5th SPL Collaboration Meeting

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# *Layout considerations based on passband modes*

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# Outline

- General Approach
- Analysed cavities
- Case studies: SNS, SPL, ESS

# General Approach

- Minimisation problem:
  - Cost, linac length, components, R&D effort
- Real estate gradient -> transition energy (GenLin)

# General Approach

- Minimisation problem:
  - Cost, linac length, components, R&D effort
- Real estate gradient -> transition energy (GenLin)
- Today: looking at other $TM_{010}$ modes

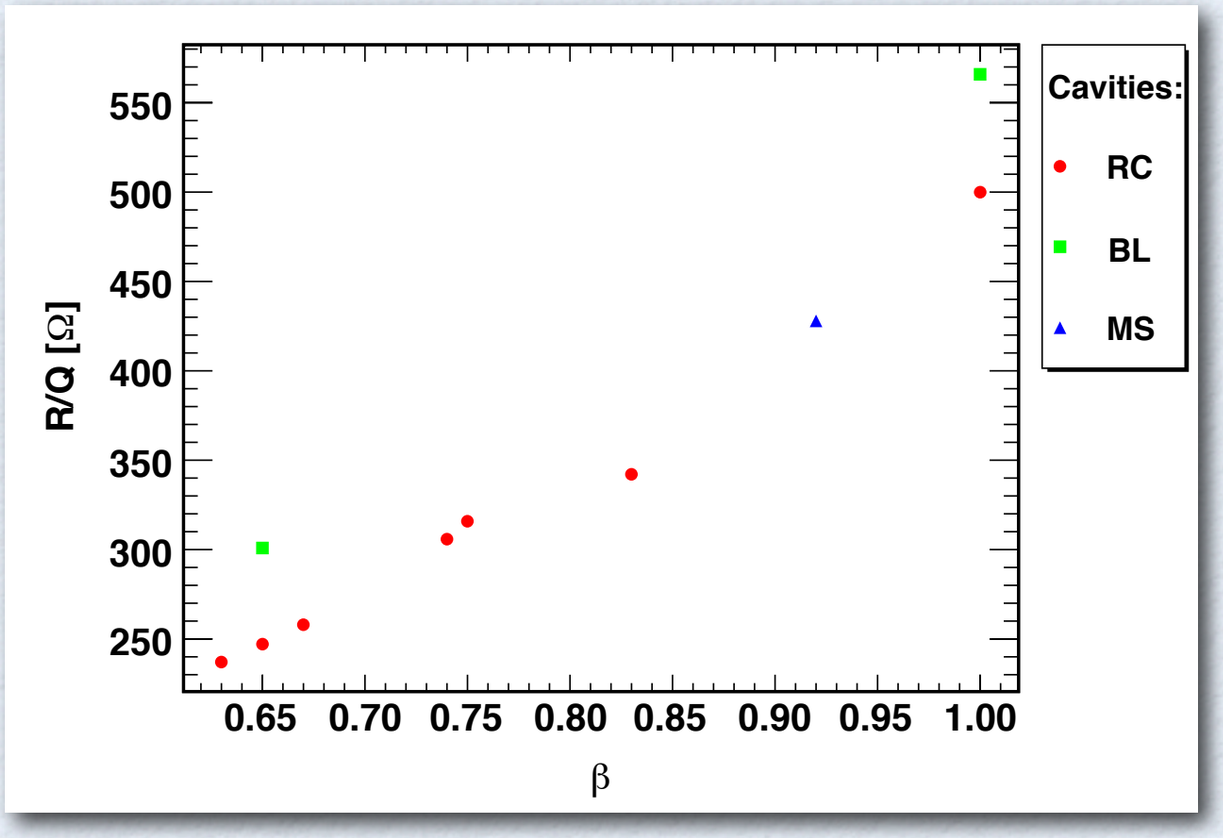
# 704 MHz cavities

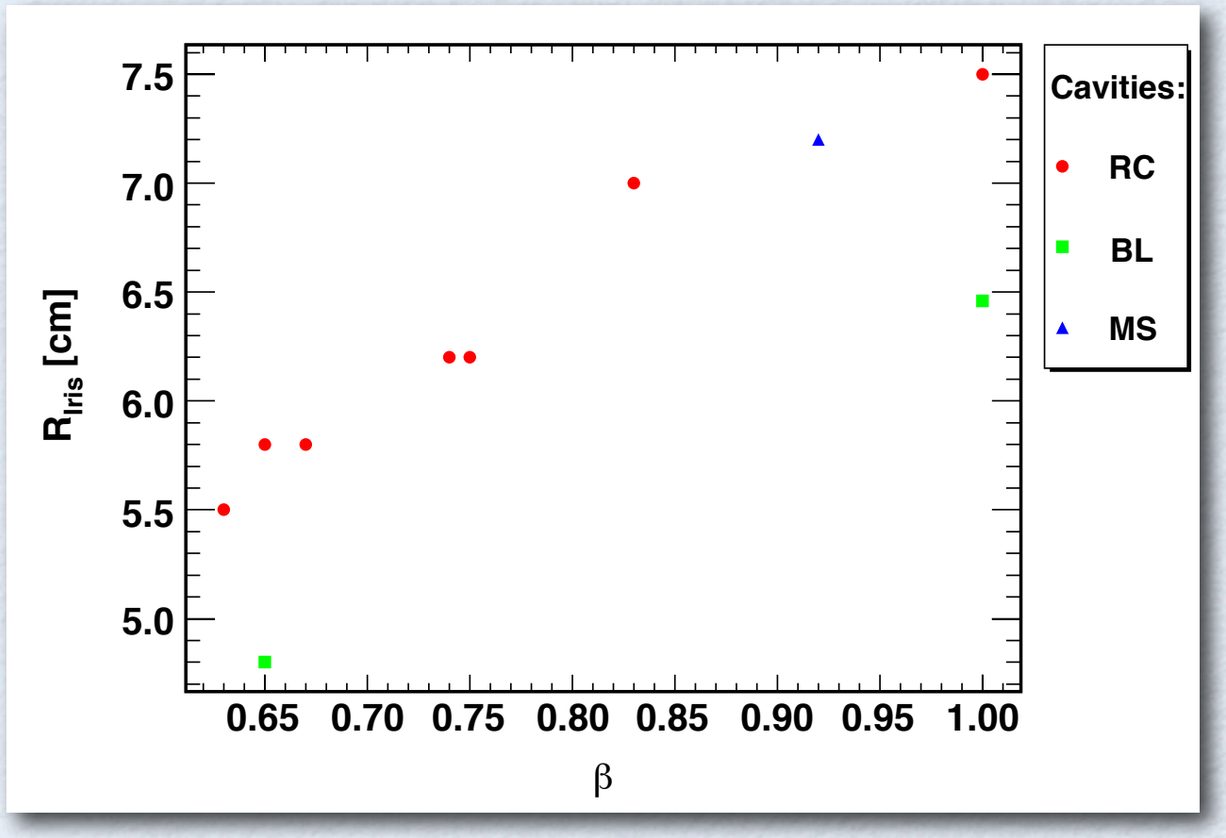
- Set of draft cavities ($\beta_g$: 0.63, 0.65, 0.67, 0.74, 0.75, 0.83, 1.0) designed by R. Calaga* (RC)
- SPL baseline cavities (BL) with $\beta_g$: 0.65, 1.0
- Additional $\beta_g$= 0.92 cavity (MS)

*http://rcalaga.web.cern.ch/rcalaga/704MHz/

# $\beta_g$ dependency of R/Q

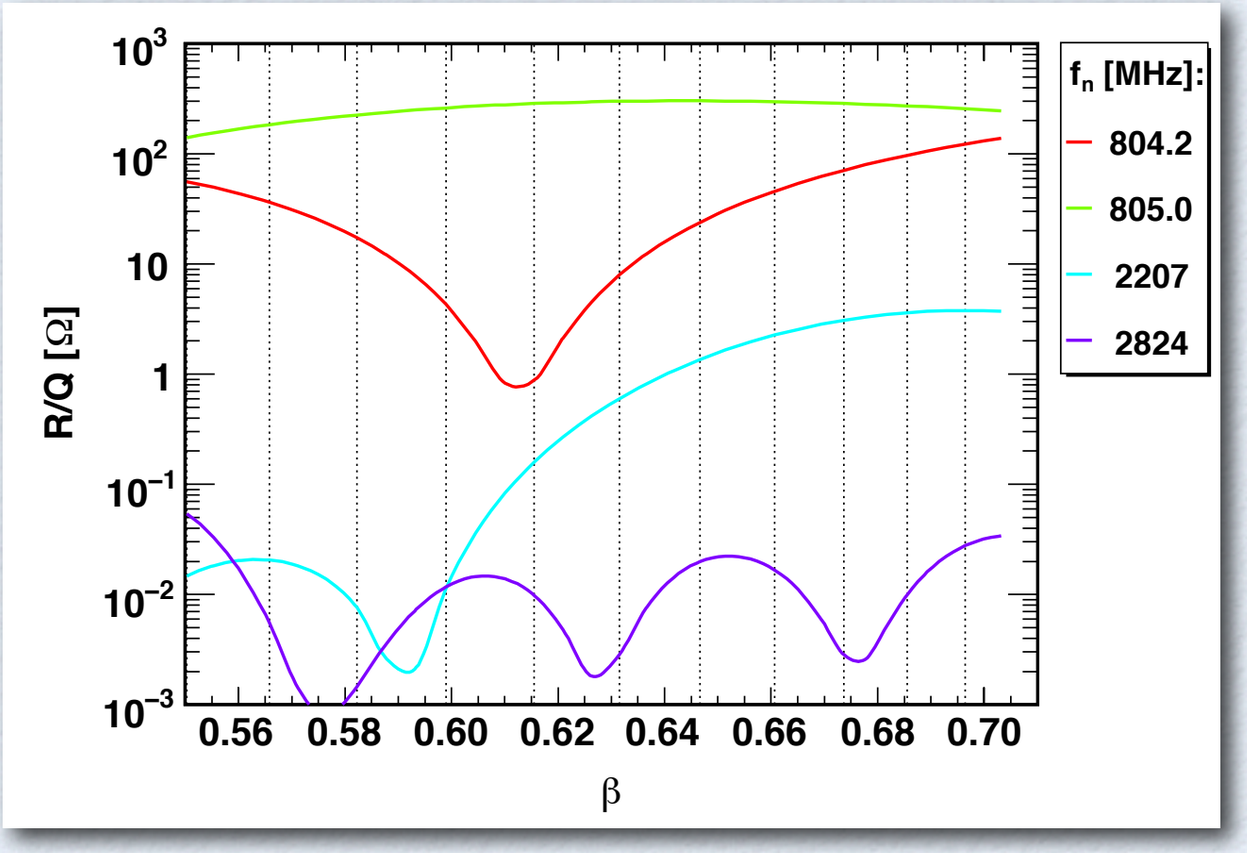
- To keep $B_{peak}/E_{acc}$ small, $R_{iris}$ has to be reduced with $\beta_g$ and so also $R/Q(\beta_g)$ decreases.



