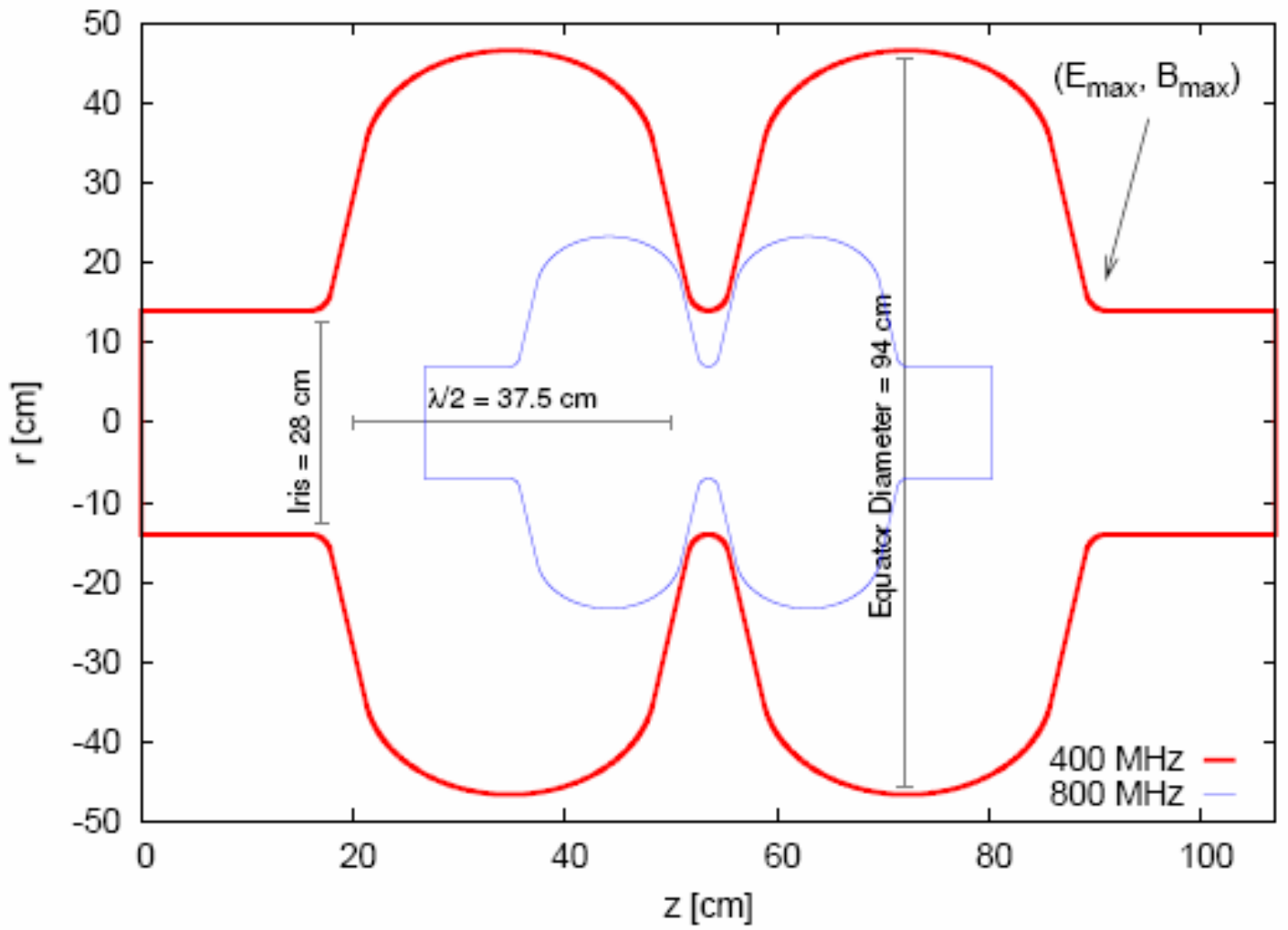
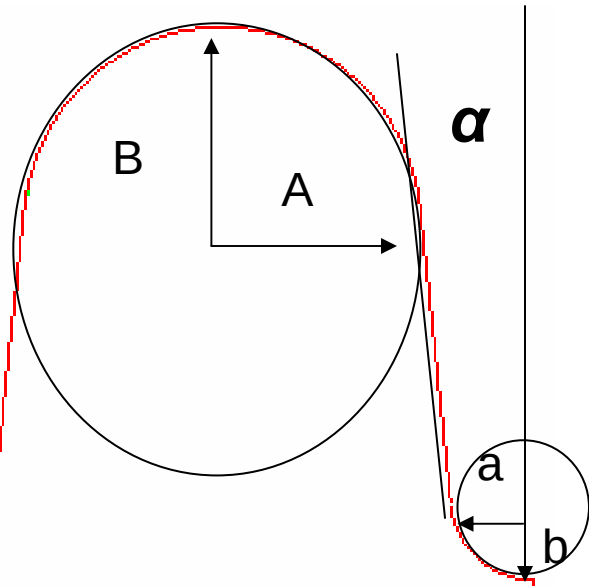


