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Memo

DATE: *September 30, 2005*

TO: RHIC E-Coolers

FROM: *Ady Hershcovitch*

SUBJECT: **Minutes of the September 30, 2005 Meeting**

Present: Ilan Ben-Zvi, Rama Calaga, Xiangyun Chang, Alexei Fedotov, Wolfram Fischer, Harald Hahn, Lee Hammons, Ady Hershcovitch, Dmitry Kayran, Vladimir Litvinenko, Derek Lowenstein, Christoph Montag, Thomas Roser, Triveni Srinivasan-Rao, Dejan Trbojevic, Gang Wang (SUNY Stony Brook).

SCRF Injector: the meeting consisted of a presentation given by Rama and Dmitry of design optimization of the Superconducting RF electron gun. The presentation is based on design options that were shown to the design review committee. Rama started by stating that all proposed designs took into account fabrication issues in order to result in a feasible injector. Rama covered design optimization based on RF issues, while Dmitry presented beam dynamic features resulting from each of the six designs that were shown to the committee. Below the minutes is the full presentation.

The committee chose the gun design (#5) with the following parameter:

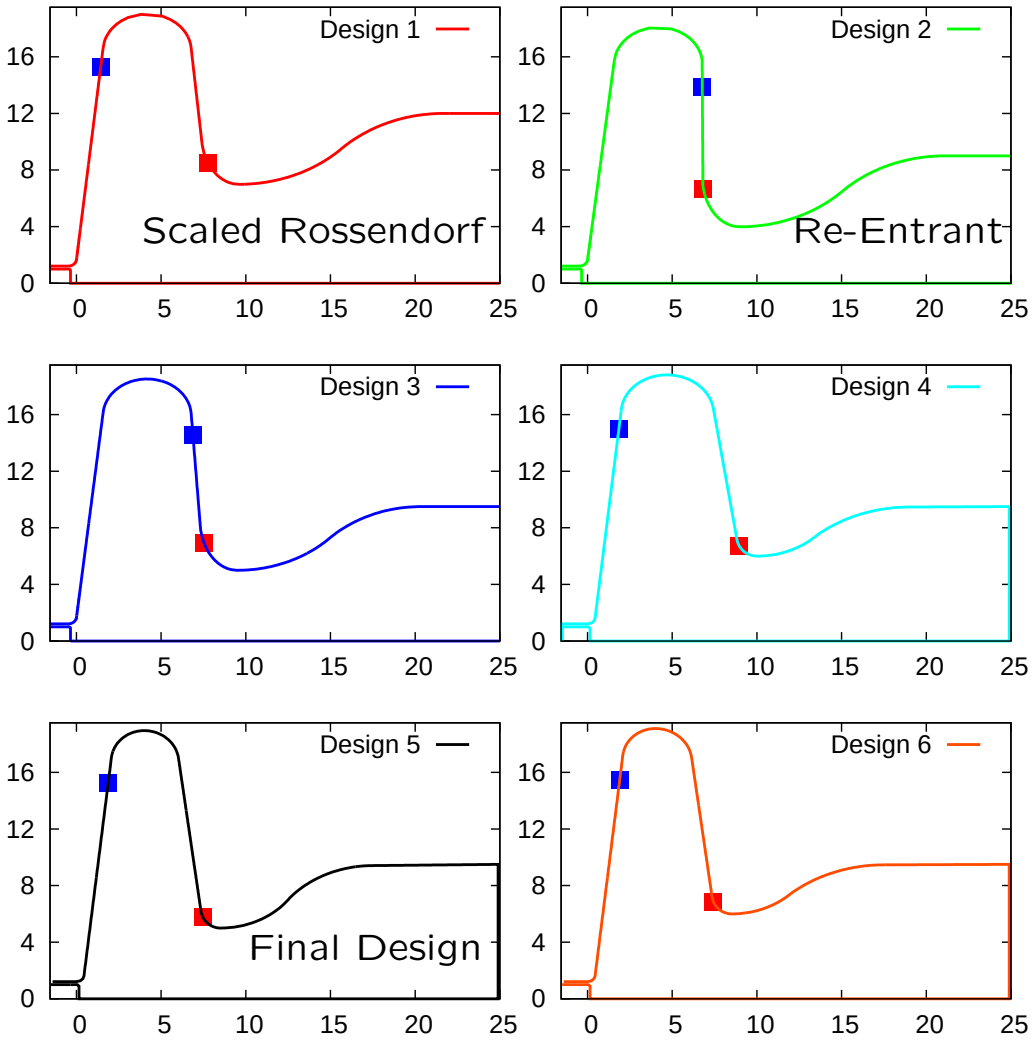
Frequency	703.75 MHz
Iris Radius, R_{iris}	5.0 cm
Wall Angle	6.5^{o}
Equatorial Ellipse, R = A/B	1.1
Iris Ellipse, r = b/a	1.2
Cav. wall to iris plane,	1.0 cm
Active cavity Length, L	8.5 cm
Center to equator end	18.95 cm
Avg. Beta, $< \beta = v/c >$	0.587

Beam pipe transition without HOM damping results in simplified mechanical design. Given the mechanical benefits, having a few undamped HOMs is a small price to pay. Emittance and energy spread calculations shown by Dmitry indicate that they are smaller by a significant factor at the LINAC exit than at the gun. Very encouraging! Finally, the cathode recess position (varied over 7 mm) shows an optimized location for minimum energy spread. It should be made adjustable.