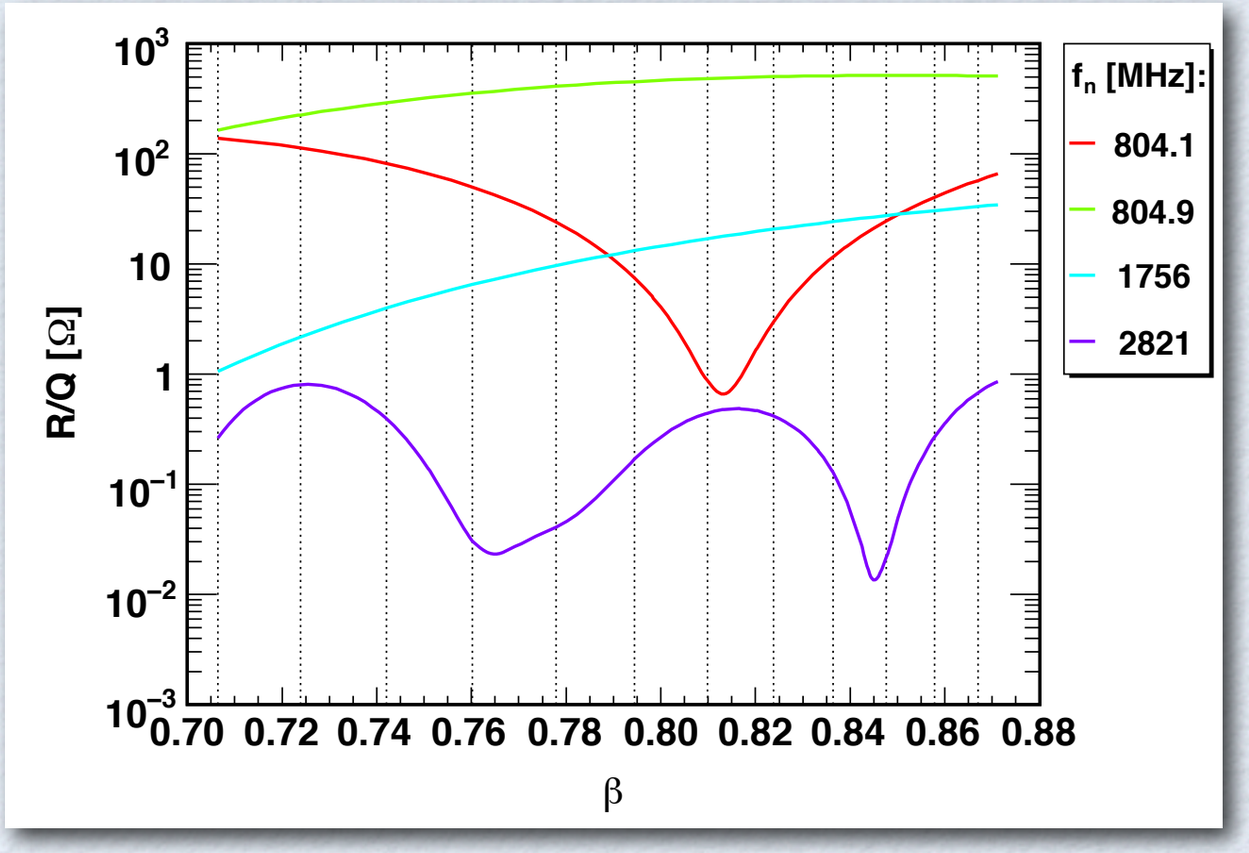



# R/Q -maps SNS linac

$\beta_g = 0.61$



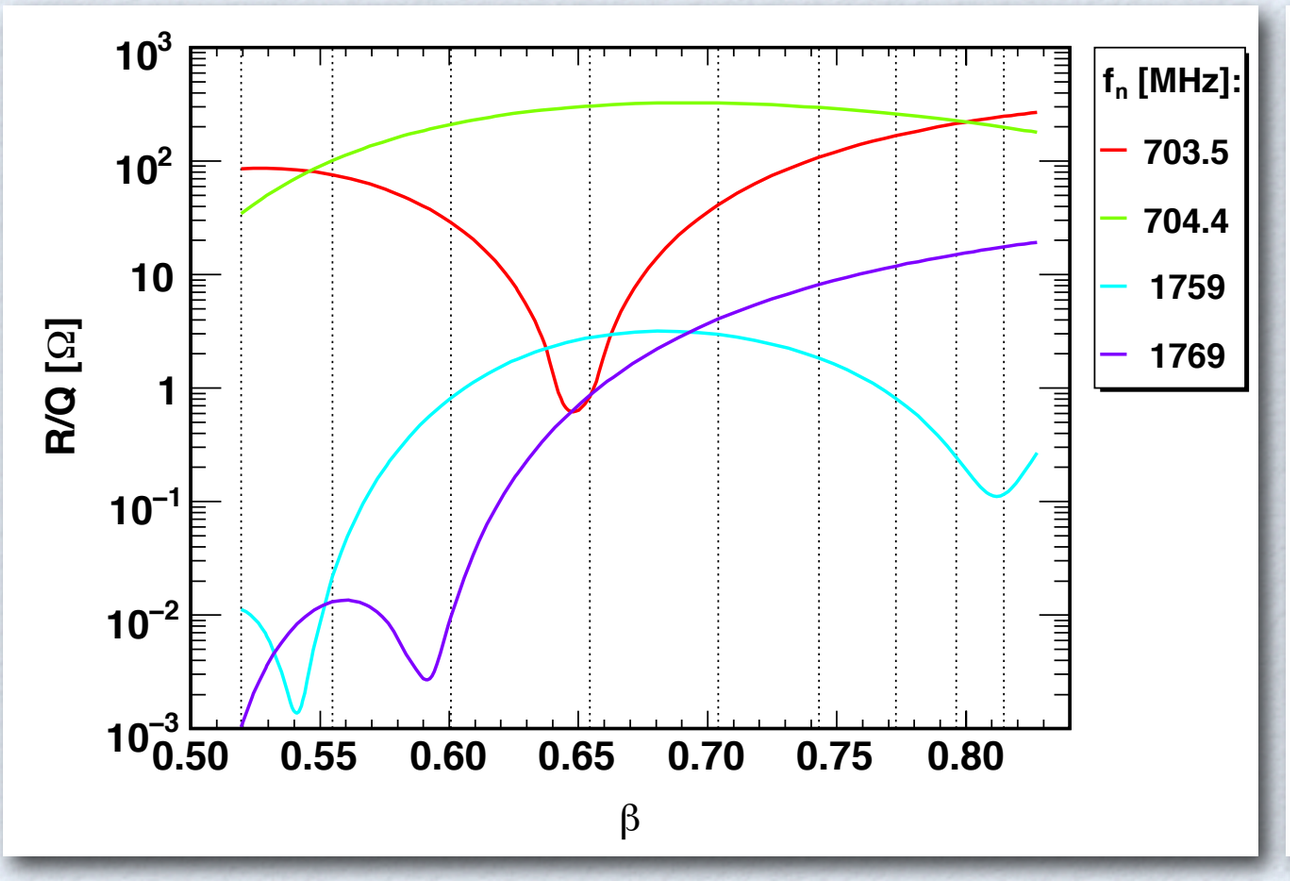

$\beta_g = 0.81$



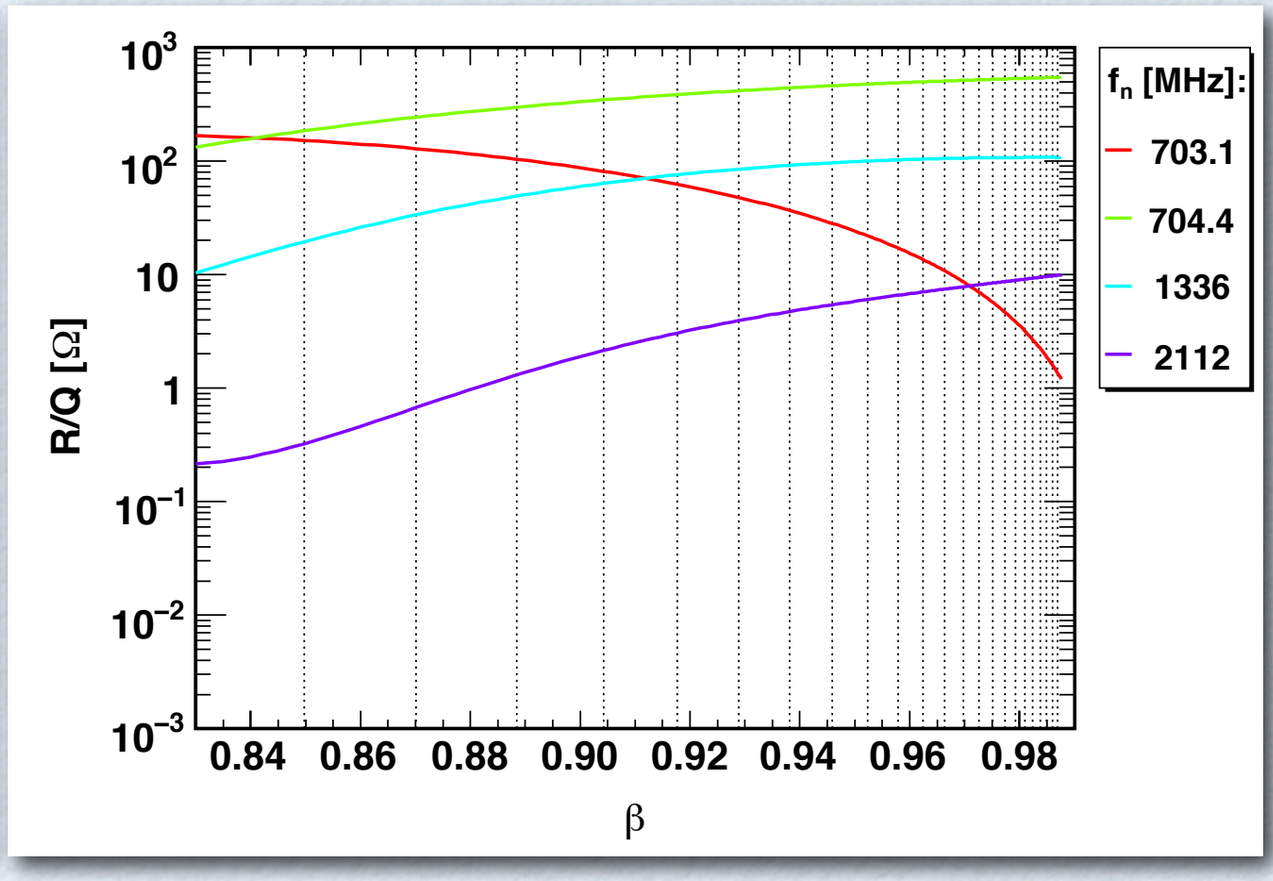

| | | |
|---|---|---|
| 805 | $f_{acc}$ [MHz] | 805 |
| 6 | cells | 6 |
| 33 (3) | cavities (per module) | 48 (4) |

