BESSY VSR 1.5 GHZ CAVITY DESIGN AND CONSIDERATIONS ON WAVEGUIDE DAMPING

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Abstract: The BESSY VSR upgrade of the BESSY II light source represents a novel approach to simultaneously store long (ca. 15ps) and short (ca. 1.5ps) bunches in the storage ring with the "standard" user optics. To this end, new high-voltage L-Band superconducting multi-cell cavities must be installed in one of the straights of the ring. These 1.5 GHz and 1.75 GHz cavities are based on 1.3 GHz systems being developed for the bERLinPro energy-recovery linac. This paper describes the baseline electromagnetic design of the first 5-cell cavity operating at 1.5 GHz as well different design approaches to ensure reliable operation.

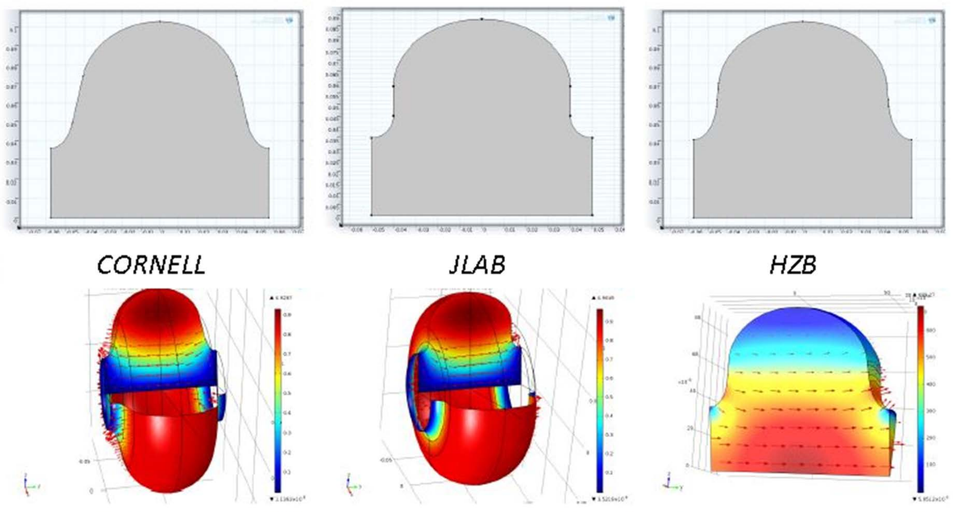
Mid-Cell/Multi-Cell RF design

- **High CW Eacc** required (20MV/m)
- Starting point: JLAB/CORNELL models
- Mid-cell parametric optimization (challenging RF Specifications)

Table 1: RF current parameters

Param.	Units	Goal	Mid-Cell	5 Cell
Epk/Eacc	-	≤ 2.3	2.29	2.29
Bpk/Epk	mT/(MV/M)	≤ 2.3	1.816	1.91
R/Q	(Ω)	≥ 95	100.7	105*5
G	(Ω)		280.05	279

COMSOL → parametric calculations for Mid-cell geometry
HFSS → 3D calculations for Qext spectrum (PMLs)