Optimization Criteria

- RF Issues
  - Peak fields, HOMs
  - Coupling 1 MW ($Q_{ext} \approx 4 \times 10^4$)
  - Multipacting, Mech. Stiffness, BCP
- Beam dynamics (Dmitry)
  - Energy Phase Slope
  - Transverse and longitudinal Emittances
- Engineering Issues (Manufacturing, Valves, etc..)

Gun Designs



Some Comparisons

Shape	r/Q [Ω]	E_p/E_a	B_p/B_a $[\frac{mT}{(MV/m)}]$
Design 1	101	1.14	2.73
Design 2	105	1.39	2.97
Design 3	103	1.20	2.81
Design 4	112	1.33	2.69
Design 5	95	1.42	2.96
Design 6	92	1.42	2.87

Design 5	Right Cell
Frequency	703.75 MHz
Iris Radius, R_{iris}	5.0 cm
Wall Angle, α	6.5°
Equatorial Ellipse, $R = \frac{B}{A}$	1.1
Iris Ellipse, $r = \frac{b}{a}$	1.2
Cav. wall to iris plane,	1.0 cm
Active cavity Length, L	8.5 cm
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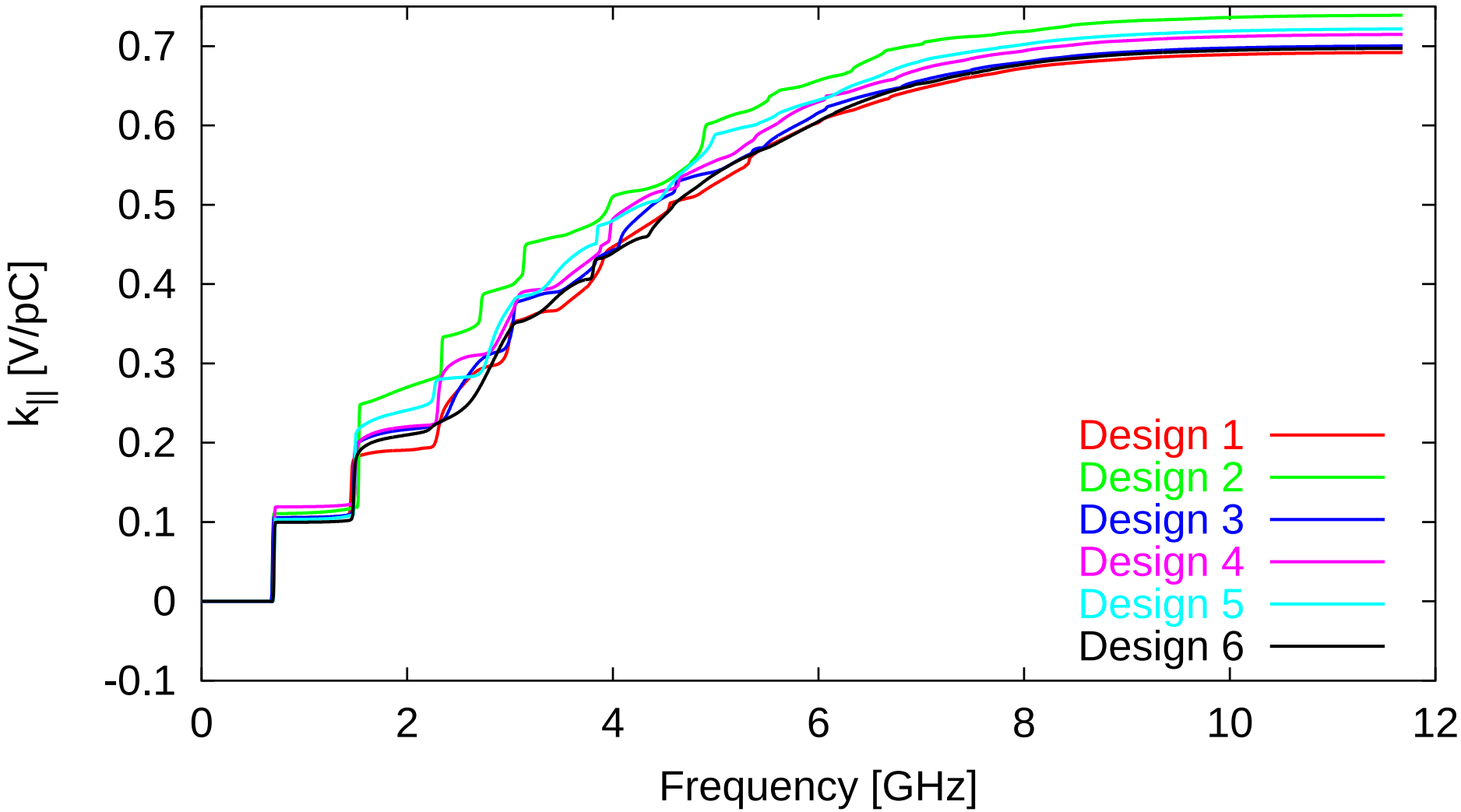
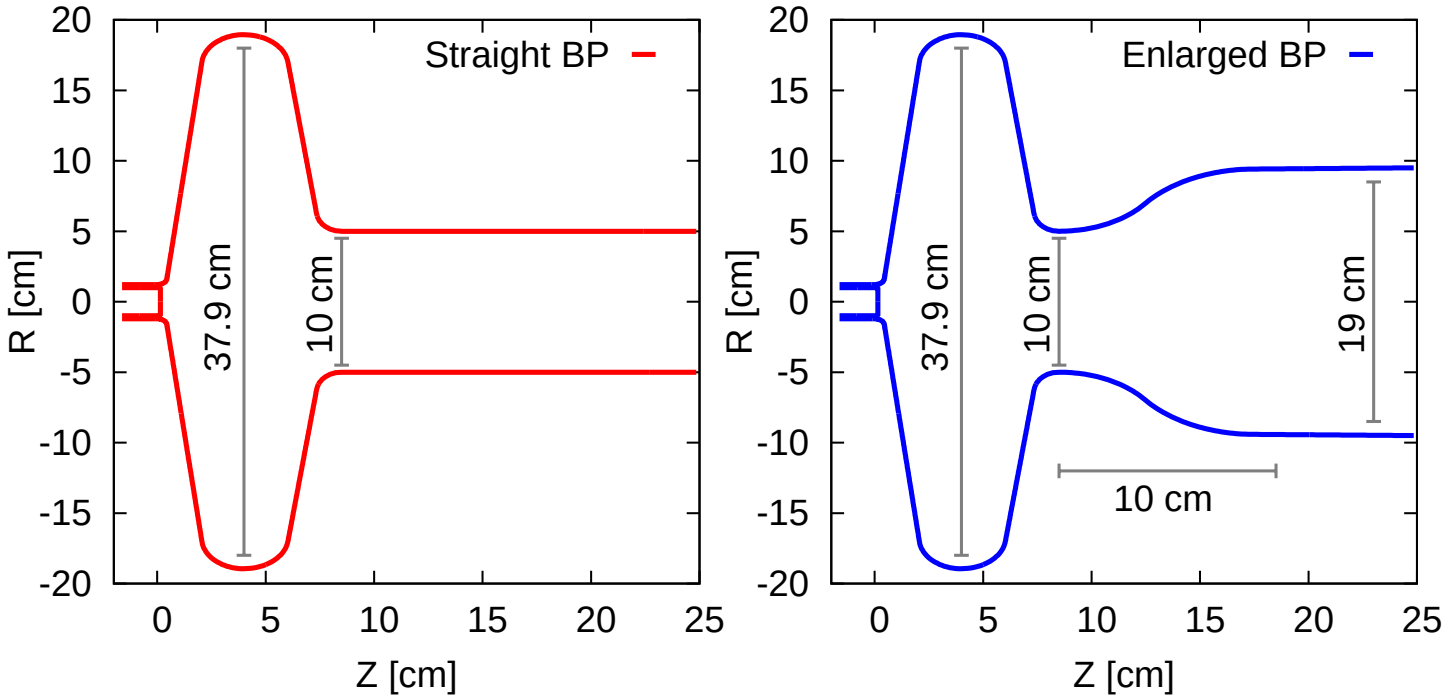
Avg. Beta, $< \beta = \frac{v}{c} >$	0.587