# R/Q -maps SPL baseline

$\beta_g = 0.65$




$\beta_g = 1.0$

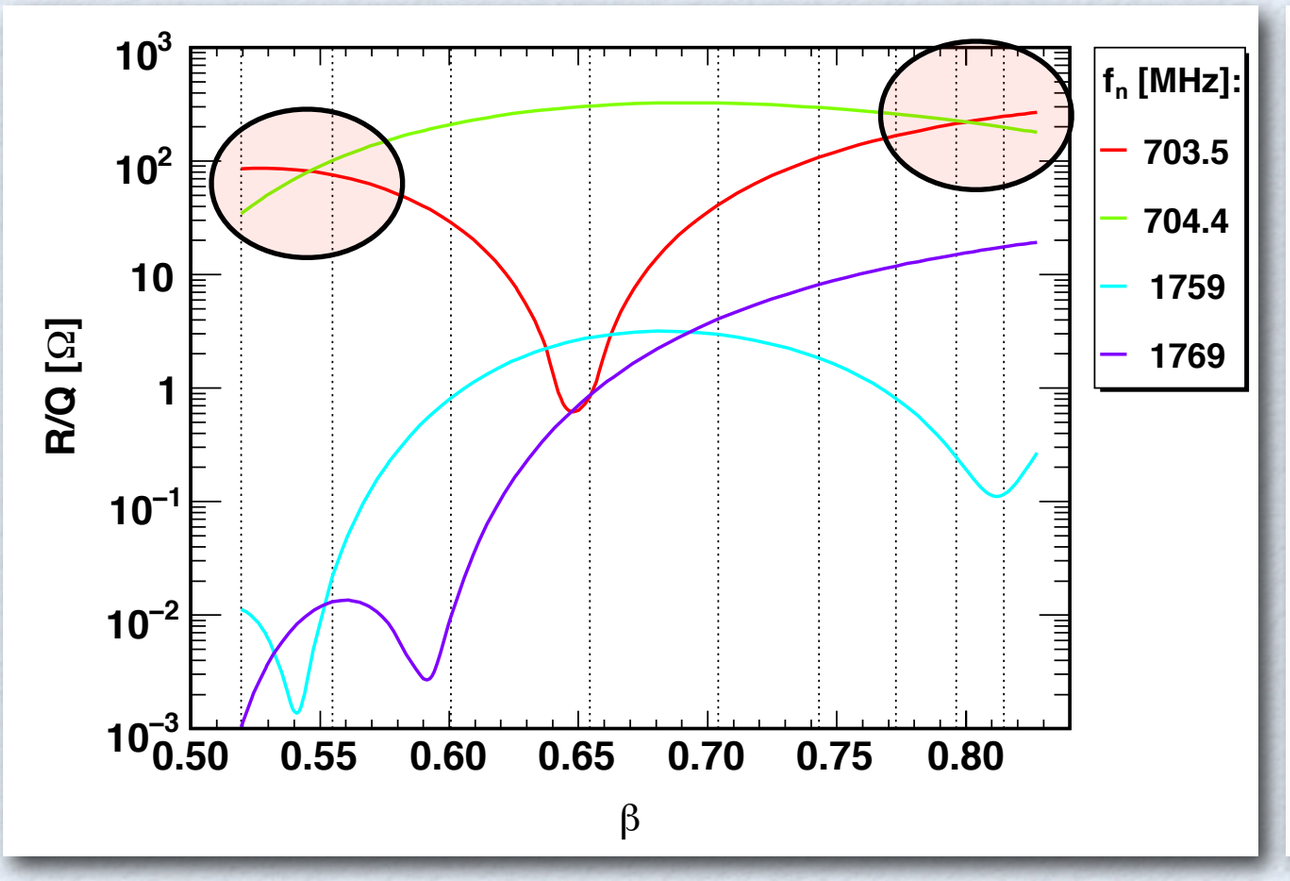



| 704.4 | $f_{acc}$ [MHz] | 704.4 |
|---|---|---|
| 5 | cells | 5 |
| 54 (6) | cavities (per module)* | 196 (8) |

