

RF couplers

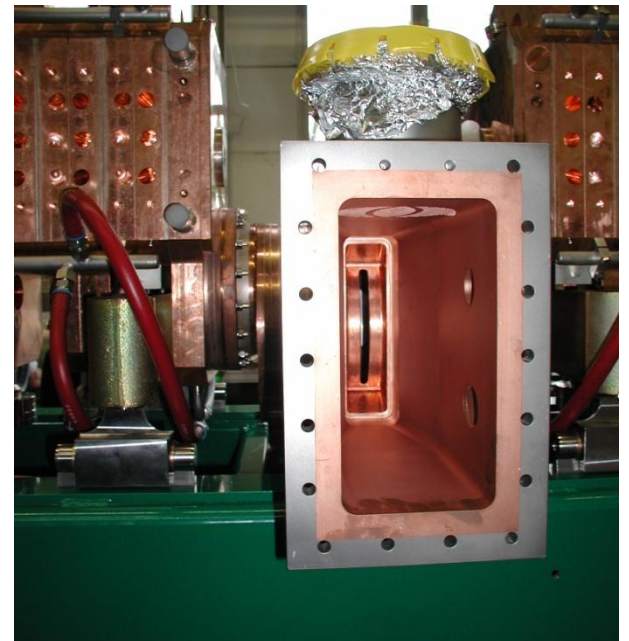
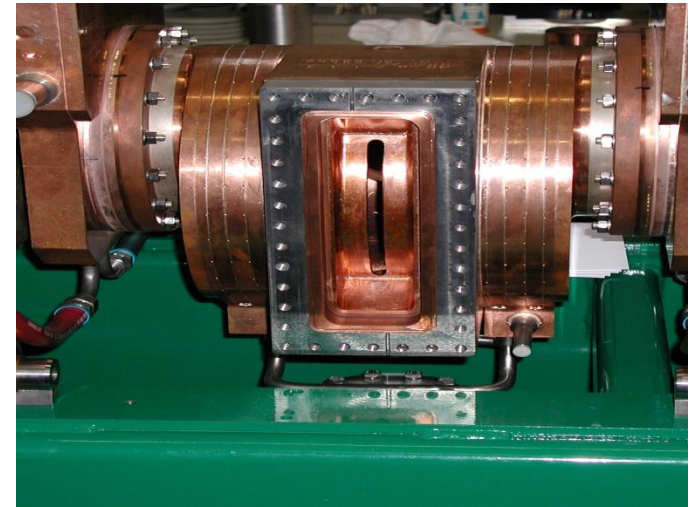
miniWorkshop on DTL Design

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Some matching methods

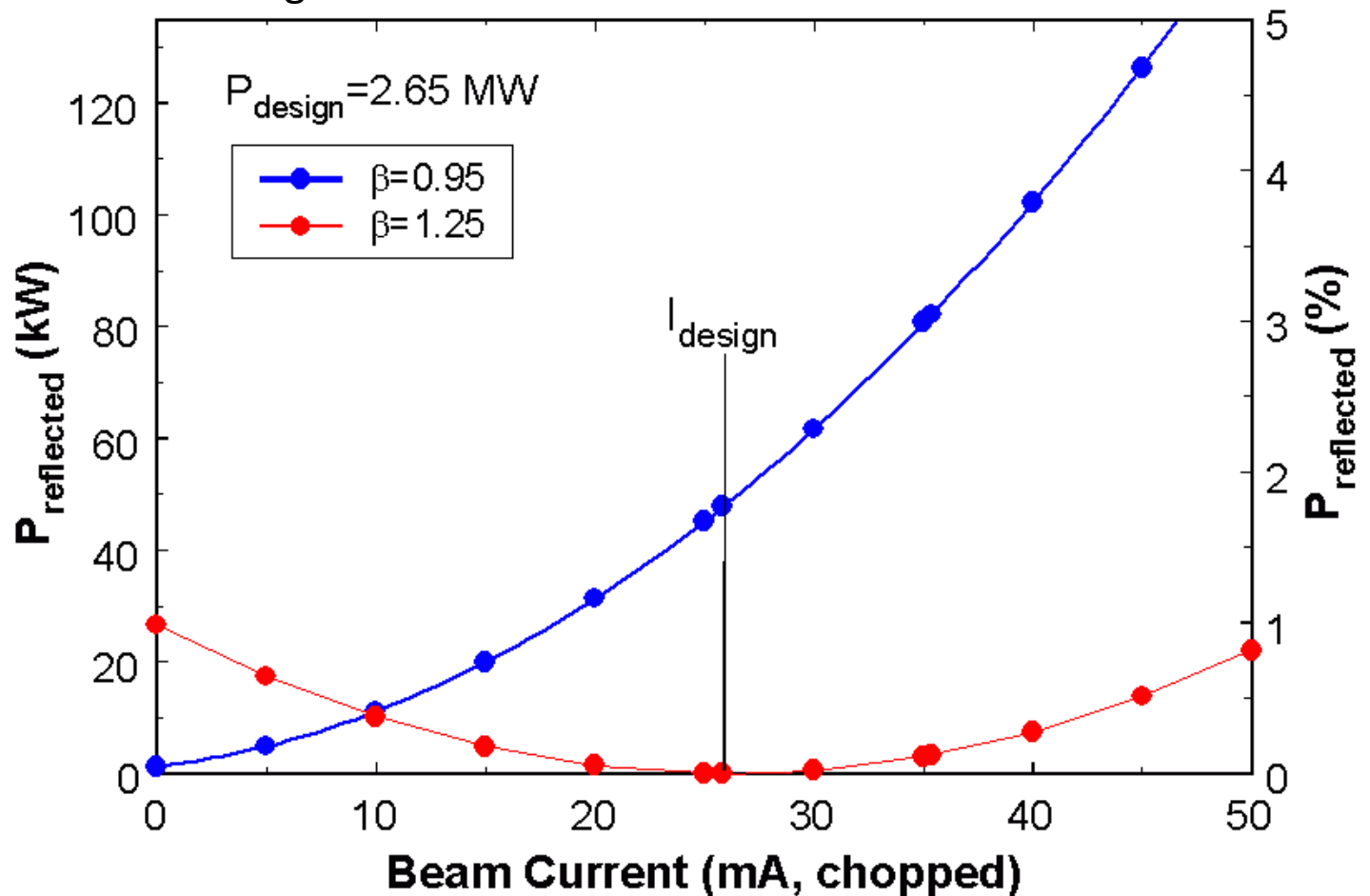
- Ridged-loaded waveguide
- T-type connection
- LINAC4 adjustable tuner