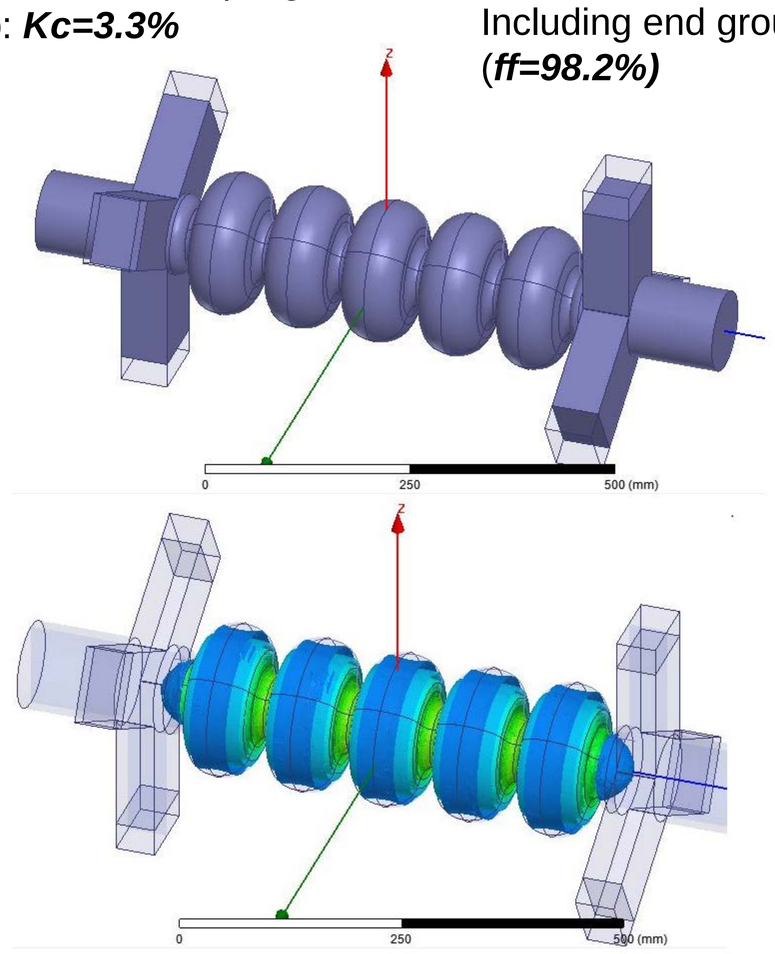


HOMs damping is critical

- High Iris diameter ϕ=71.34mm
- High cell to cell coupling for
- TM010: ***Kc=3.3%***

Simetrical end cells

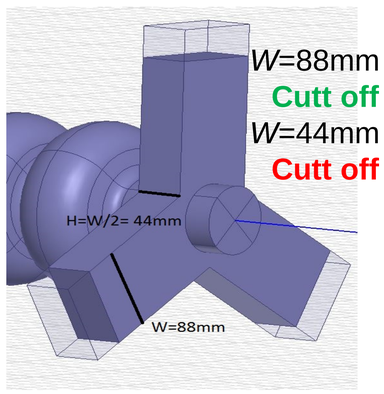
HFSS parametric studies for field flatness Including end groups (***ff=98.2%)***



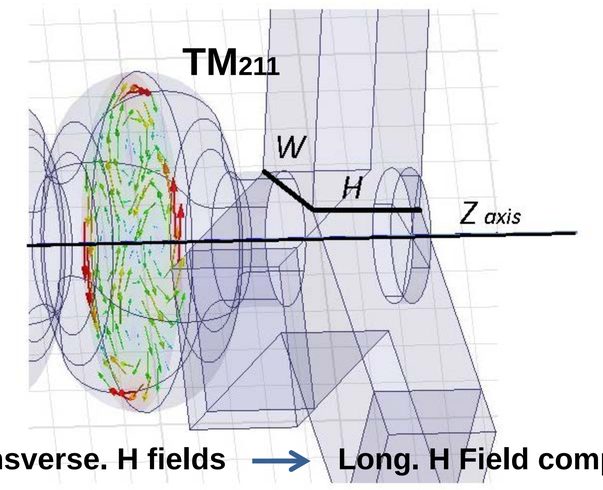
Damping Studies

- **HZB 5 cells** (beam pipe ϕ=71.34mm)
- **HZB 5 cells enlarged beam pipe** (ϕ=105mm)

Standard WG

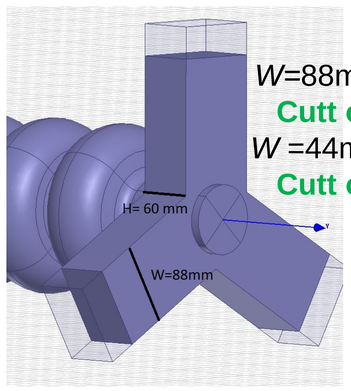


W=88mm *H*=44mm
Cutt off *1.7 GHz*
W=44mm *H*=88mm
Cutt off *3.4 GHz*

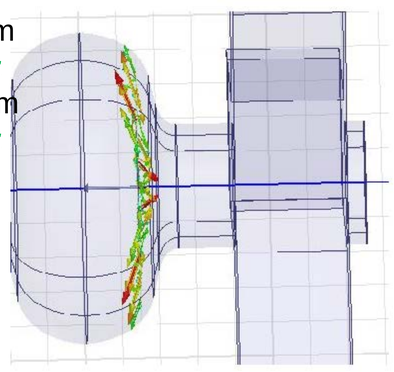


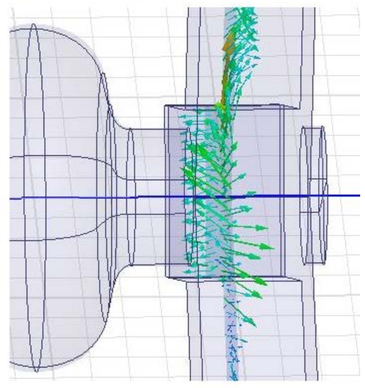
Pure transverse. H fields → **Long. H Field component**