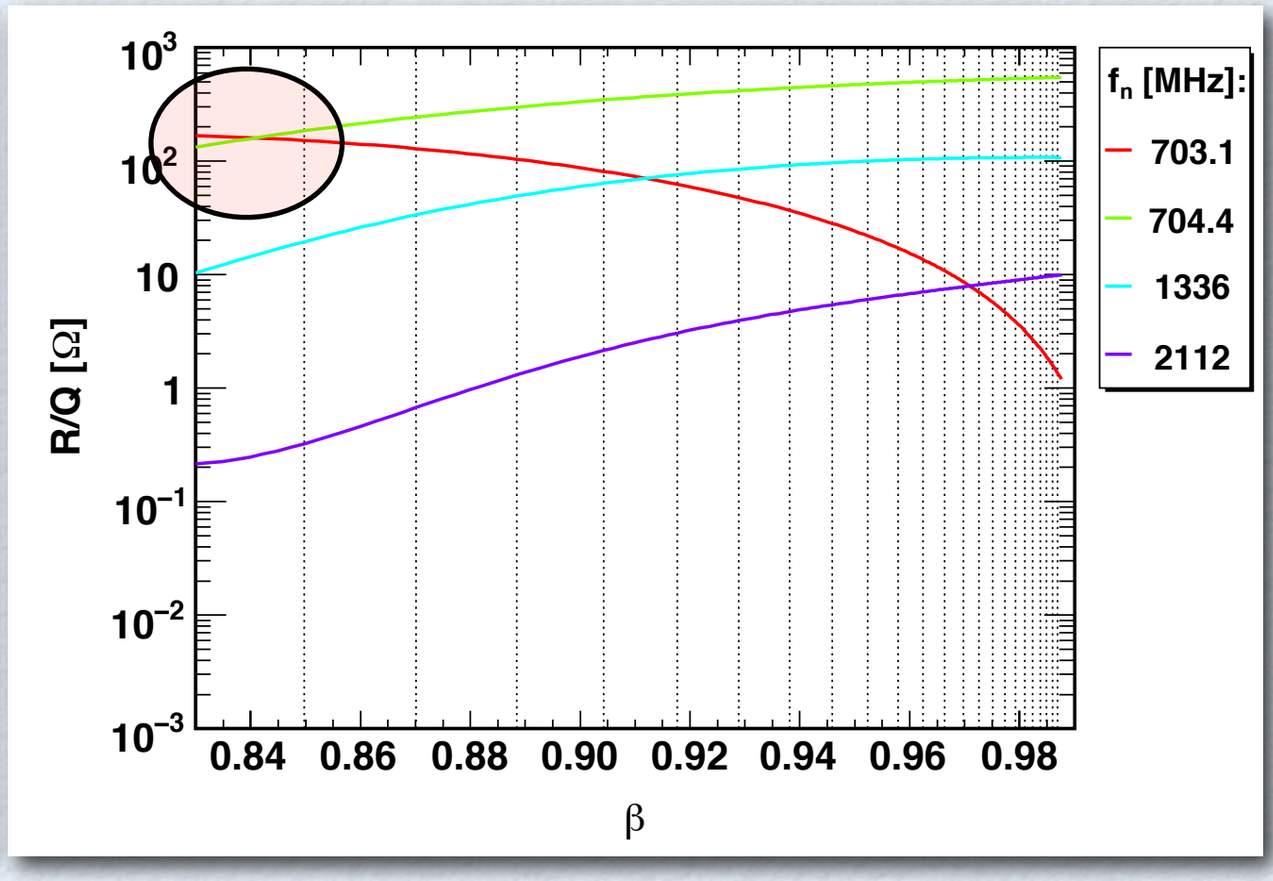
* old CDR2 layout

# R/Q -maps SPL baseline

$\beta_g = 0.65$



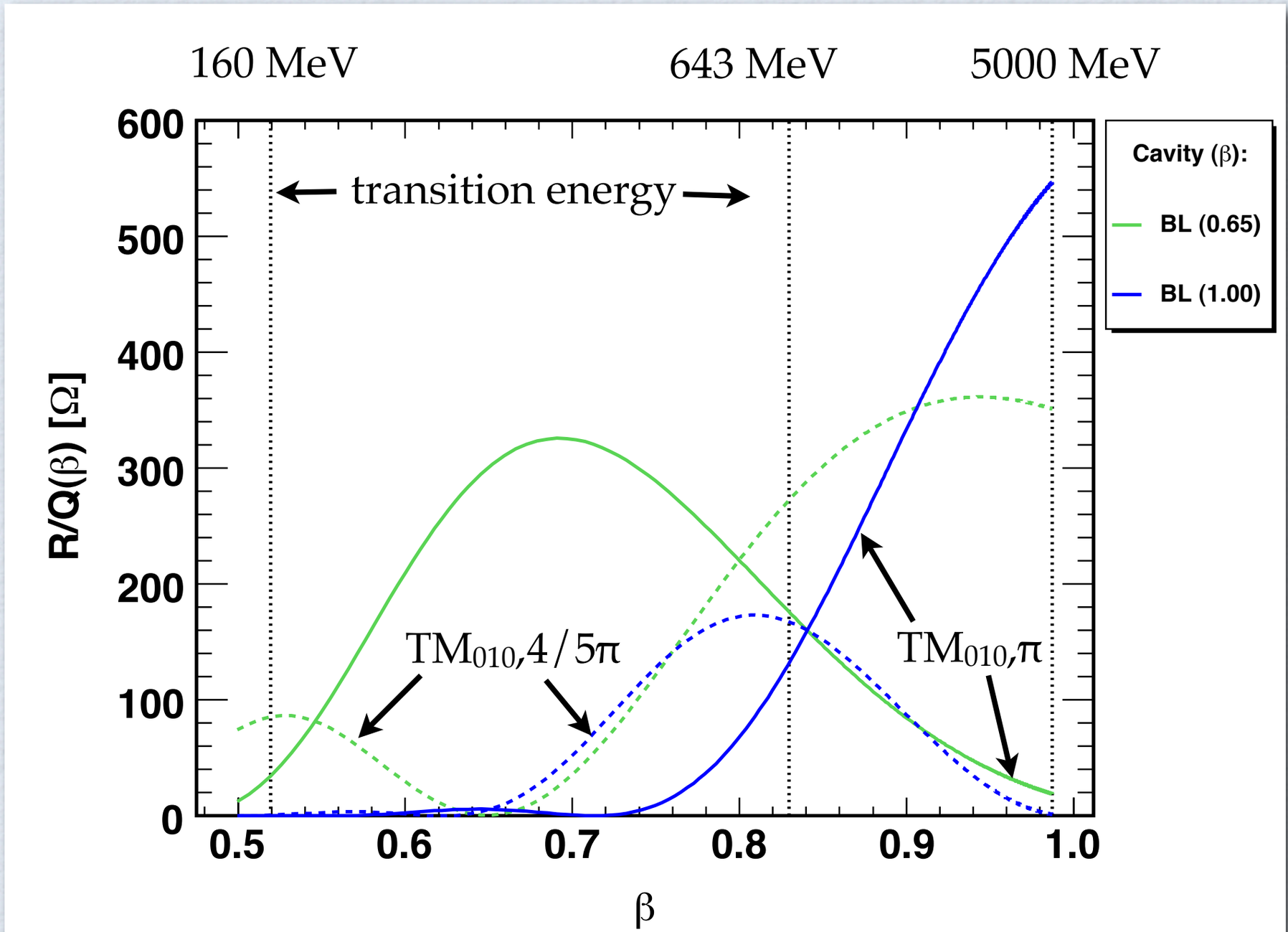

$\beta_g = 1.0$




| 704.4 | $f_{acc}$ [MHz] | 704.4 |
|---|---|---|
| 5 | cells | 5 |
| 54 (6) | cavities (per module)* | 196 (8) |

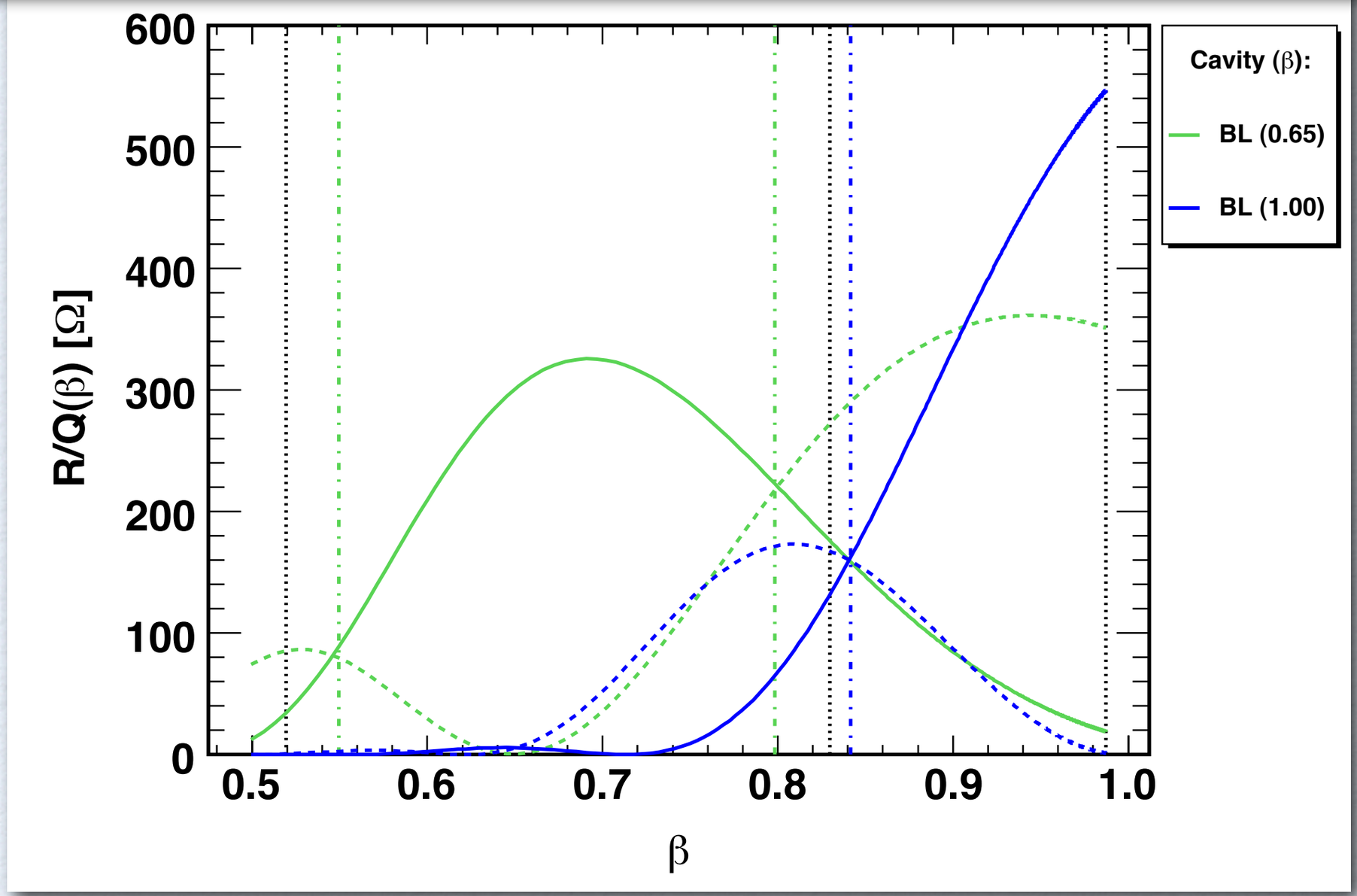
* old CDR2 layout

# SPL baseline



# SPL baseline

Define operation β limit, where R/Q(β) of other $TM_{010}$ mode exceeds R/Q(β) of operation mode.