Longitudinal Loss Factors

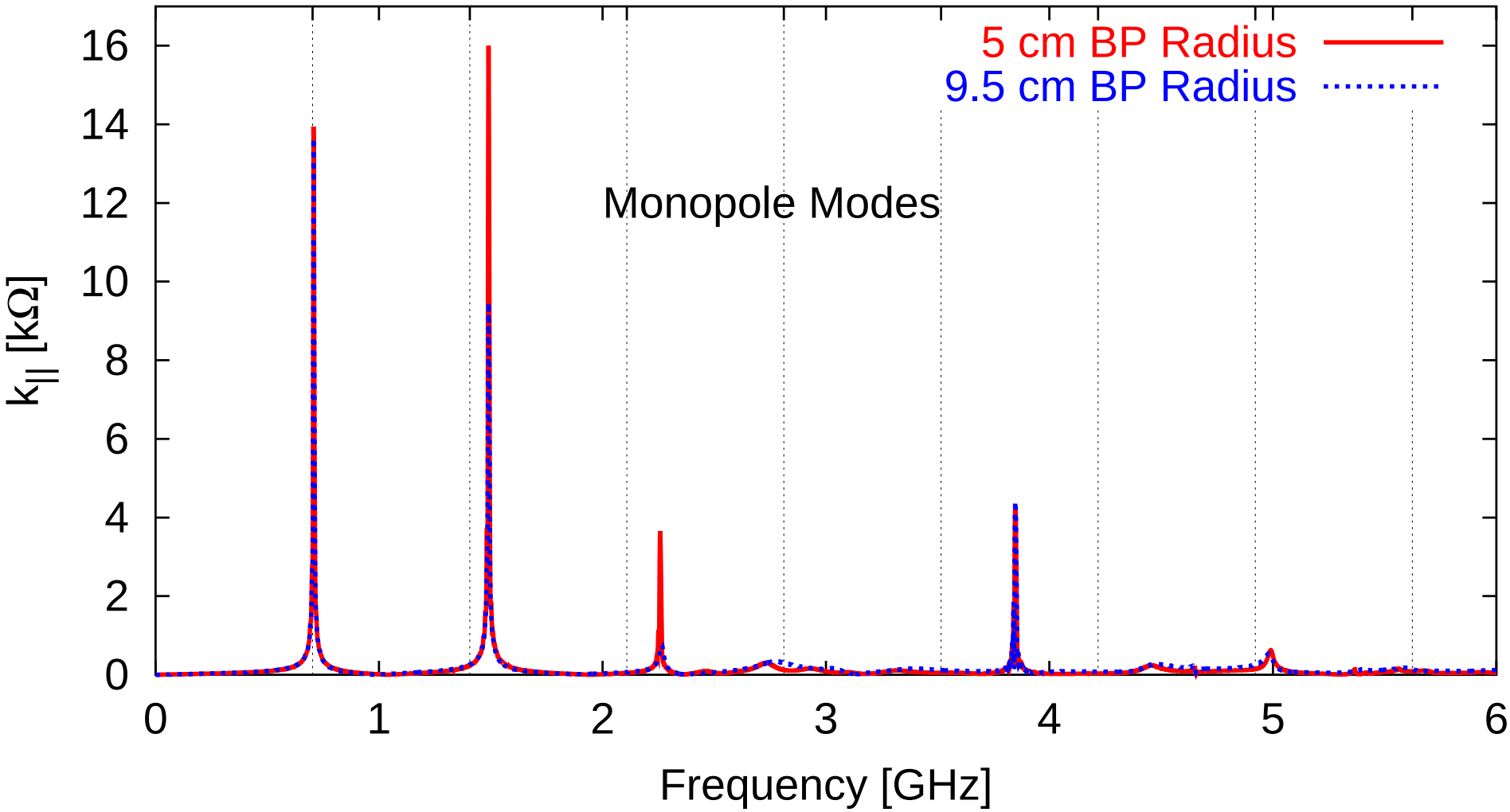


Beam Pipe Transition

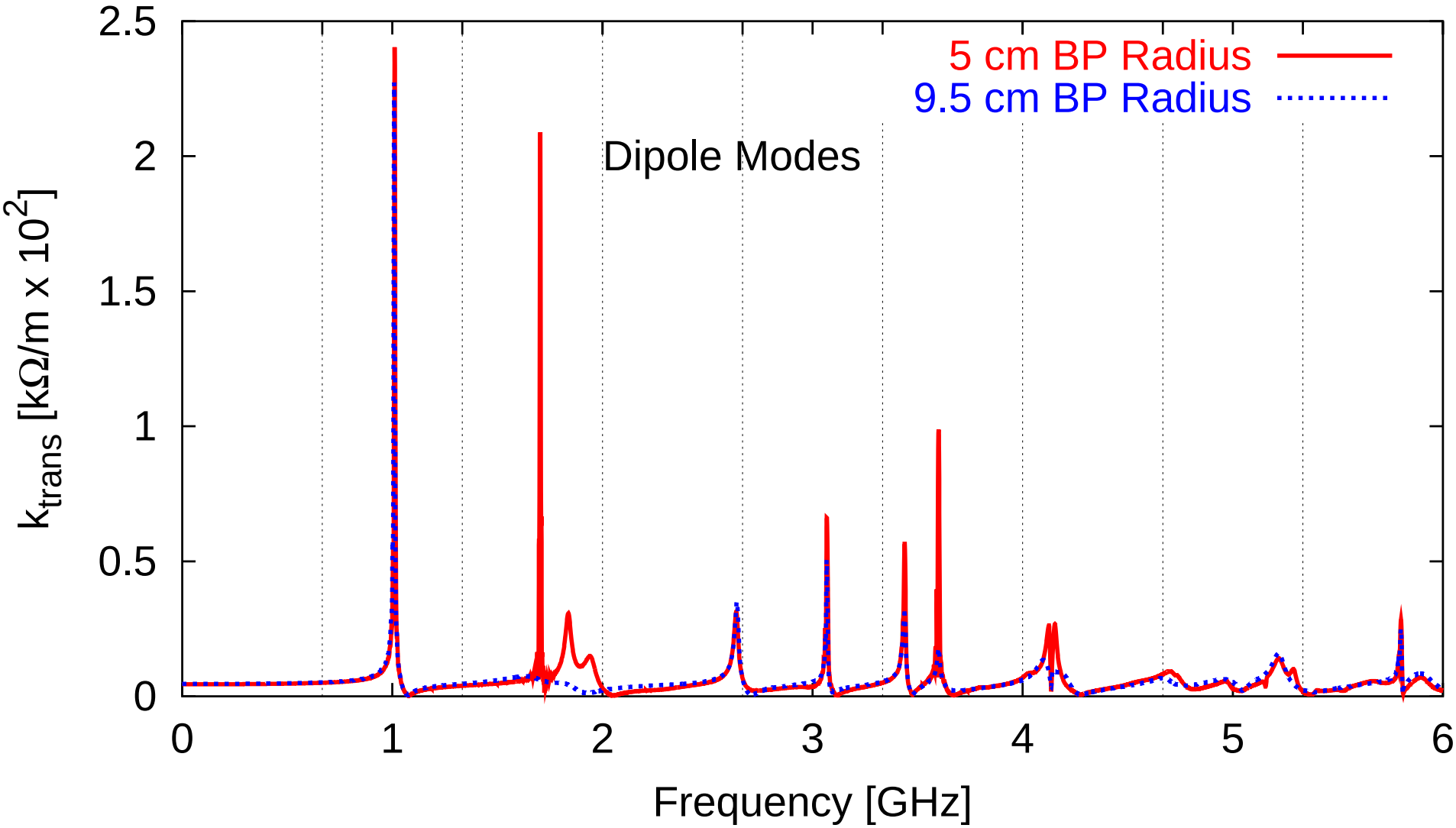


- HOM Damping (is it needed ??)
- Loss Factor ($\sim 0.7 \pm 0.03$ V/pC)
- FPC Coupling (field level $< 10^2$ - 10 cm away)
- Mechanical Design (manufacturing, valves etc..)

