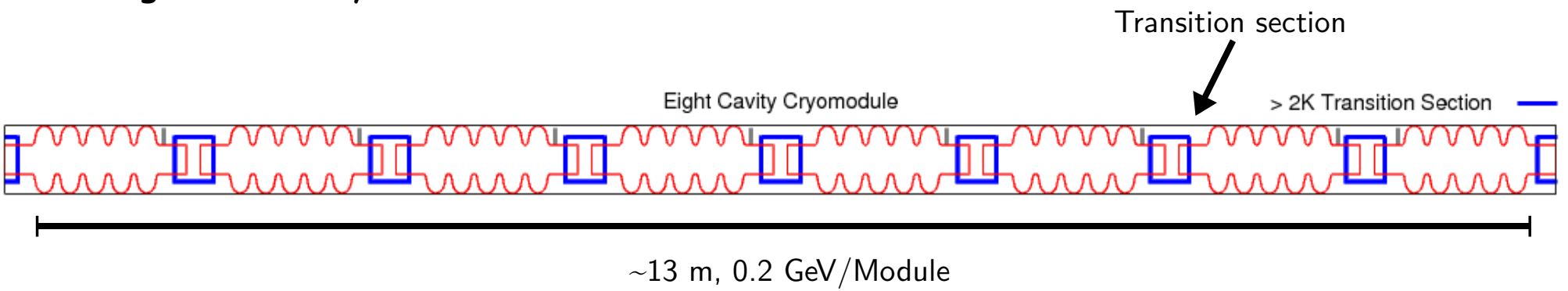
704 MHz Cavity Evolution

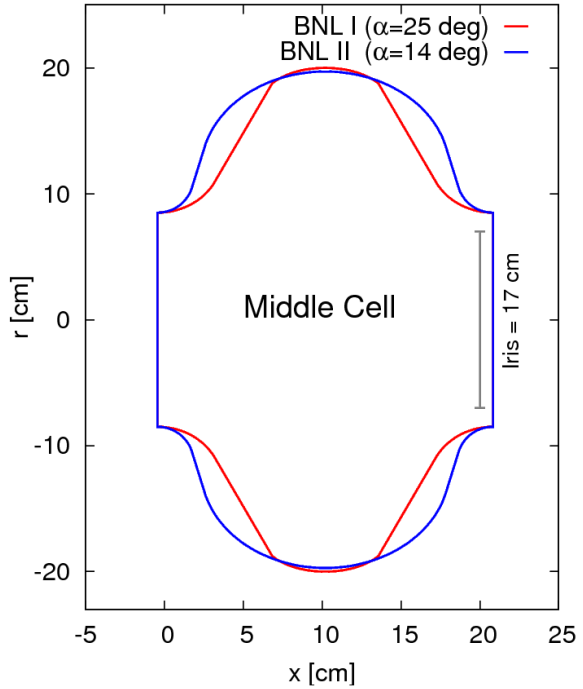
R. Calaga, BNL, May 8, 2009

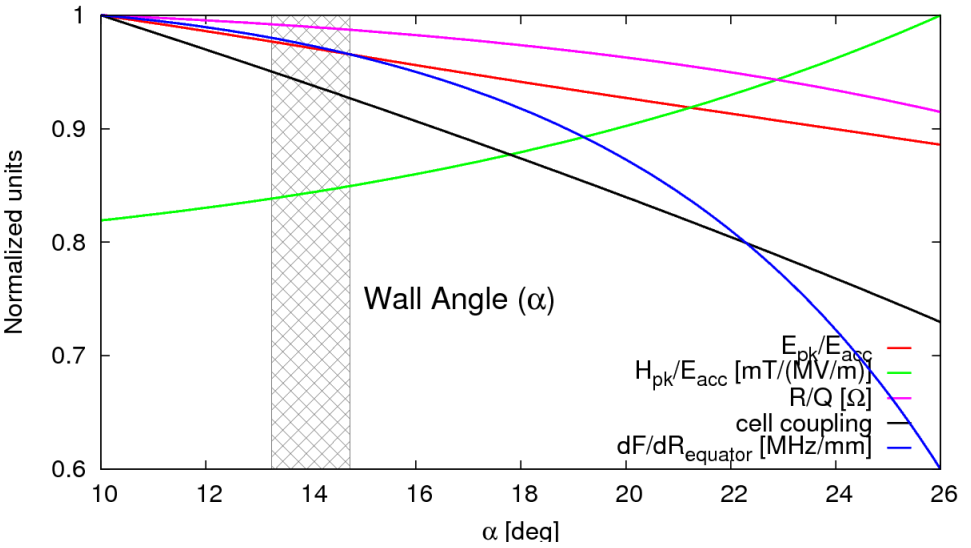


Cryomodule will consist of:

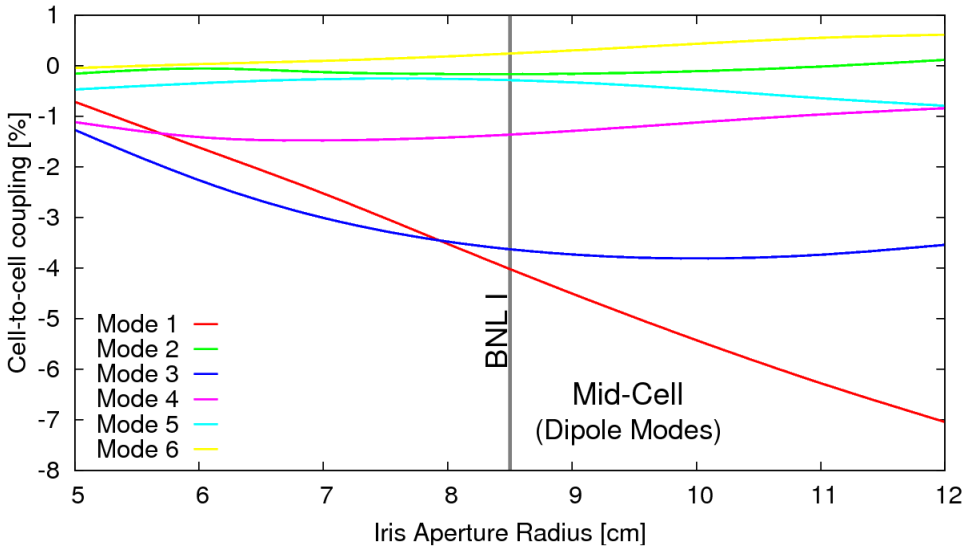
- 8 x 5-cell cavities
- 8 fundamental power couplers
- 7 compact transition sections
- 2-half end-caps
- 8 tuner assemblies
- 8 helium vessels and cryogenic feed-throughs
- Super-insulation, thermal, magnetic shielding
- Support structures, access ports, instrumentation etc...