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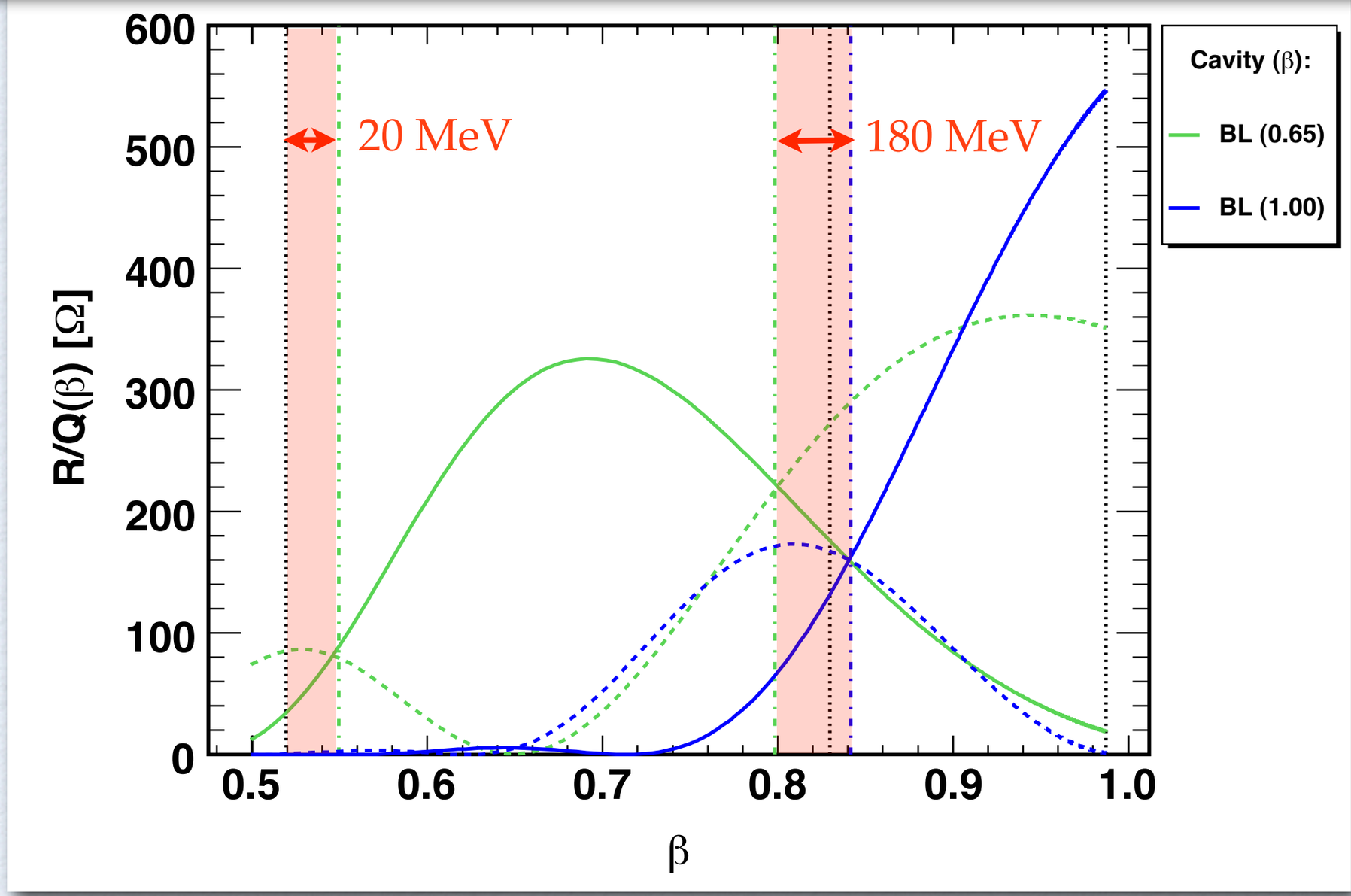
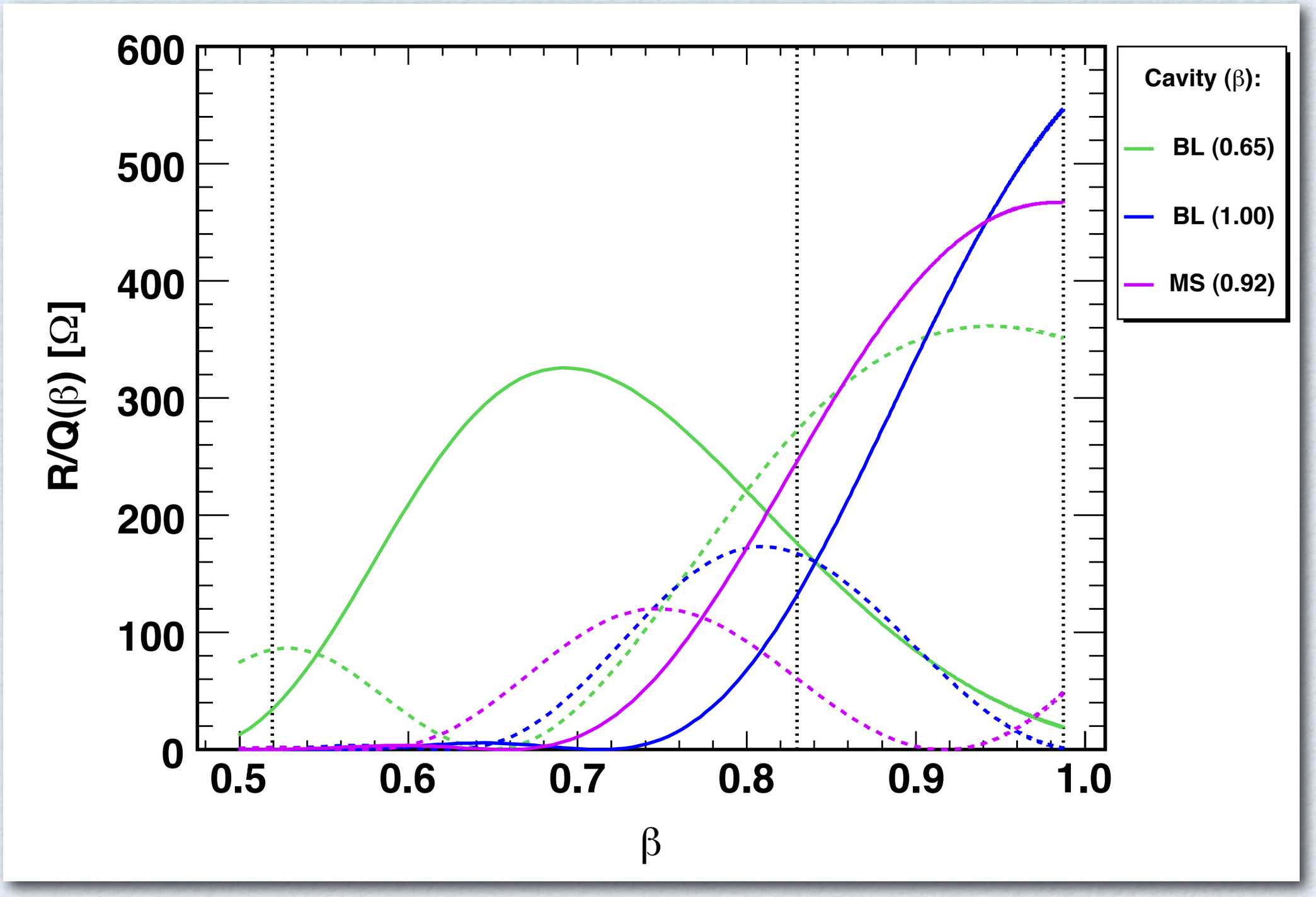
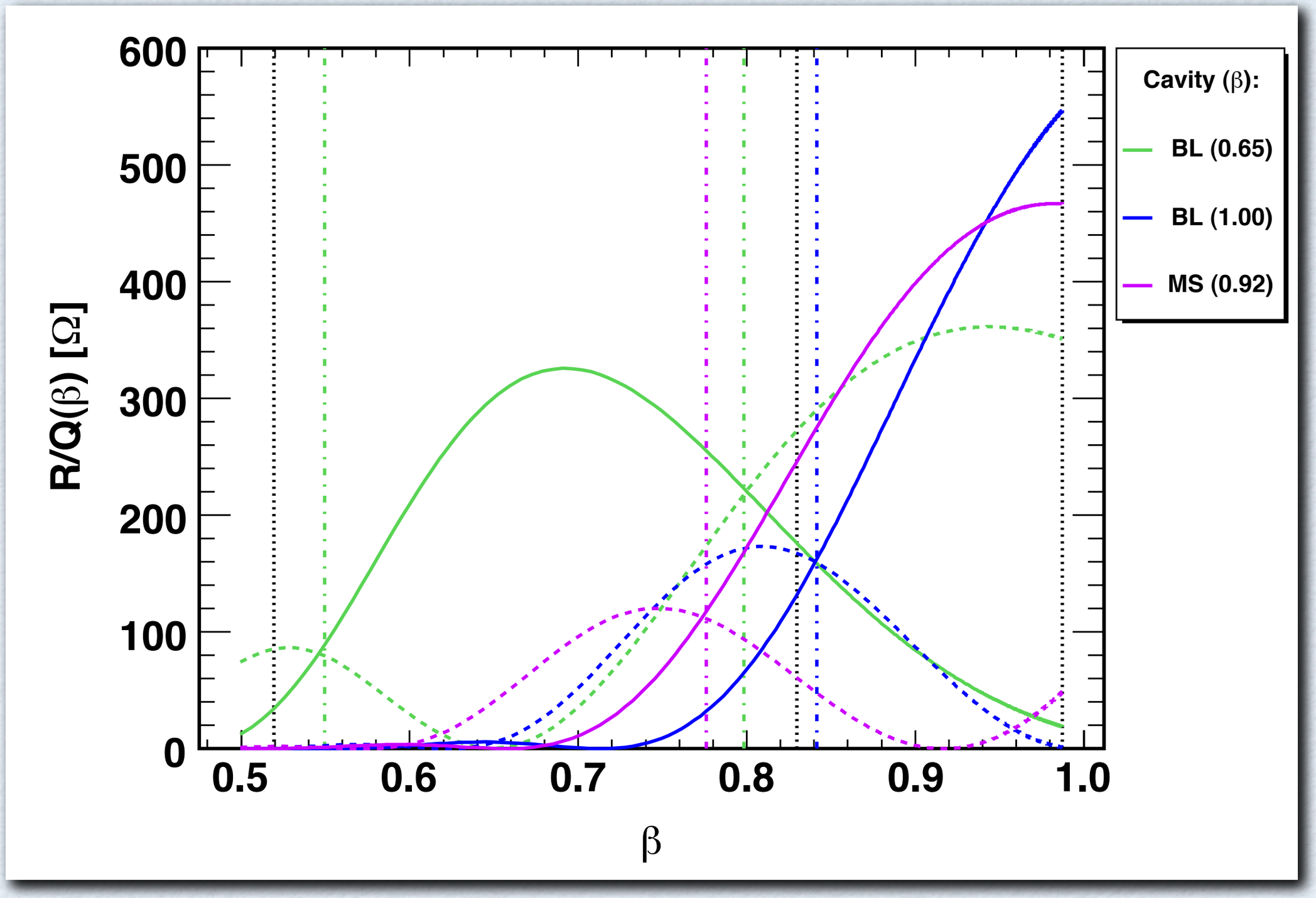