Tuned WG



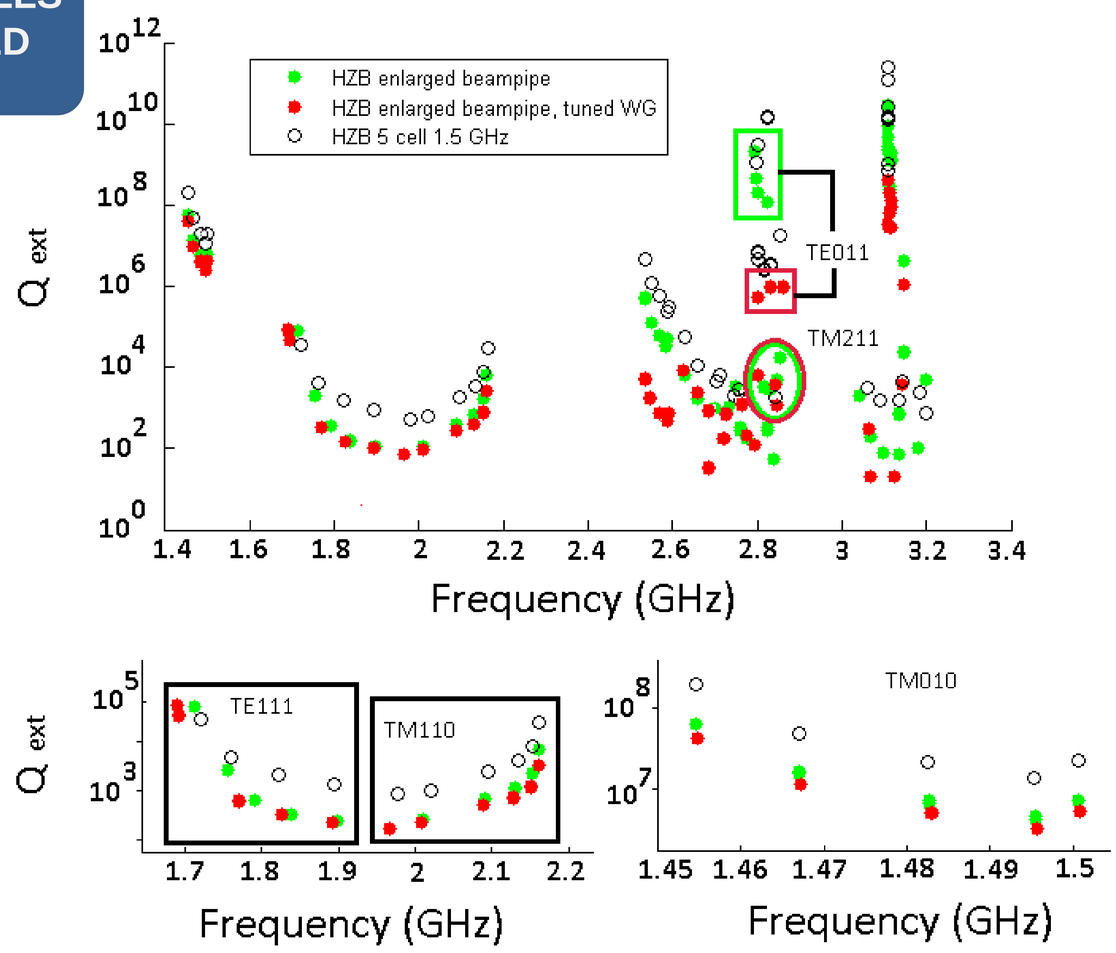
W=88mm *H*=44mm
Cutt off *1.7 GHz*
W =44mm *H*=88mm
Cutt off *2.5 GHz*





HZB 5 CELLS

HZB 5 CELLS ENLARGED BP.



SUMMARY

- Efficient dipole damping by using enlarged beam pipe is obtained (cut off below first dipole band)
- Damping improvement on dangerous modes (Monopole TM011)
- Tuning waveguide technique shows significant improvement on damping the 2.8 GHz TE011/TM211 bandS
- High cell to cell coupling is applied K_c***=3.3%***