Mid-Cell Optimization

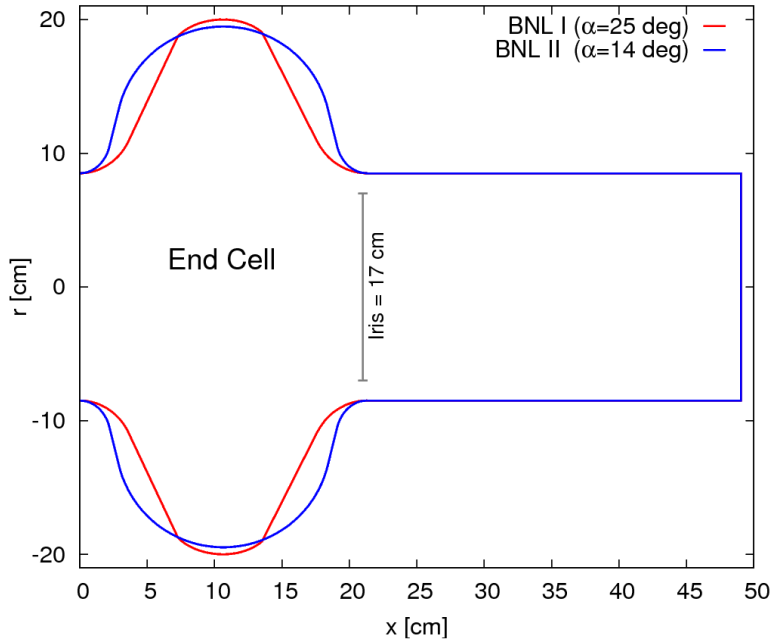


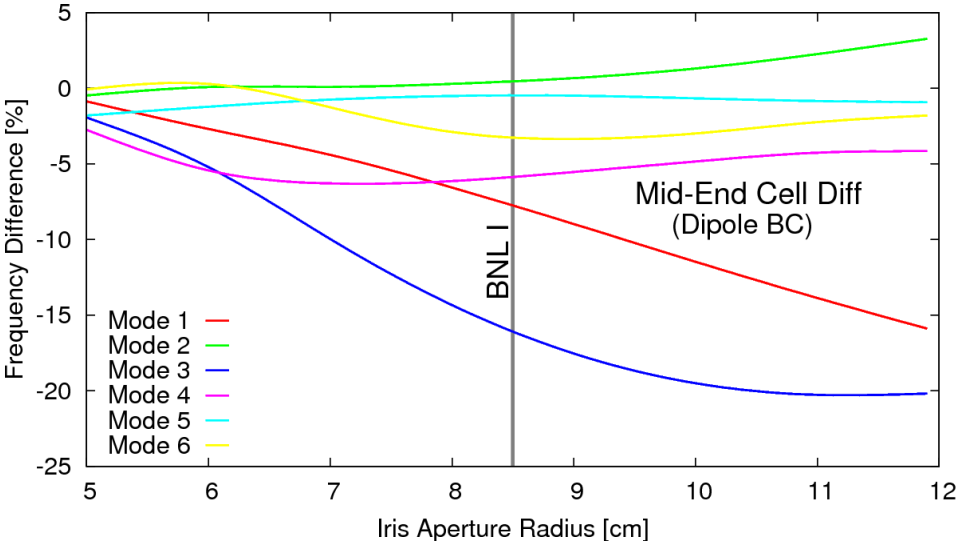


Parameter	BNL I Mid & End Cell	BNL II Mid & End Cell
Frequency [MHz]	703.75	703.75
Iris Radius, R_{iris} [cm]	8.5	8.5
Wall Angle, α [deg]	25	{14,12}
Equatorial Ellipse, $R = \frac{B}{A}$	1.0	1.0
Iris Ellipse, $r = \frac{b}{a}$	1.1	1.2
Cavity wall to iris plane, d [cm]	2.5	{1.7,1.2}
Half Cell Length, $L = \frac{\lambda\beta}{4}[cm]$	10.65	10.65
$H = D - (R_{iris} + b + B)[cm]$	{4.195,3.792}	{19.7124,19.4034}
Cavity Beta, $\beta = \frac{v}{c}$	1.0	1.0