Start with Rama Calaga's 400MHz baseline design

Assuming: R_beampipe=R_iris=70mm, L=187.5mm

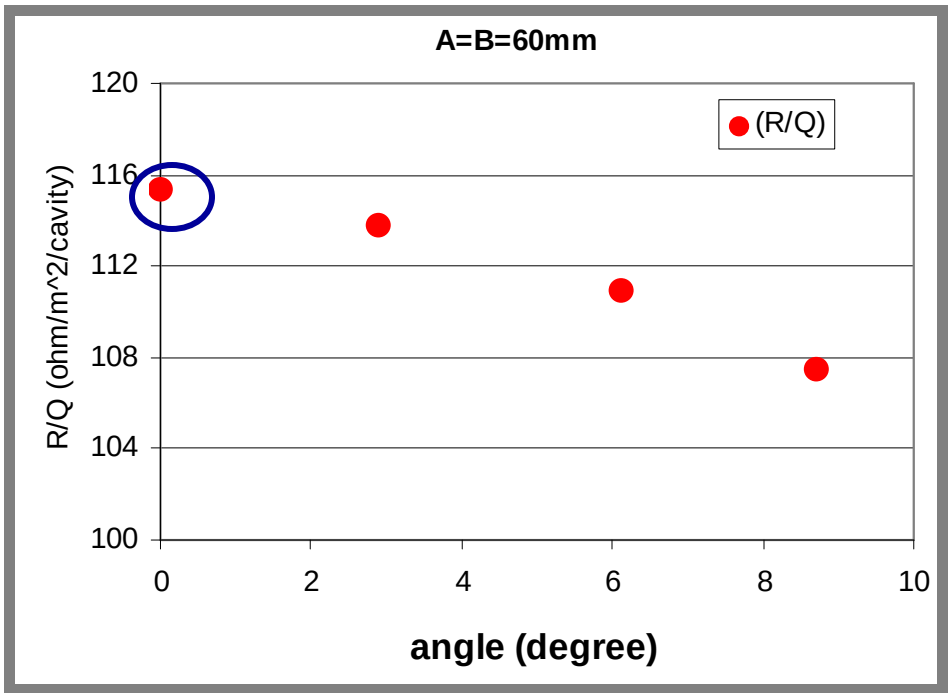
1. Effect of varying cell parameters
2. Effect of squashing the cavity
3. Preliminary RF results