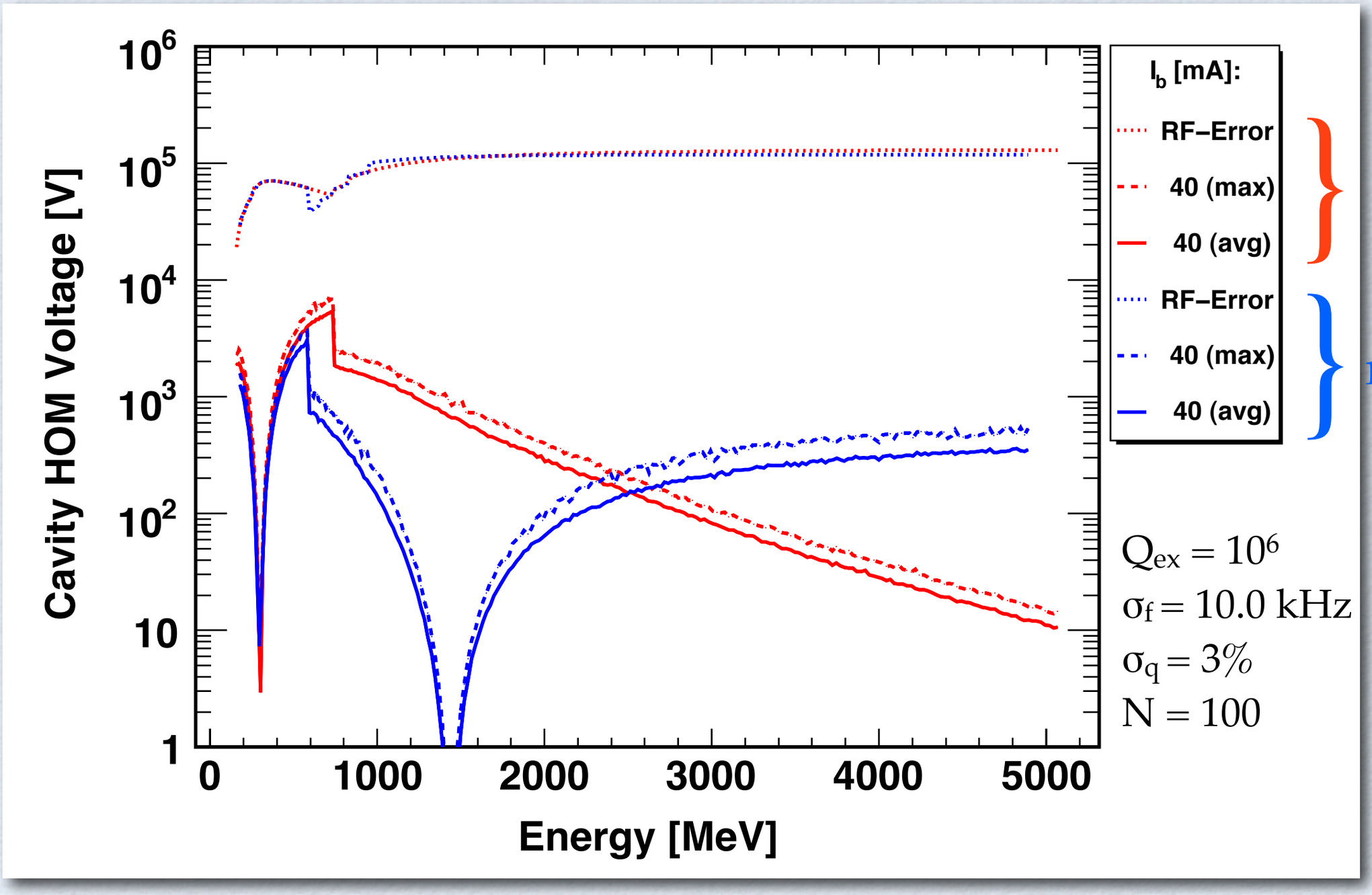
# SPL Baseline + $\beta_g = 0.92$



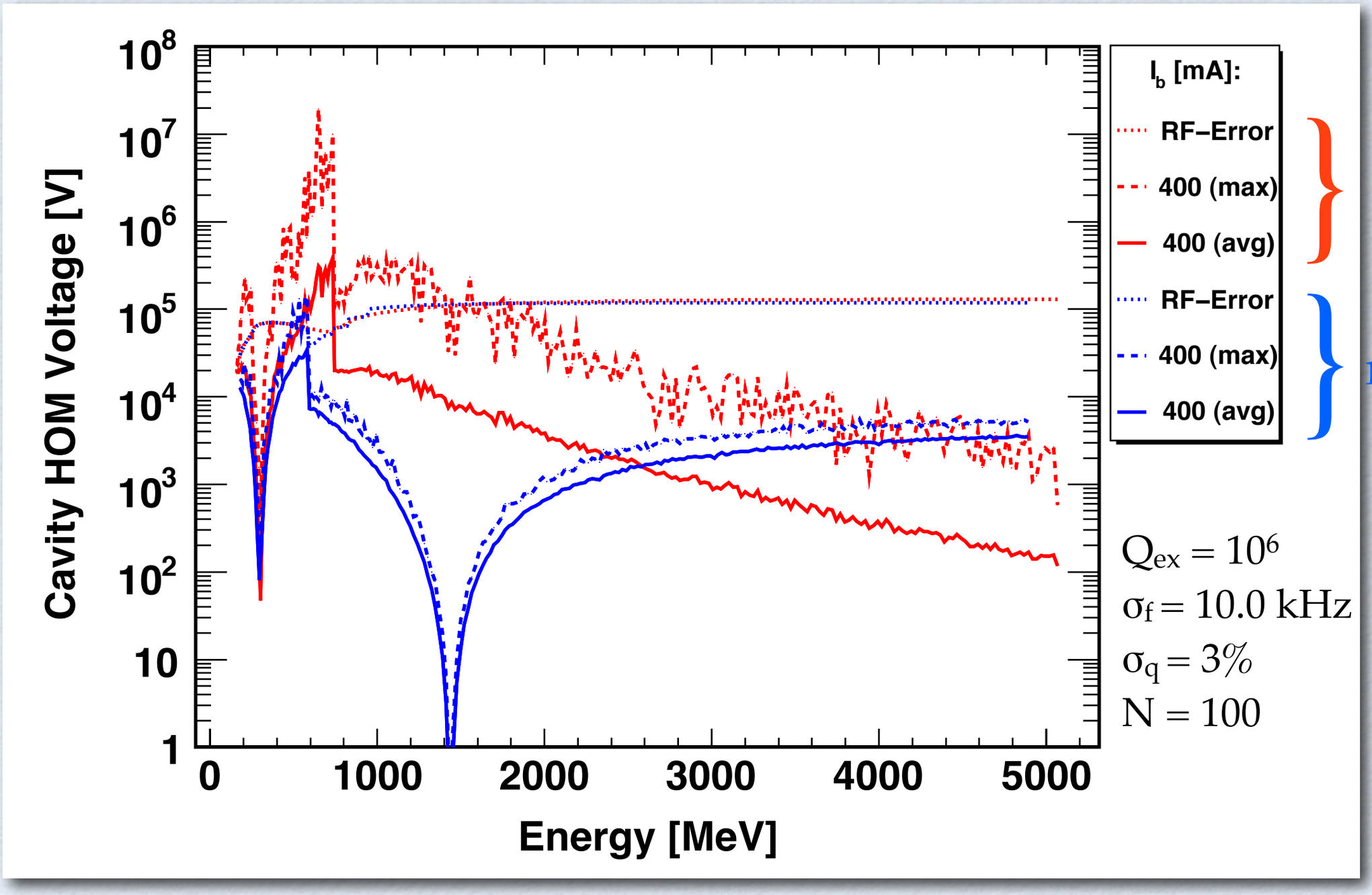
# SPL Baseline + $\beta_g = 0.92$



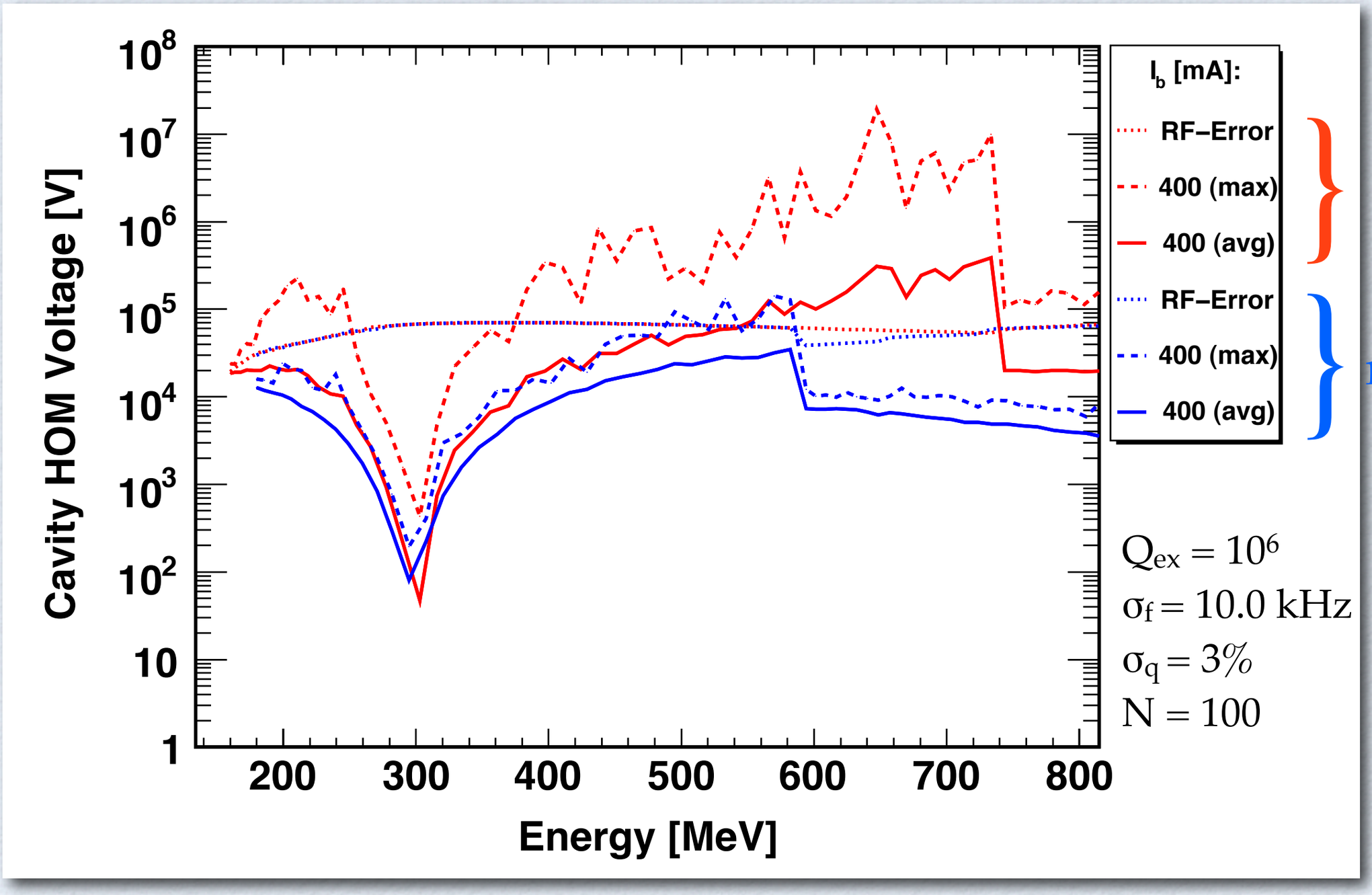
# Induced HOM voltage



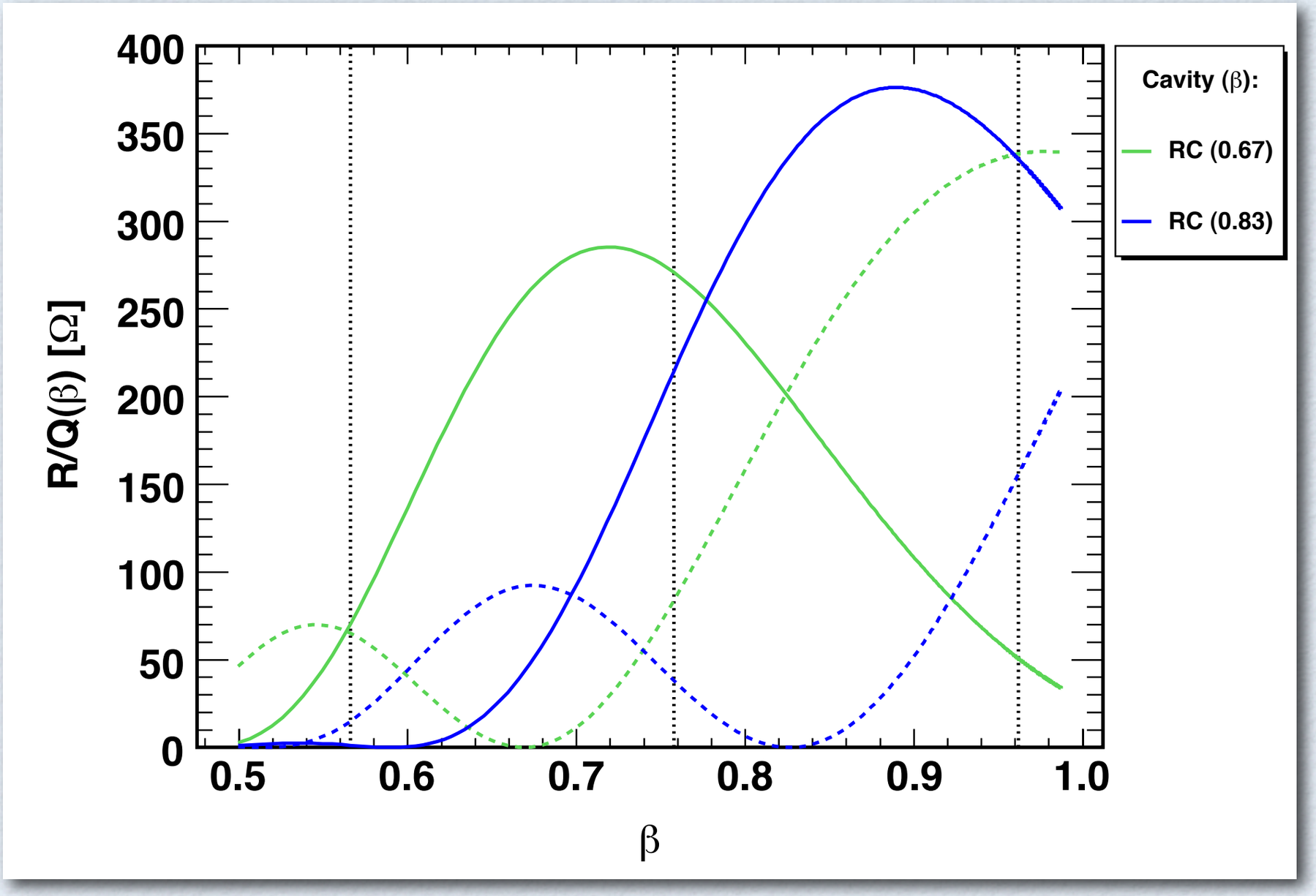