End-Cell Optimization





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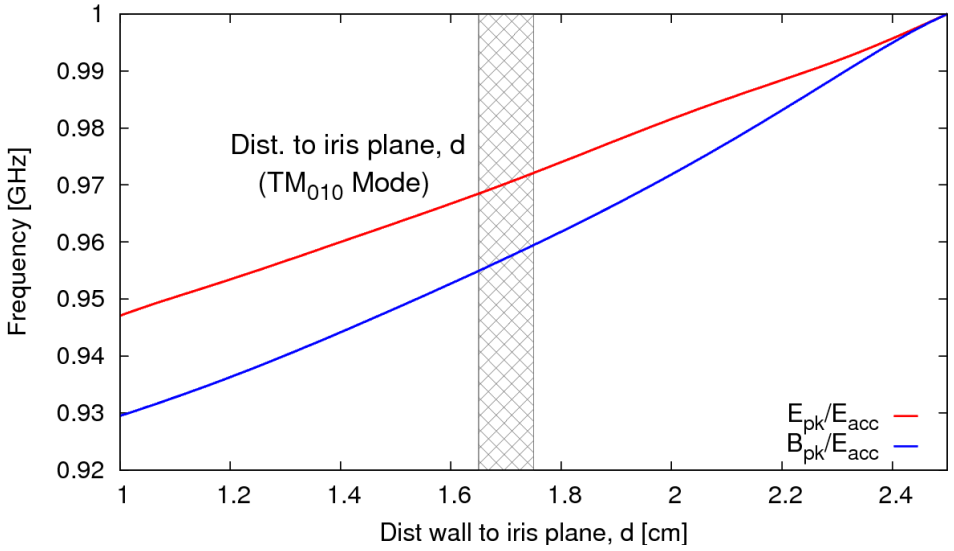
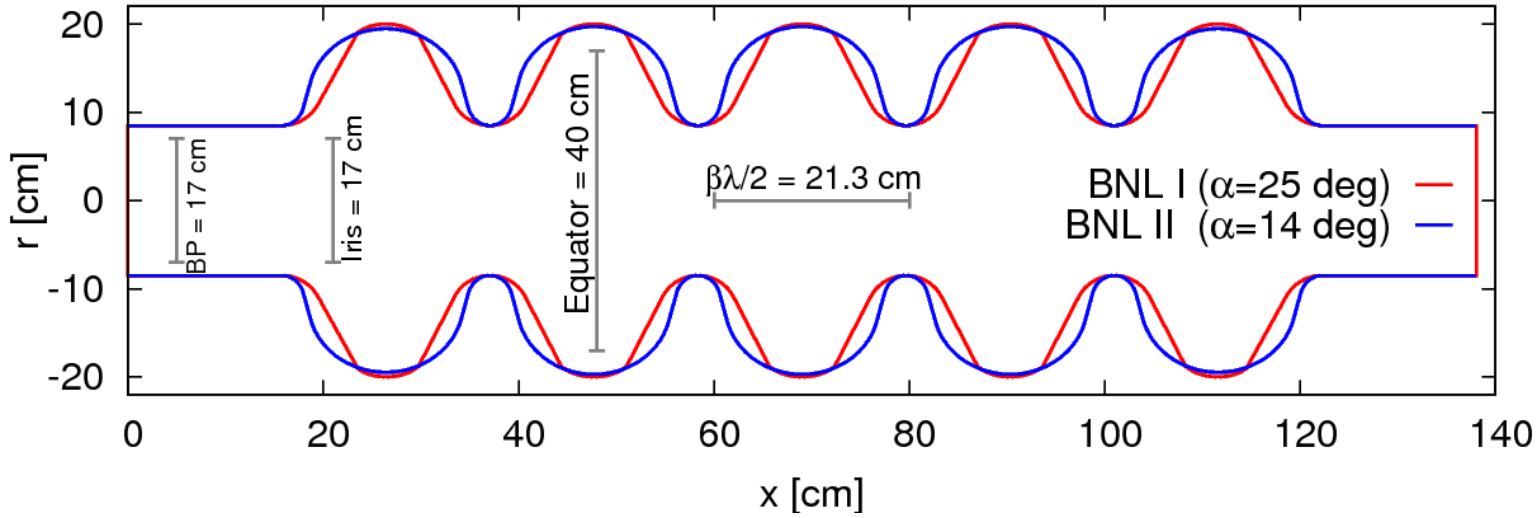


Five-cell



Eacc = 25 MV – 5 cells (15 MV/m)