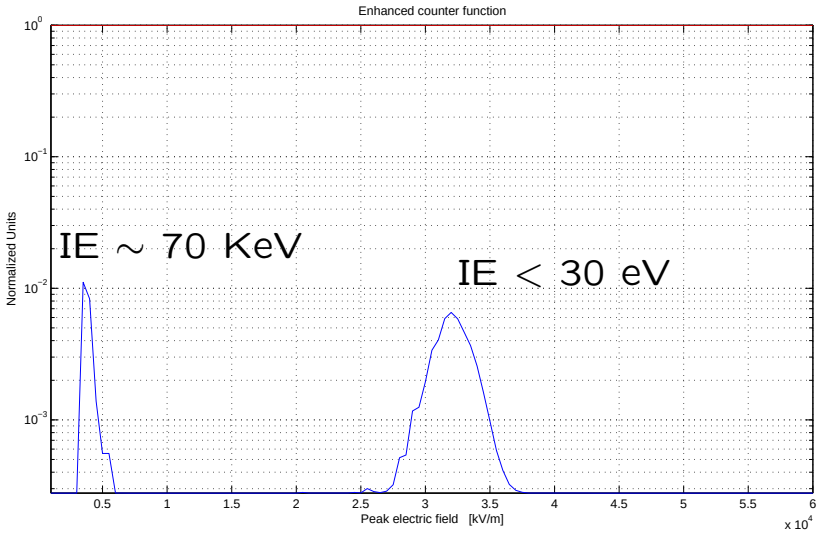
Monopole Impedance Spectrum



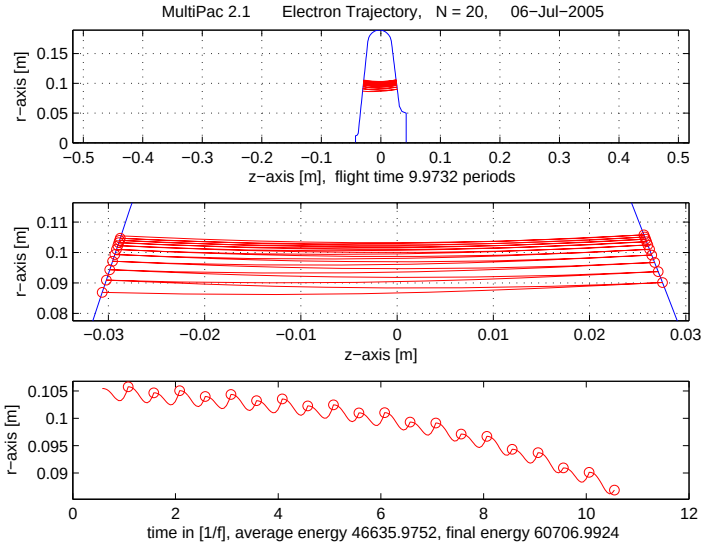
Dipole Impedance Spectrum

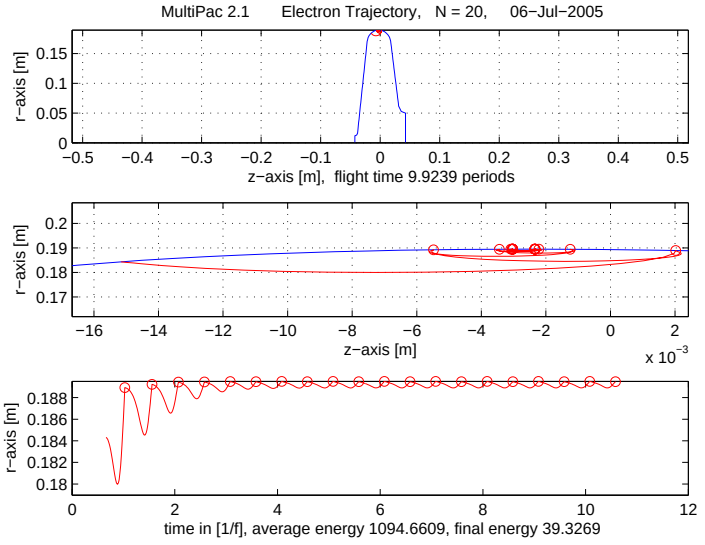


Multipacting