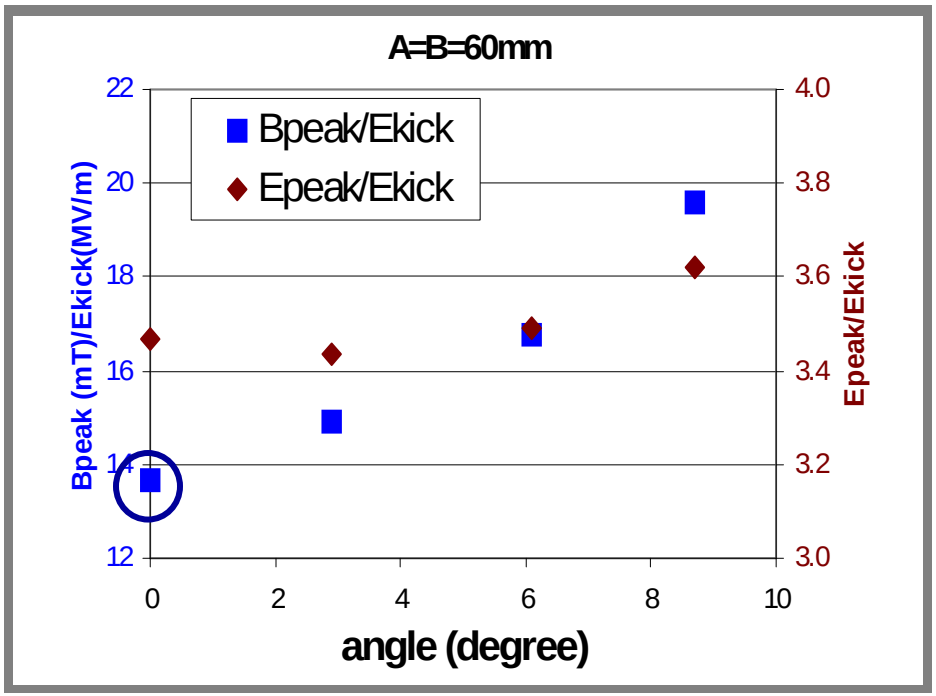


Goal: Higher R/Q, lower Epeak & Bpeak

TM110-π mode
@ 800MHz

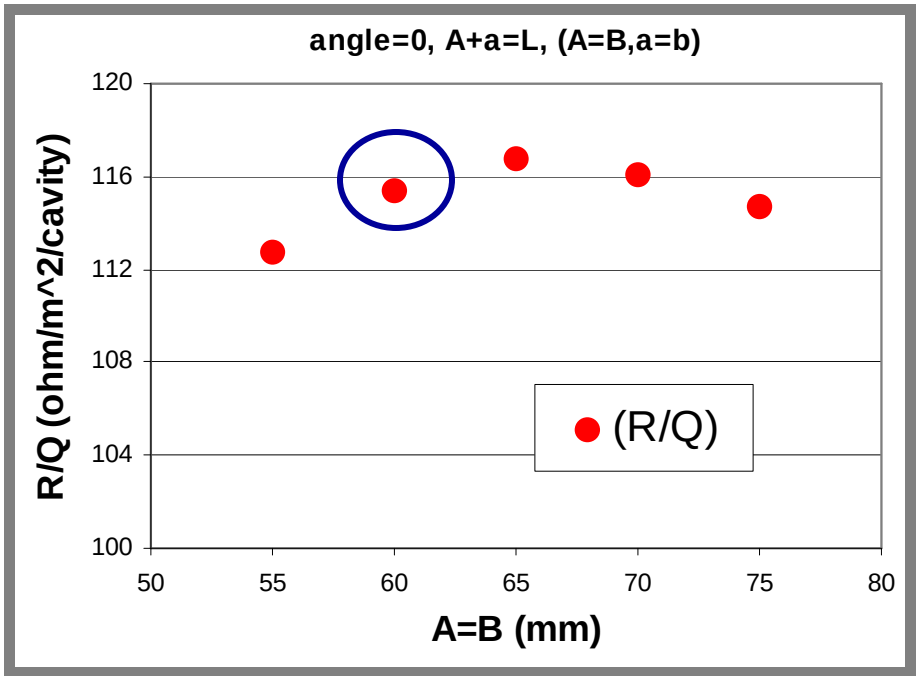
1. Effect of the angle α on R/Q and peak fields