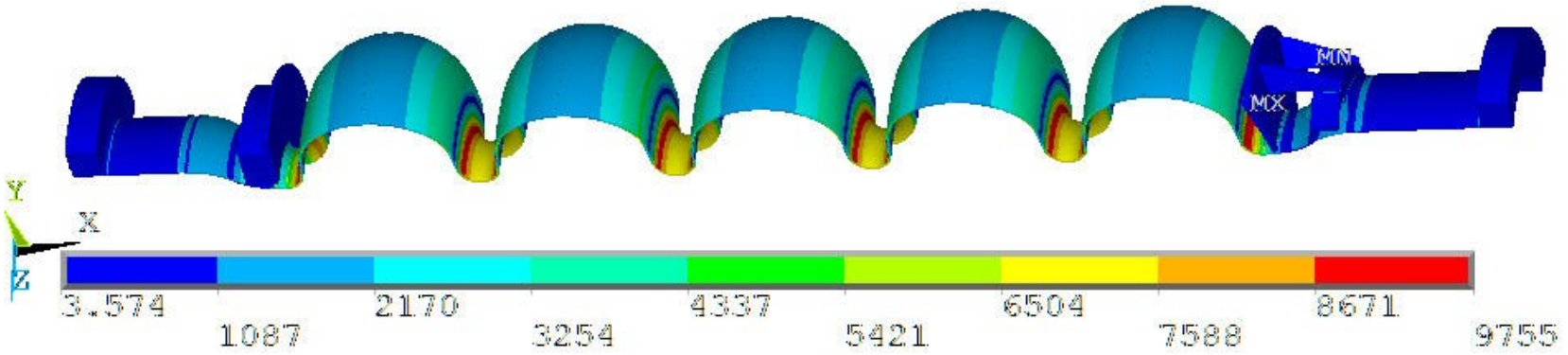
Epk/Eacc = 2.34 (19% increase)

Bpk/Eacc = 4.69 mT/MV/m (18% decrease)

R/Q = 930 (7% increase)