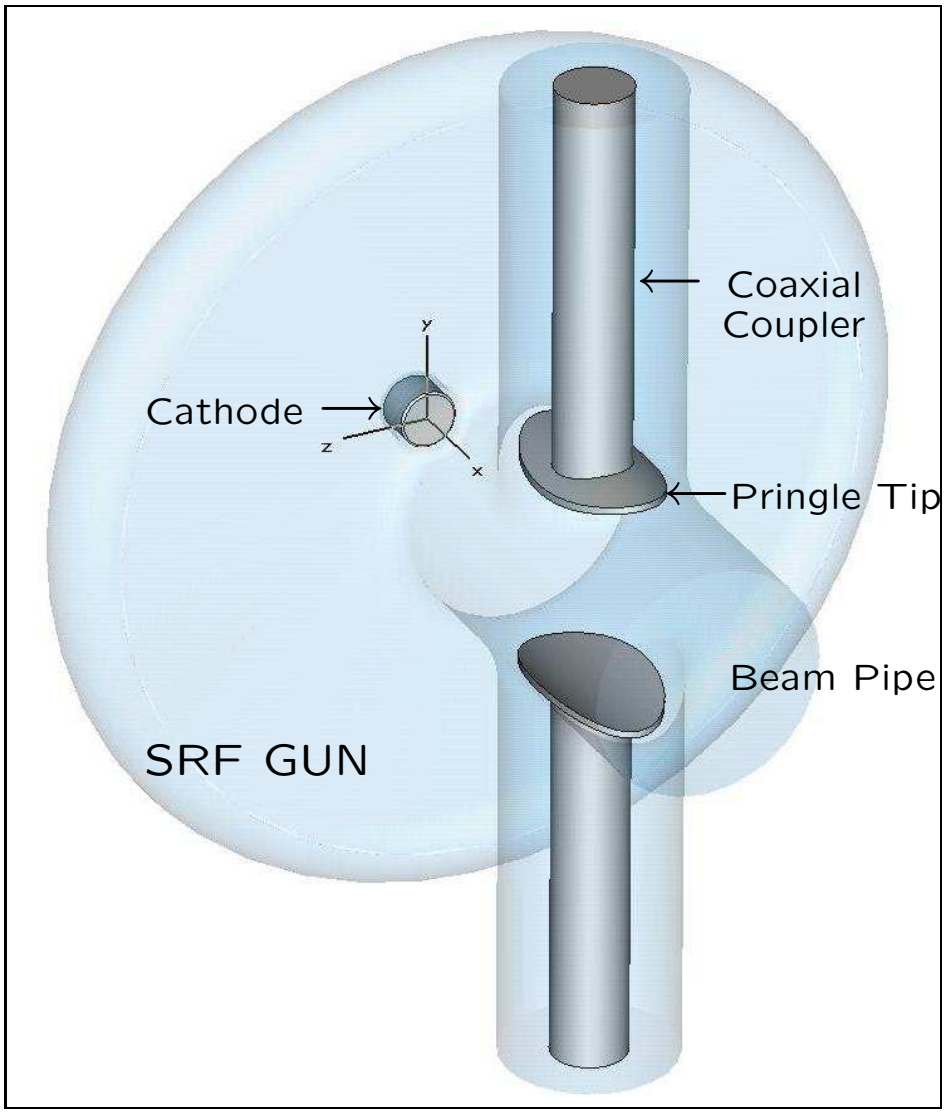


# of secondary electrons normalized to impact energy



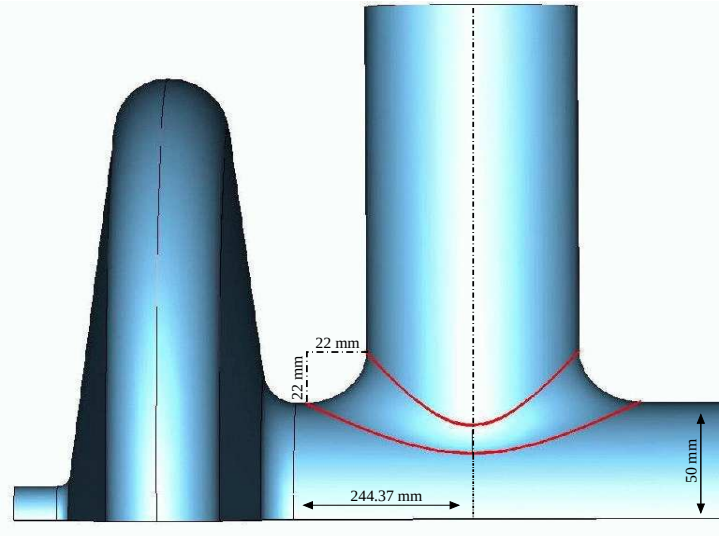


Coupling Fundamental Power

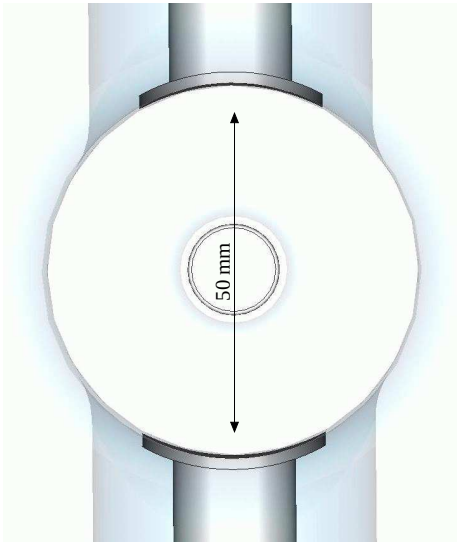