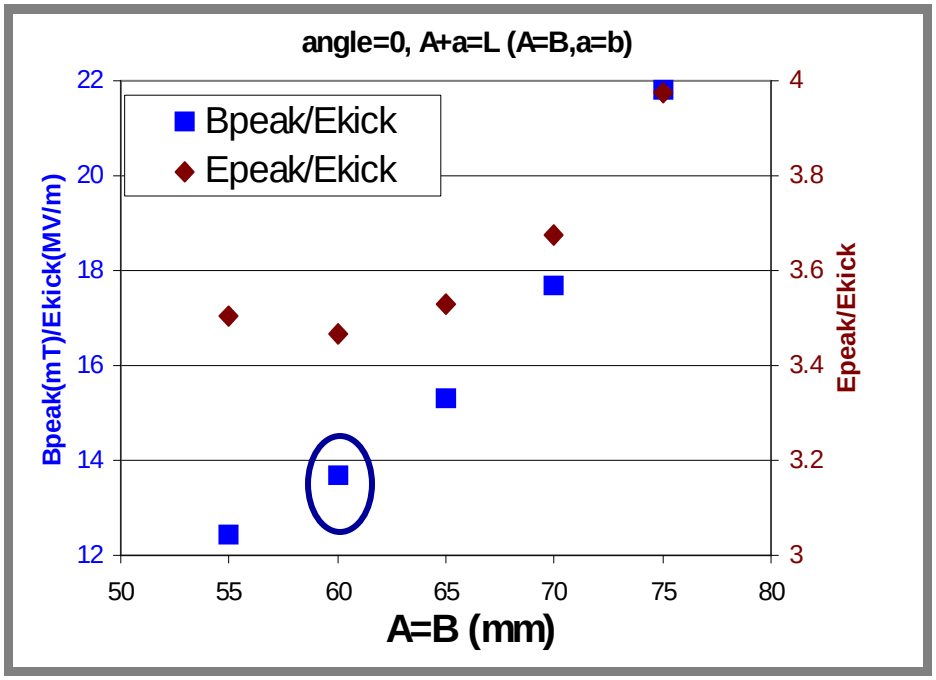


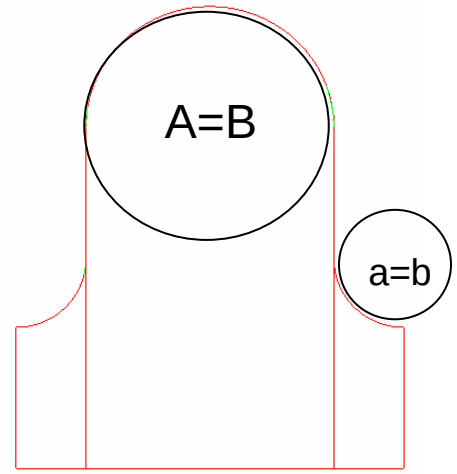


Smaller α angle or larger iris curvature can achieve larger (R/Q) and smaller Bpeak.