# Induced HOM voltage



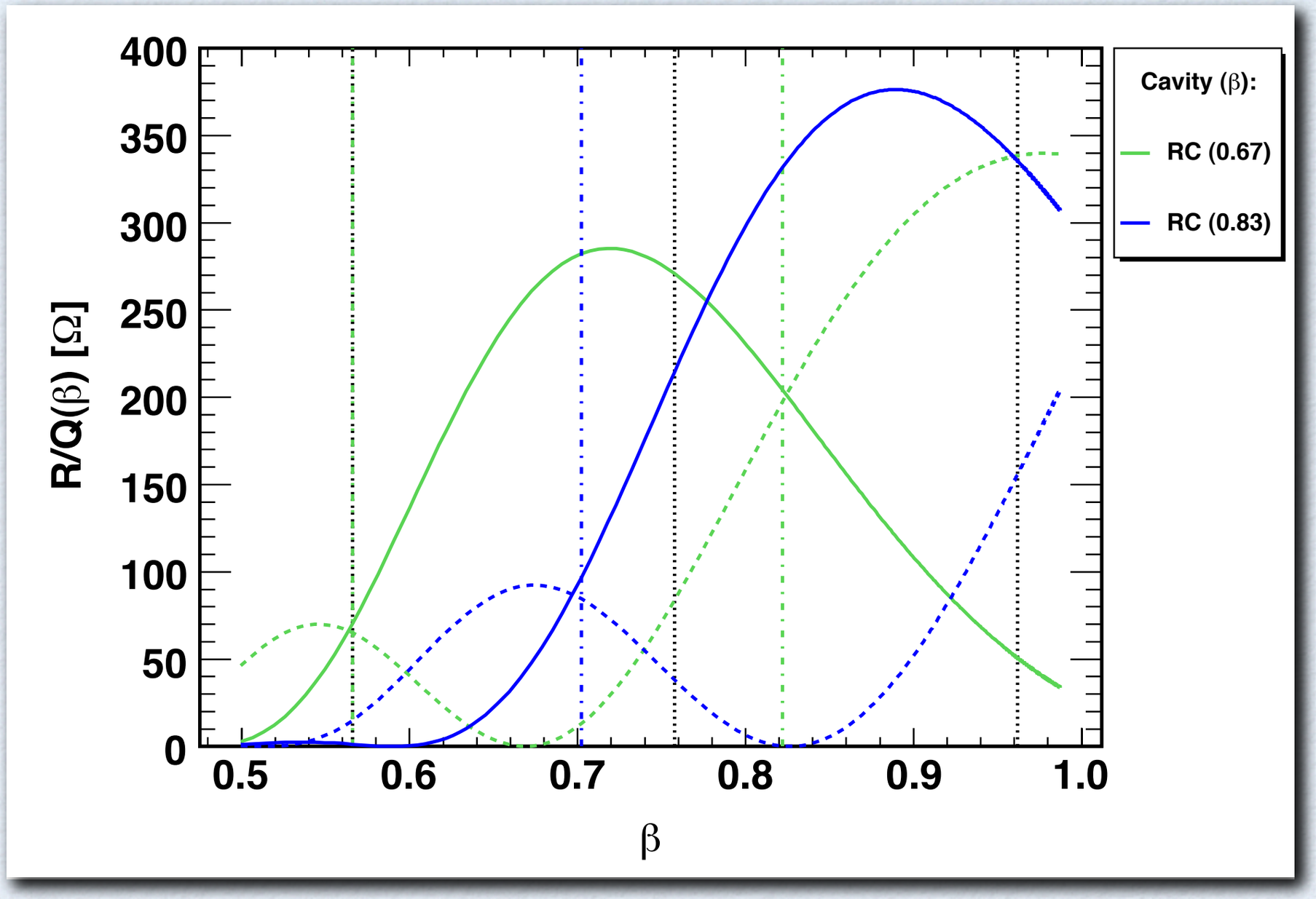
# Induced HOM voltage



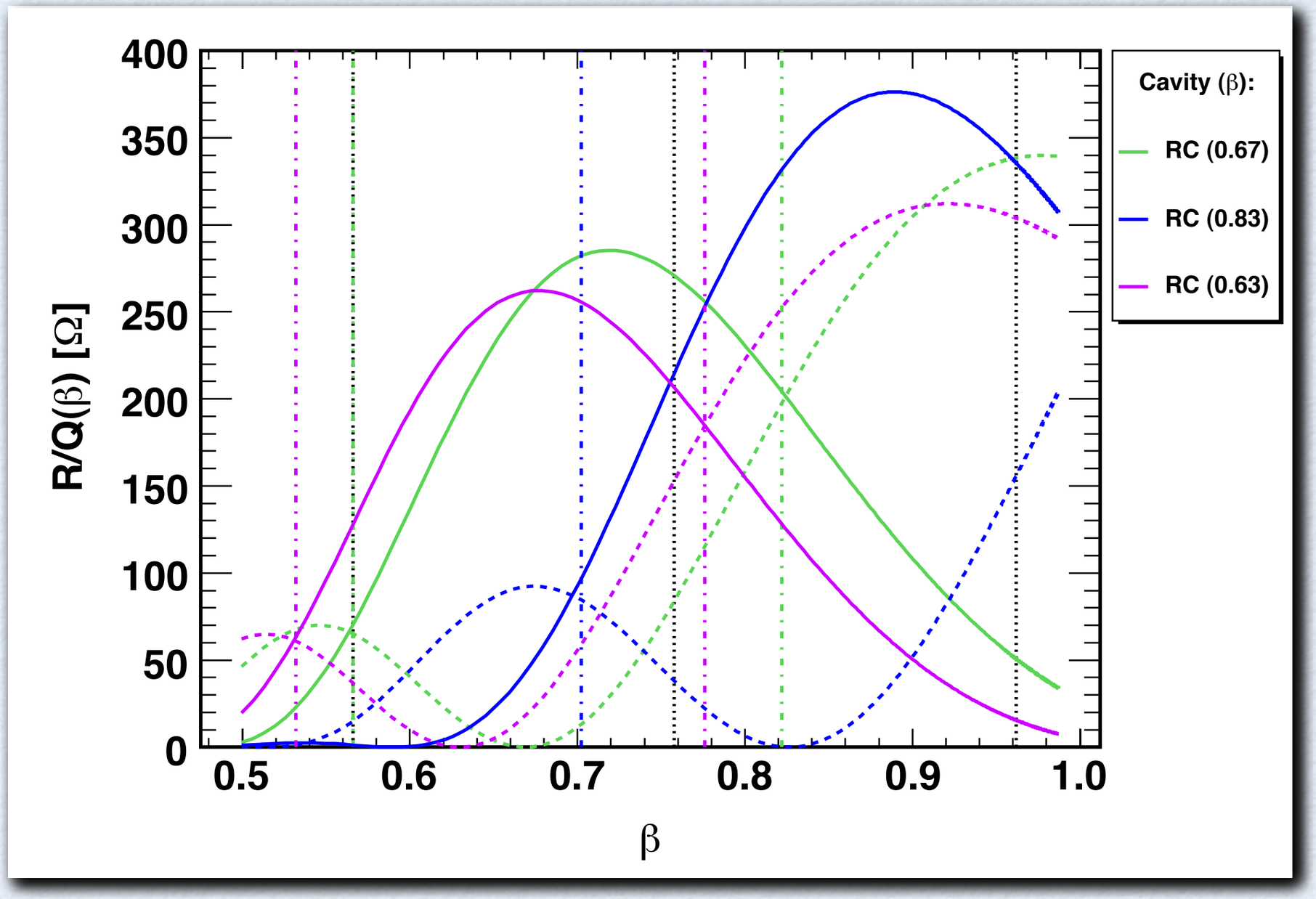
# ESS


400
350
300
250
200
150
100
50
0
R/Q(β) [Ω]
0.5
0.6
0.7
0.8
0.9
1.0
β
Cavity (β):
RC (0.67)
RC (0.83)