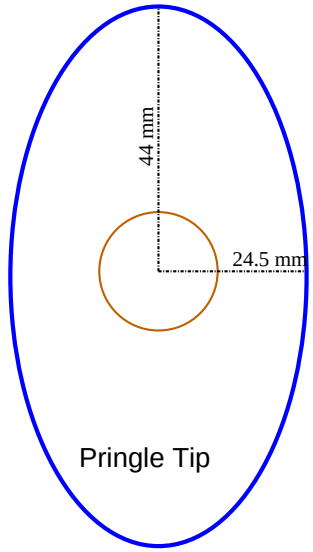
FPC Optimization

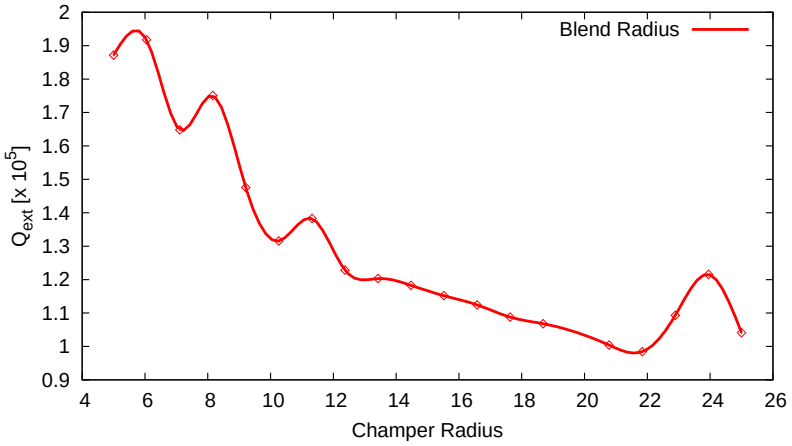
FPC - Beam Pipe Edge

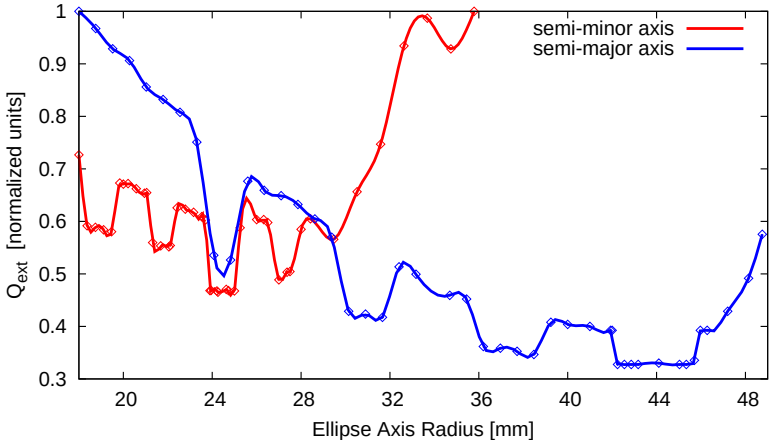


Pringle Tip