2. Effect of the cell dome radius A

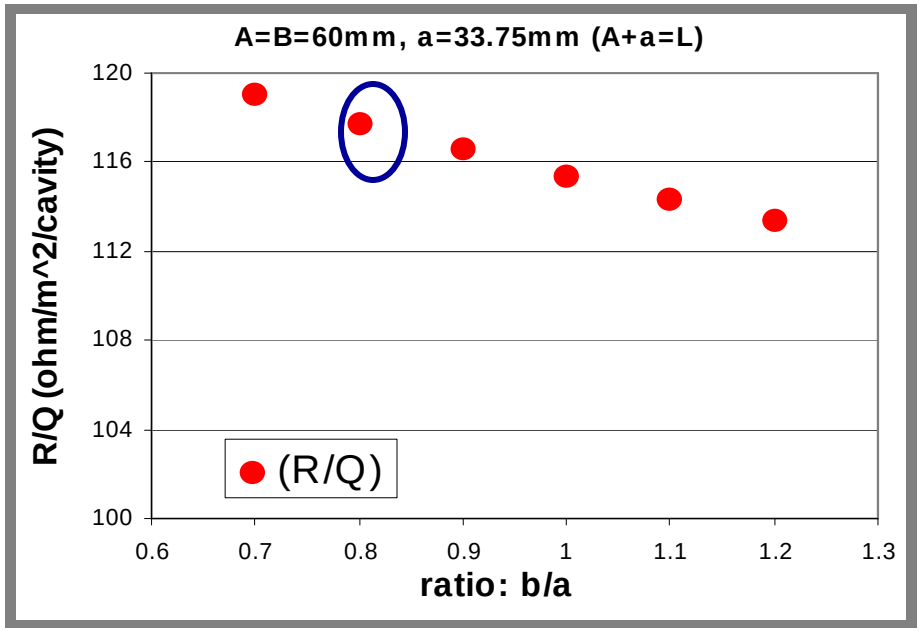


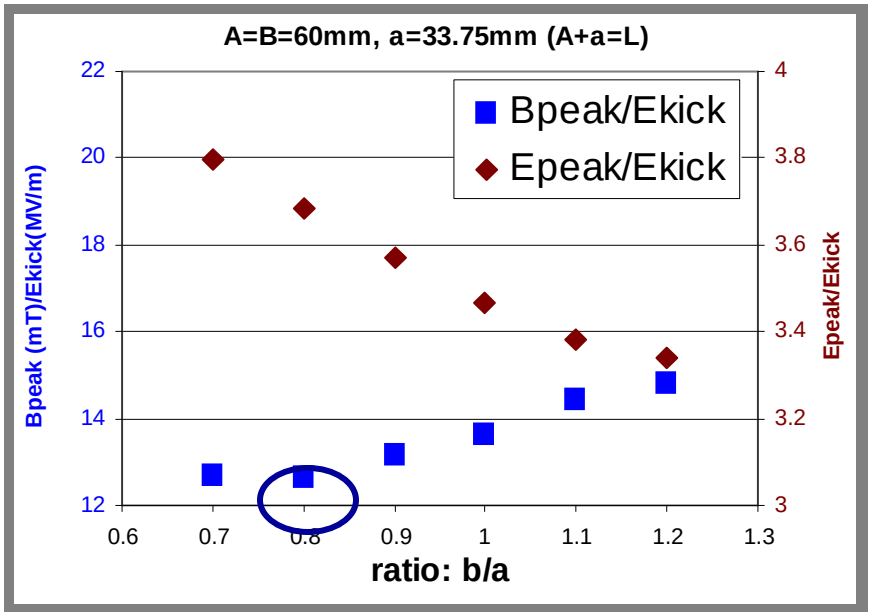


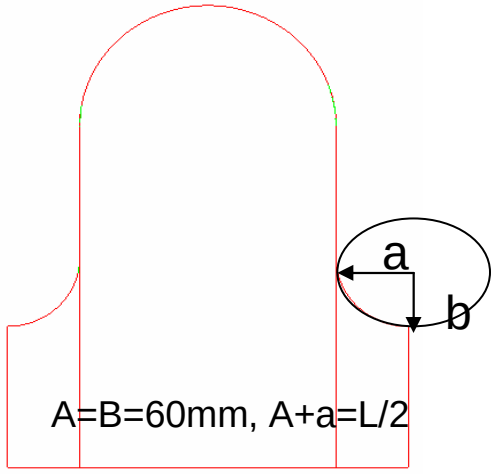


A cell dome radius of 60mm seems a good choice.

3. Effect of iris aspect ratio b/a on R/Q and peak fields







The max Ekick for a crab cavity is determined by the critical magnetic field and not by the field emission.