Ridged-loaded waveguide (1)



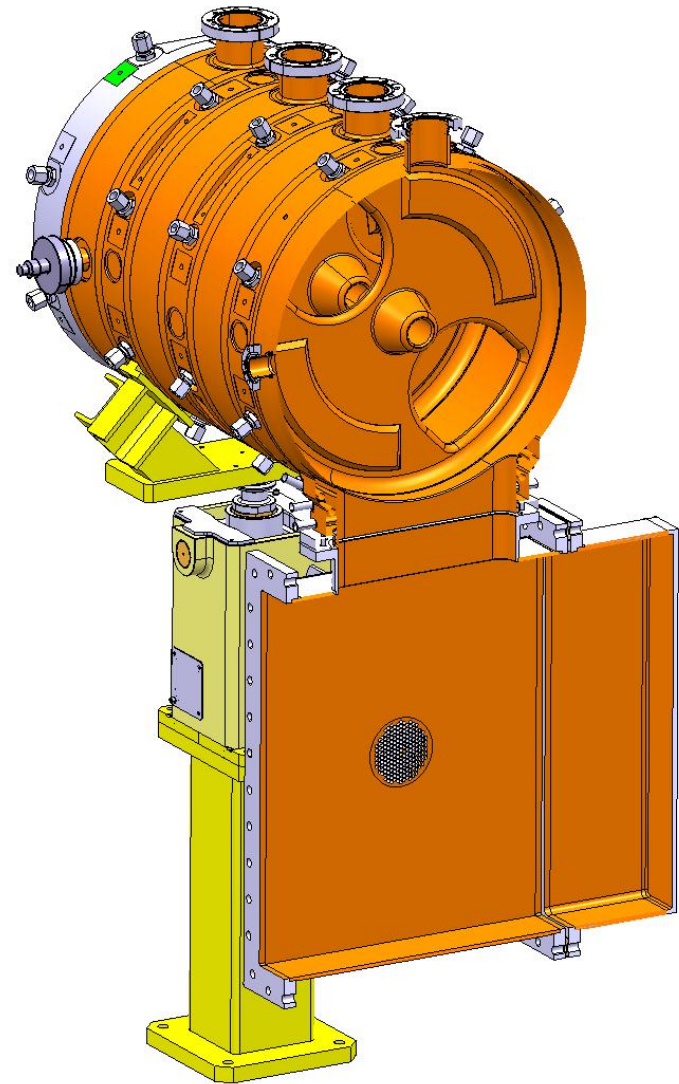
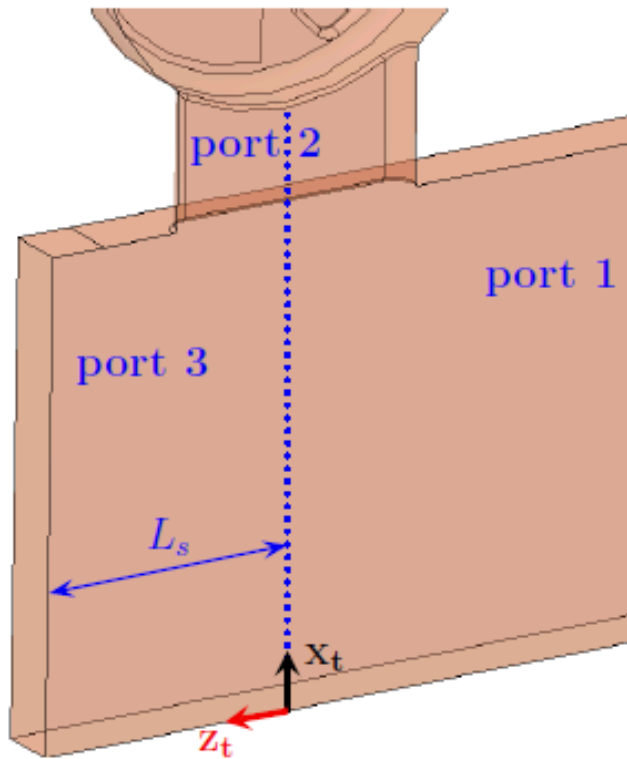
Ridged-loaded waveguide (2)