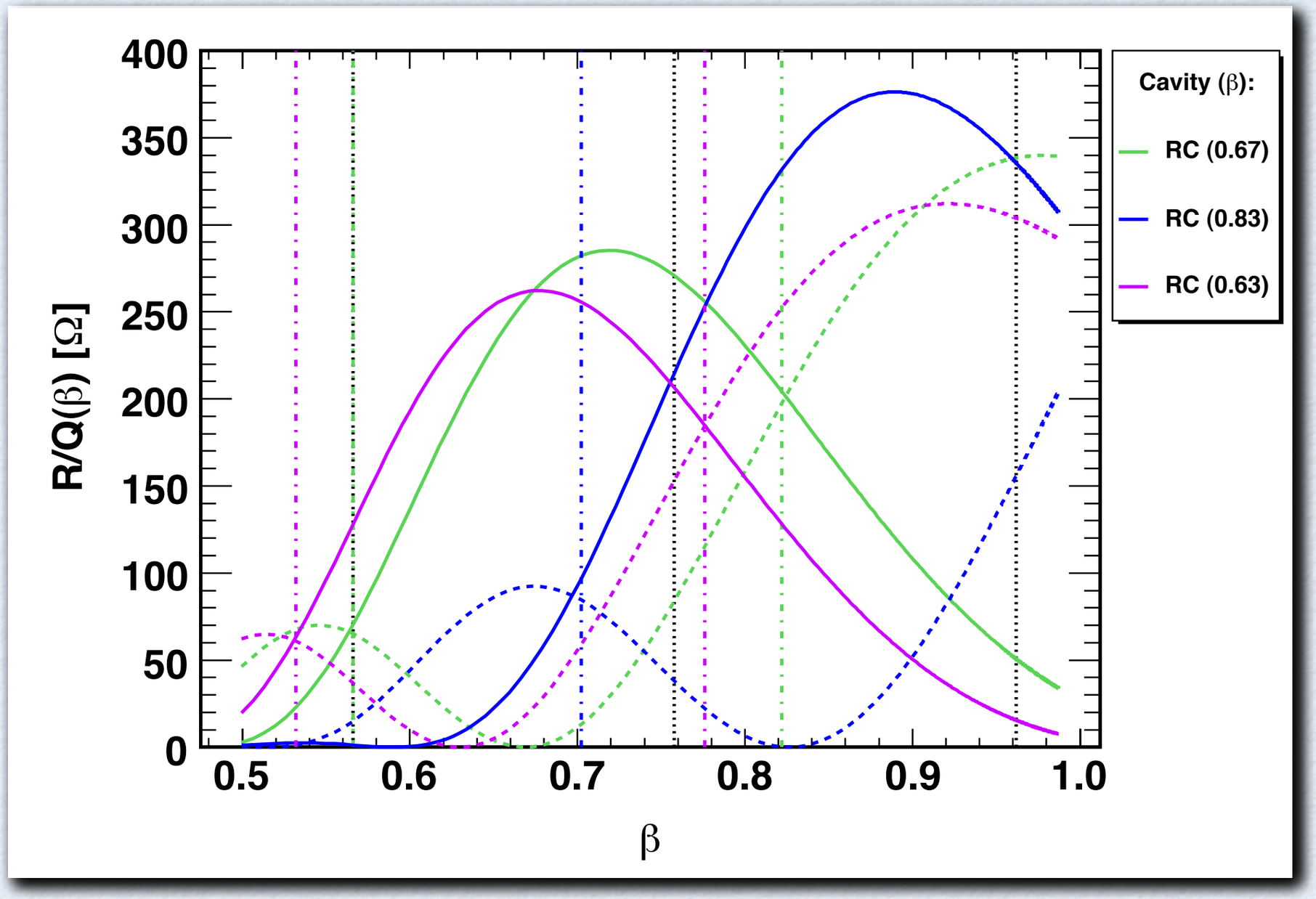
# ESS


400
350
300
250
200
150
100
50
0
R/Q(β) [Ω]
0.5
0.6
0.7
0.8
0.9
1.0
β
Cavity (β):
RC (0.67)
RC (0.83)

# ESS


400
350
300
250
200
150
100
50
0
R/Q(β) [Ω]
0.5
0.6
0.7
0.8
0.9
1.0
β
Cavity (β):
RC (0.67)
RC (0.83)
RC (0.63)

# ESS

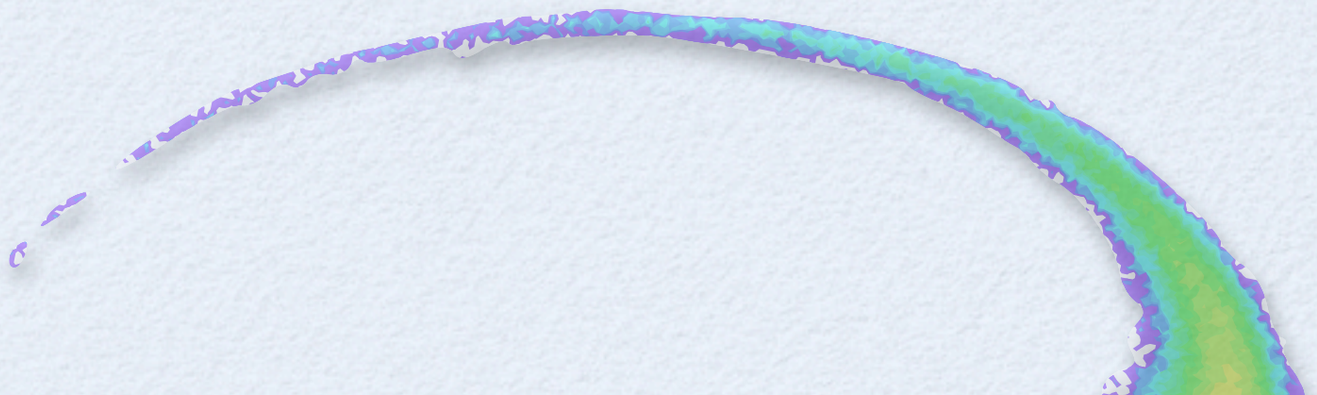



- $\beta_g$ =0.63 would improve the situation at injection, but makes it worse at transition.

# Conclusions SPL

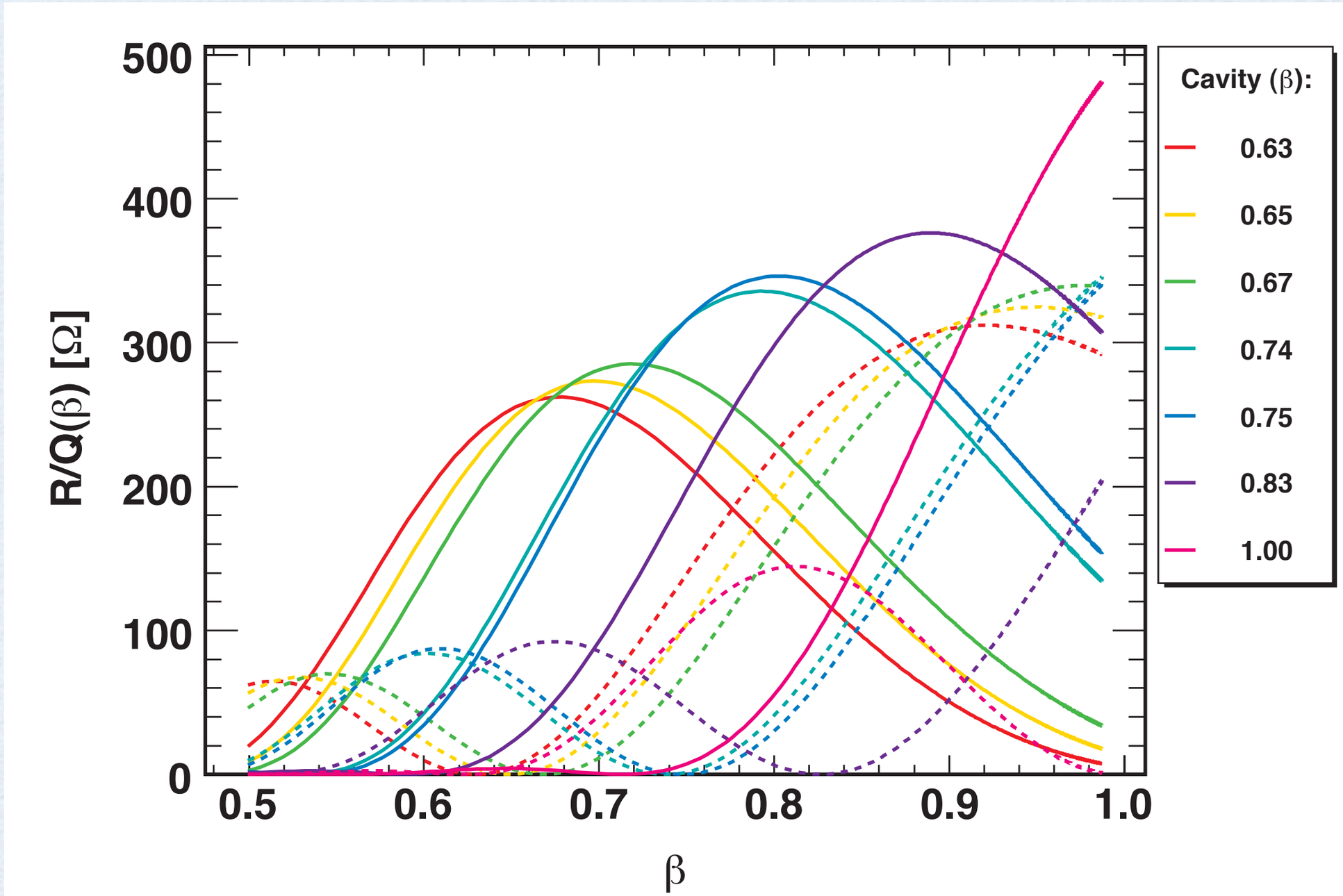
- The combination of $\beta_g = 0.65$ and $\beta_g = 1.0$ cavities cause high $R/Q(\beta)$ values of the $TM_{010},4/5\pi$ modes at transition.
- A higher injection energy and a lower $\beta_g$ in the high beta section is preferable from this point of view.

# Thank You!



# Questions

# RC Cavities: R/Q(β)



# $R/Q(\beta)_{max}$ Monopoles