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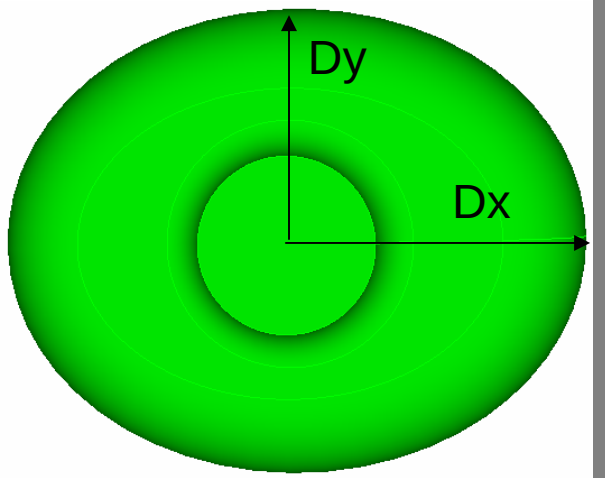
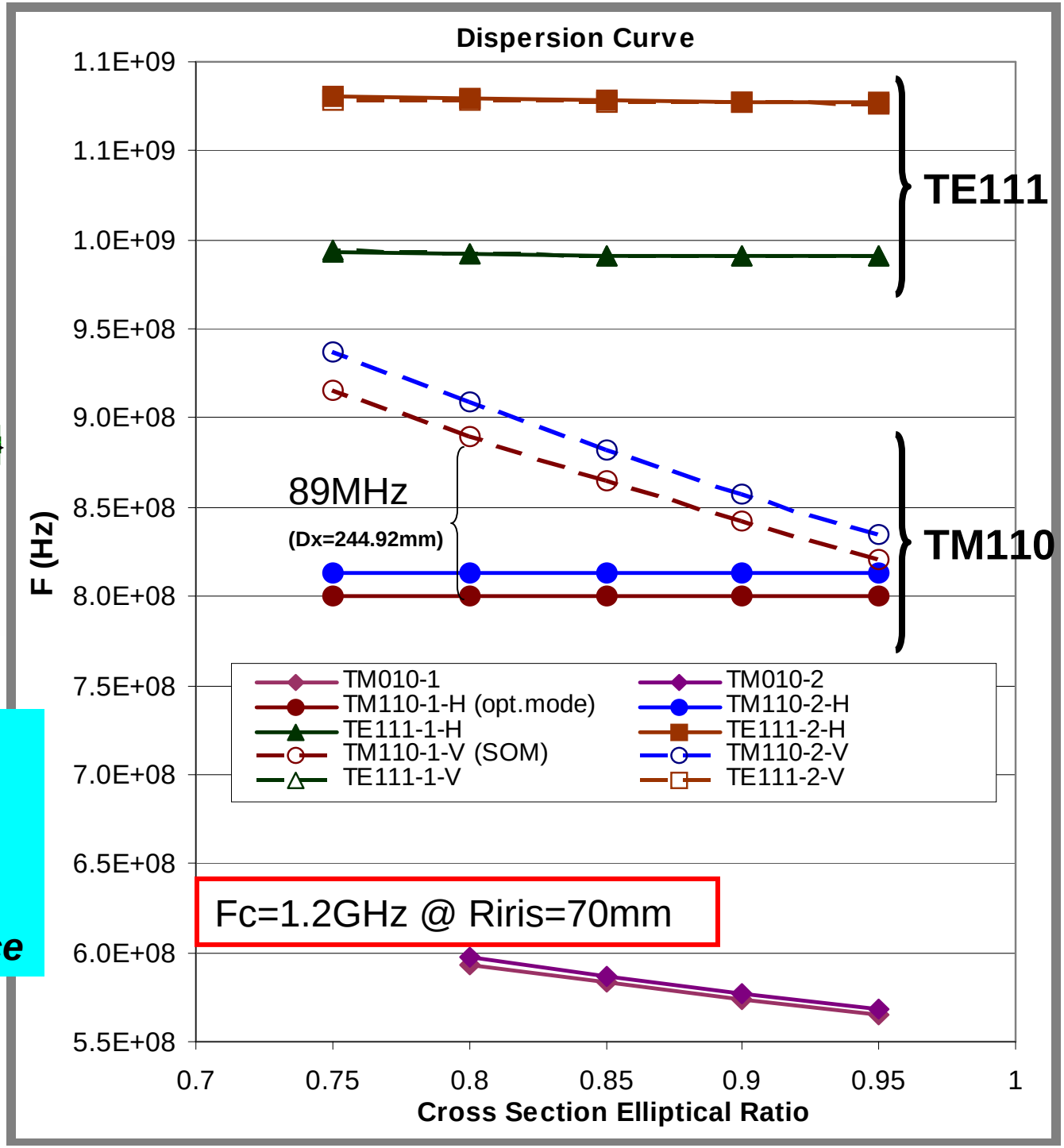
4. Effect of cell squash ratio



Chose squash ratio to optimize mode separation/spectrum.