Stiffness x2 smaller

Cavity Stiffness & Tuning

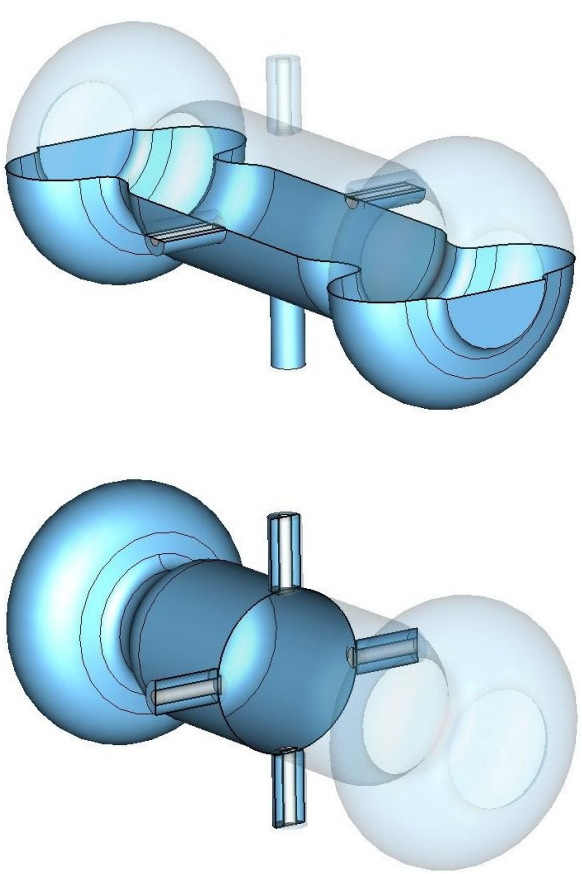


Stiffness and tuner load reduced by x2 compared to BNL I design

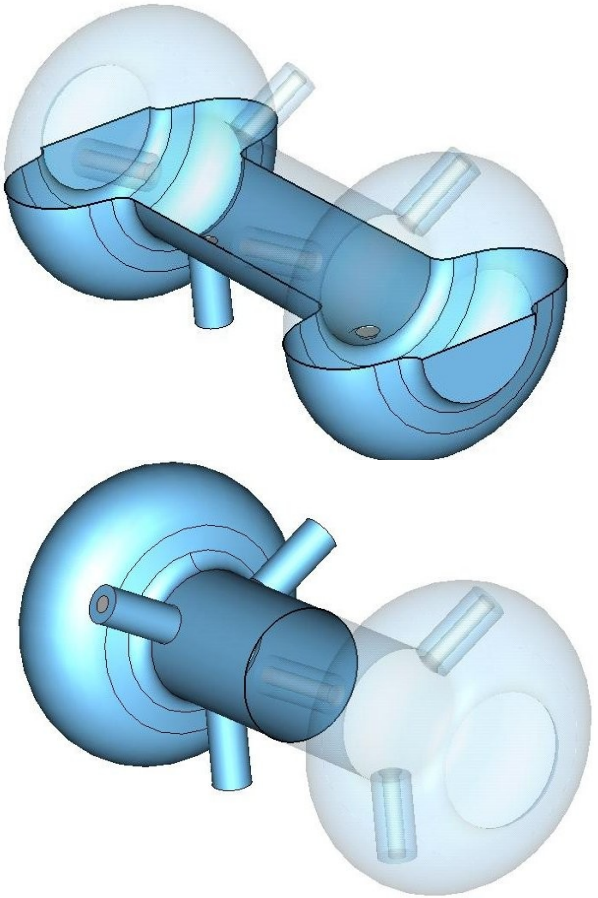
Local machined thickness at iris & equator (~1.4 mm).