- Cavity's resonant frequency stays almost unchanged
- Delicate re-machining
- Single beam current matching



T-type Connection

Port 1: Input port
Port 2: Connection to the cavity
Port 3: short circuited at a correct distance



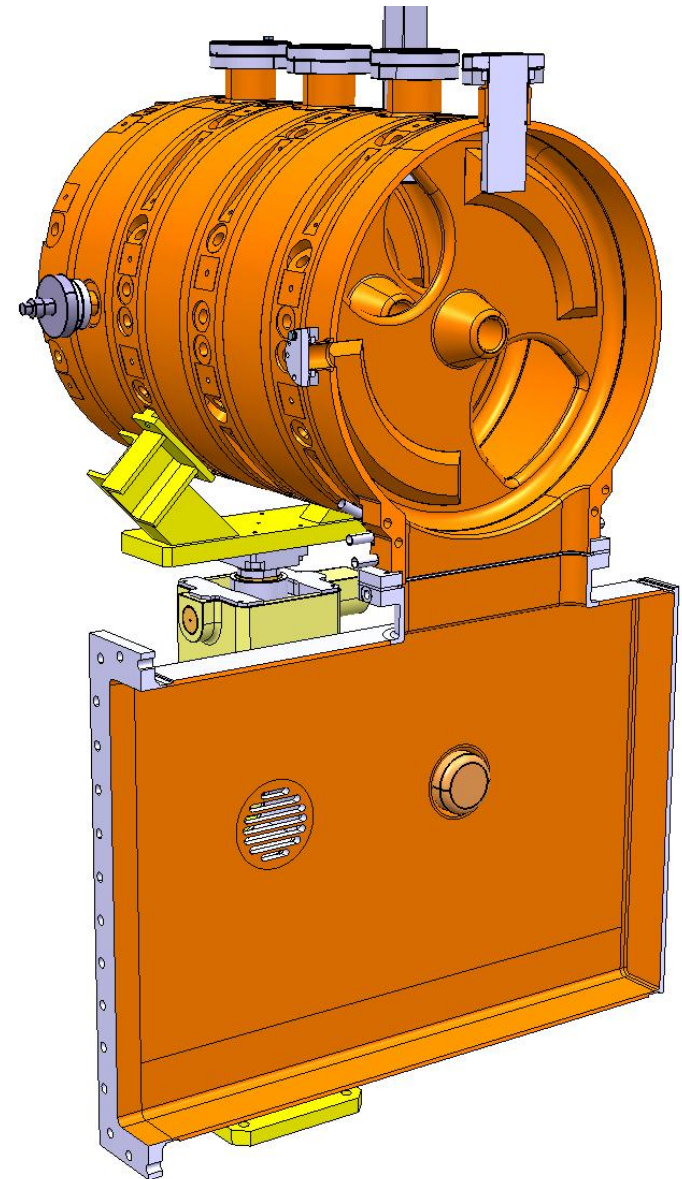
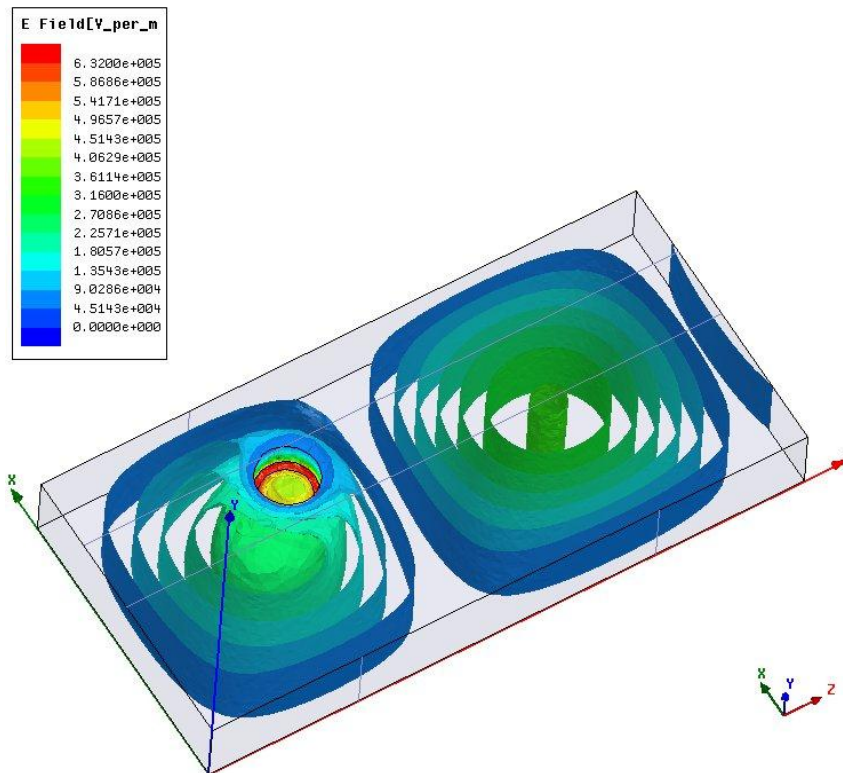
After finding the most suitable distance a fixed short circuit is machined