Max Dx is limited by available horizontal space

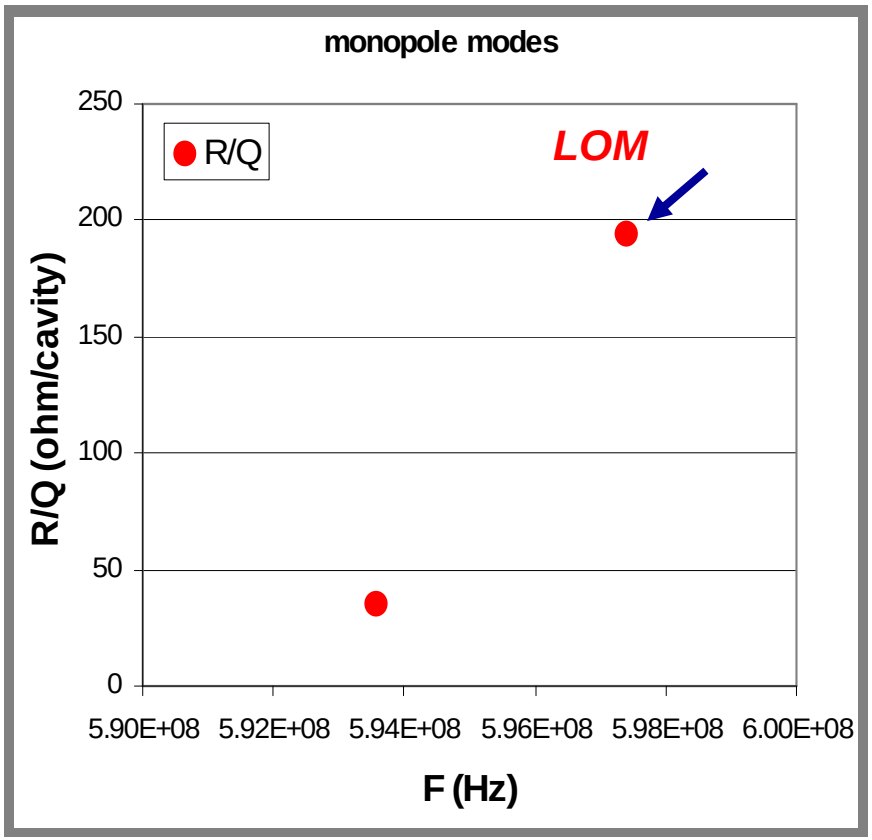


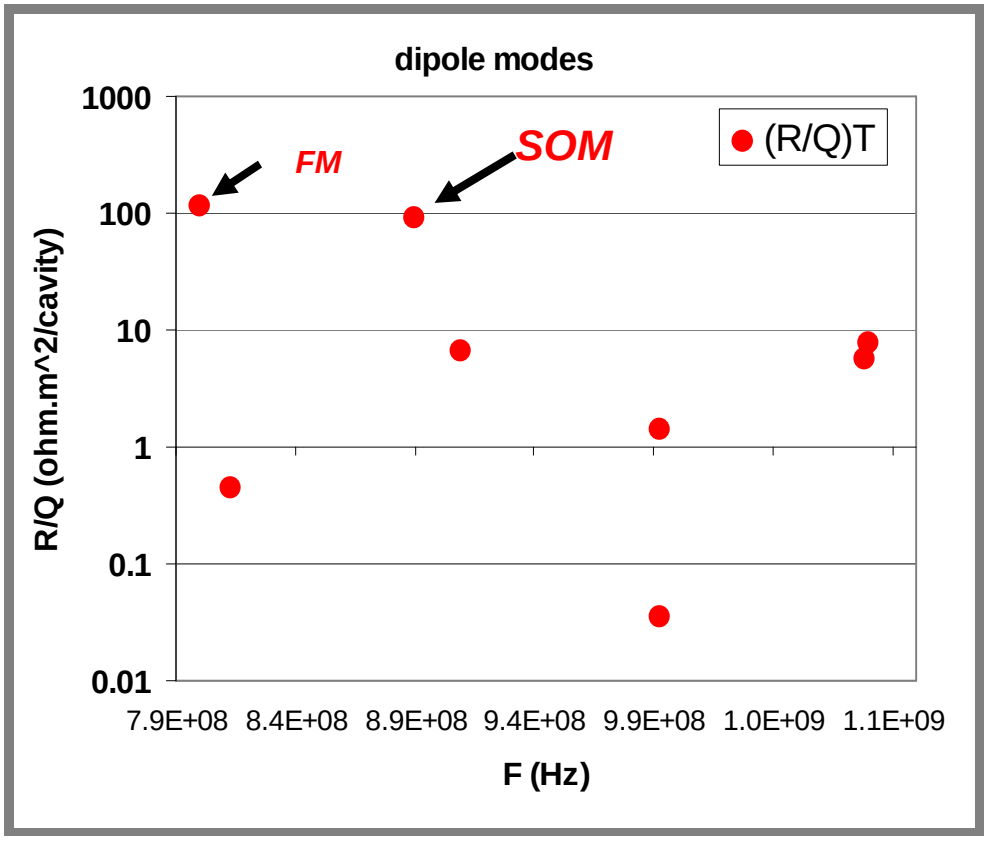
800MHz crab cavity RF parameters

Frequency	800MHz
(R/Q)	117ohm/m^2/cavity
Deflecting Voltage V_T	2.5MV
Deflecting Gradient Ekick	6.67MV/m
Epeak	24.72MV/m
Bpeak	82.75mT
Mode separation (Opt.-SOM)	89MHz

TESLA TDR cavity peak fields for comparison:
Epeak: 70~90MV/m
Bpeak: 150~190mT

What are the damping requirements for the LOM and SOM modes?