2.5 mm compression, ~35 kHz

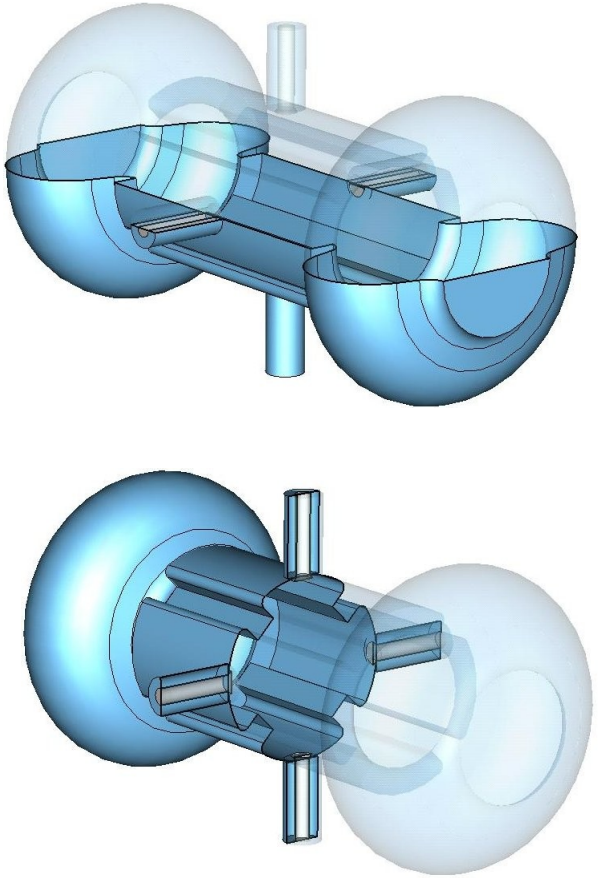
Towards a compact transition section



Enlarged beam pipe +
Couplers and/or ferrites



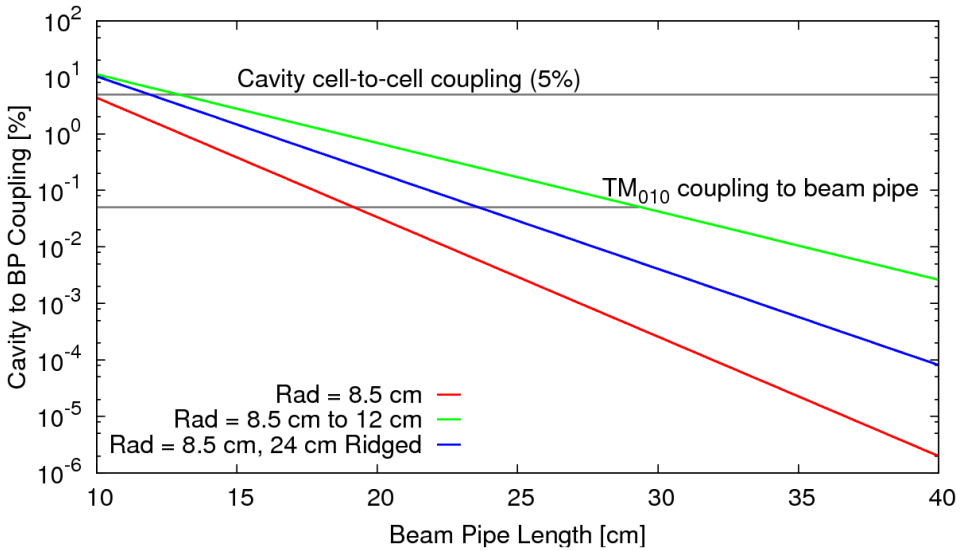
Conventional HOM couplers



Ridged waveguide +
Couplers and/or ferrites

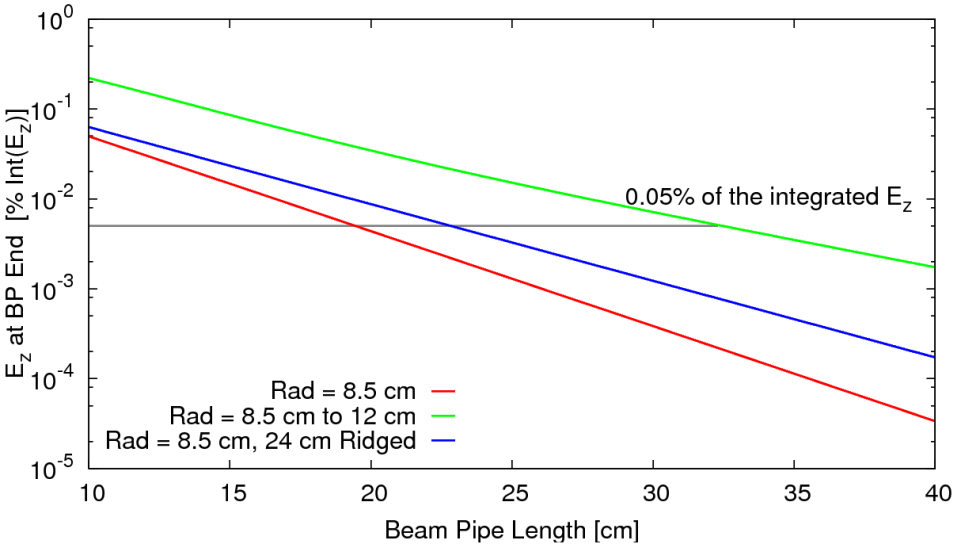
- Option 3 will need shorter than 2, which is the current ERL design
- No sensitive rejection-filter required, HOM power handling easier, FPC/tuner placement easier

Transition Section



24 cm BP transition section long. Ridged transition helps reduce it significantly

Ridges can be modified to further decrease the transition length. Simulations needed to evaluate the effectiveness



Outlook

Need further optimization of iris aperture (7.5-8.5 cm)

Detailed studies on transition section (ridged structures)

- Transmission line charateristics
- Manufacturing difficulties
- Loops and/or ferrites

Superconducting joint using radial loop