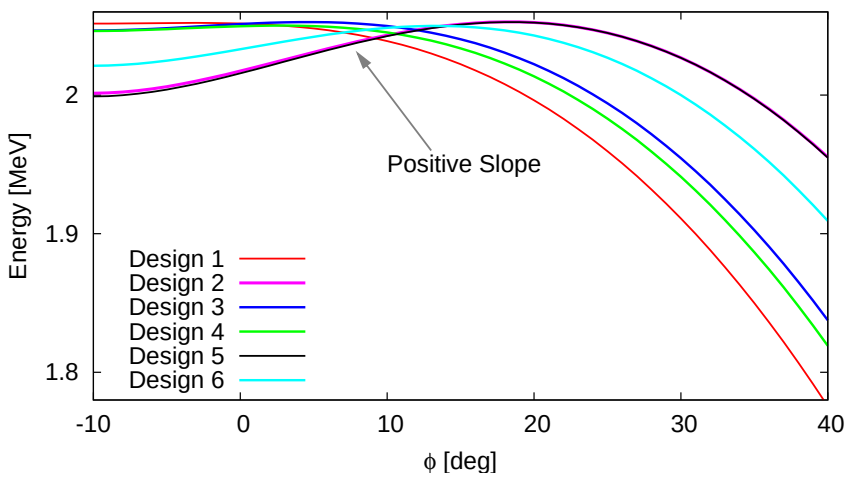


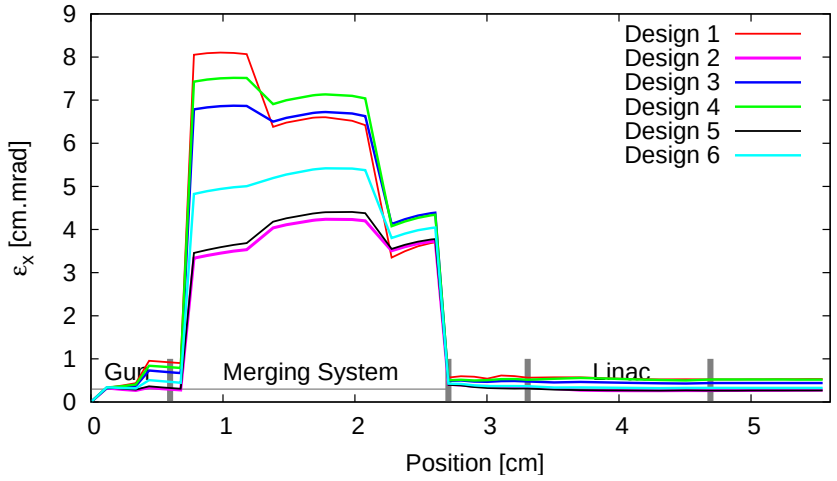


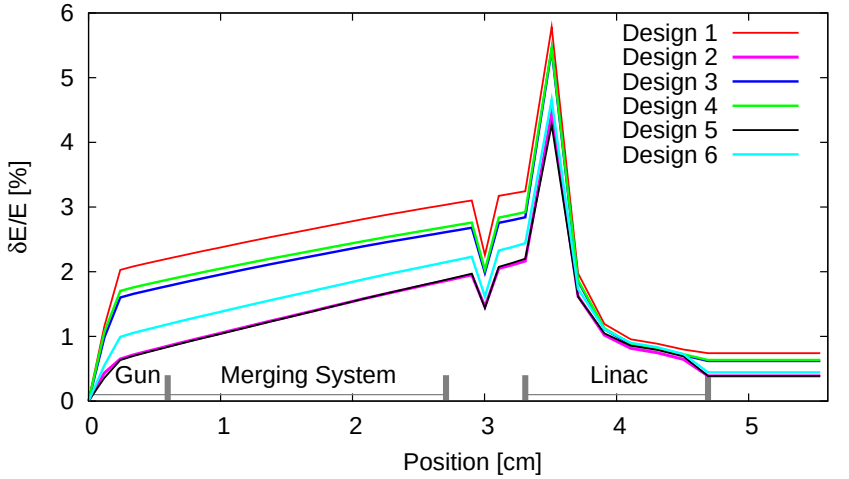


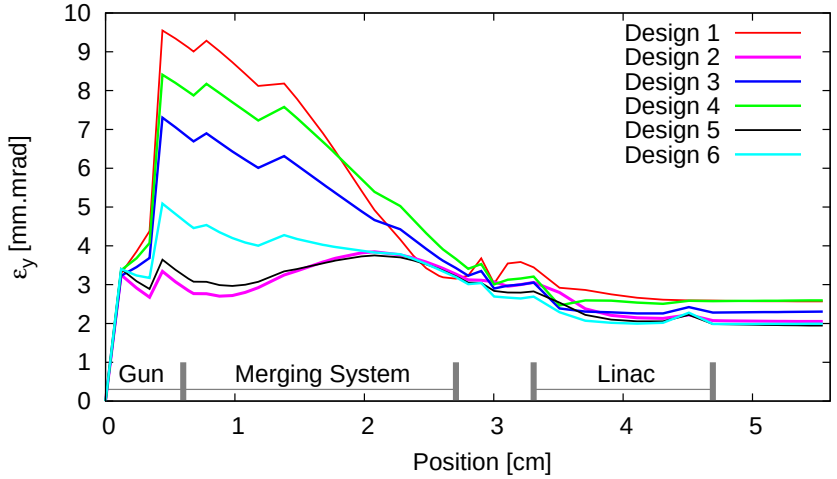


Emittance & Energy Spread









Cathode Recess