High R/Q LOM and SOM modes

A Preliminary R & D Results:

Omega2/Omega3p were used to optimize the cell shape.

- ✓ R/Q=117ohm/m^2/cavity;
- ✓ Epeak=24.72MV/m for V_T=2.5MV/cavity;
- ✓ Bpeak=82.75mT for V_T=2.5MV/cavity;
- ✓ There is one LOM and SOM need to be damped;

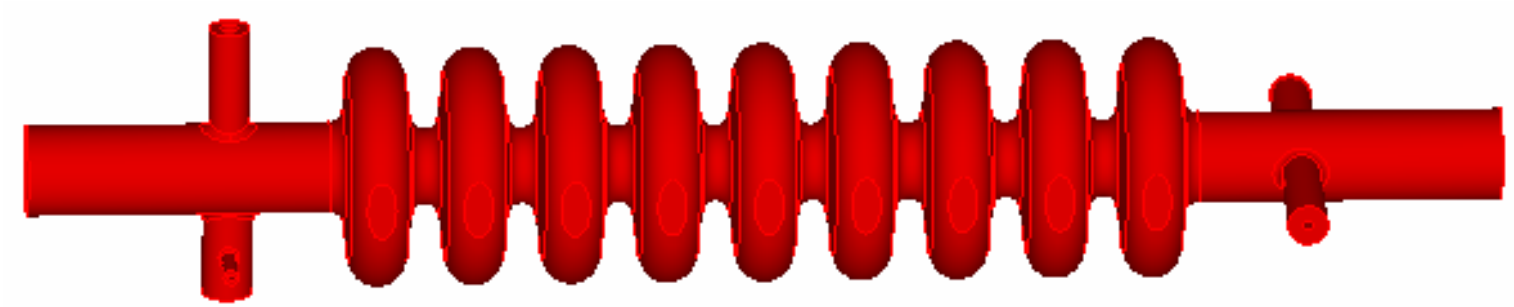
Need to know the space constraints

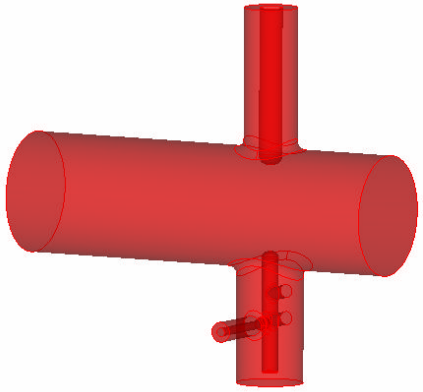
- ➢ the maximal cross section dimensions that will determinate the max squash ratio;
- ➢ the smallest Riris in terms of the beam dynamics study;
- ➢ the smallest distances between the couplers and the end cell;
- ➢ the damping requirements for the LOM, SOM and HOM.

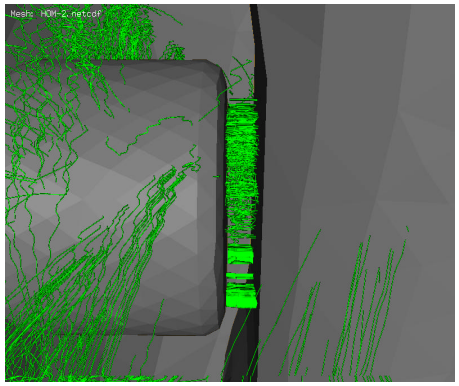
Next to do

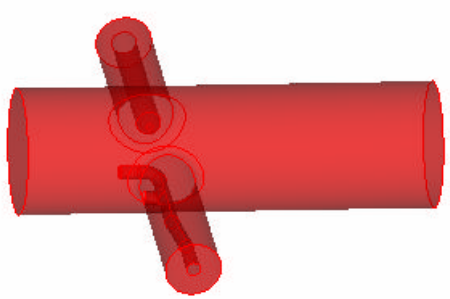
- ➢ Study damping schemes for LOM and SOM modes
- ➢ Simulate multipacting in cell and couplers
- ➢ …

Crab Cavity Design for the ILC BDS









"HOM and LOM Coupler Optimizations for the ILC Crab Cavity", slac-pub-12635

Collaboration with FNAL and UK lab on this project.

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