Adjustable Tuner

Principle:

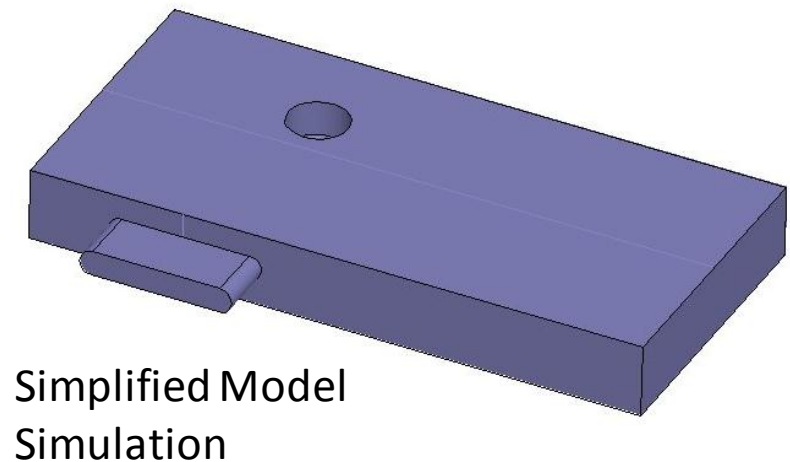
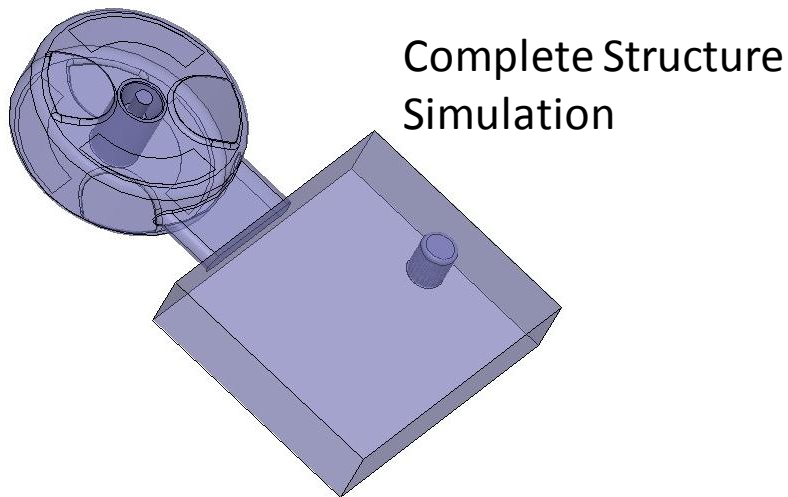
- Distance to the short is fixed
- Only tuner penetration is changed

It attracts the electromagnetic field changing the field distribution



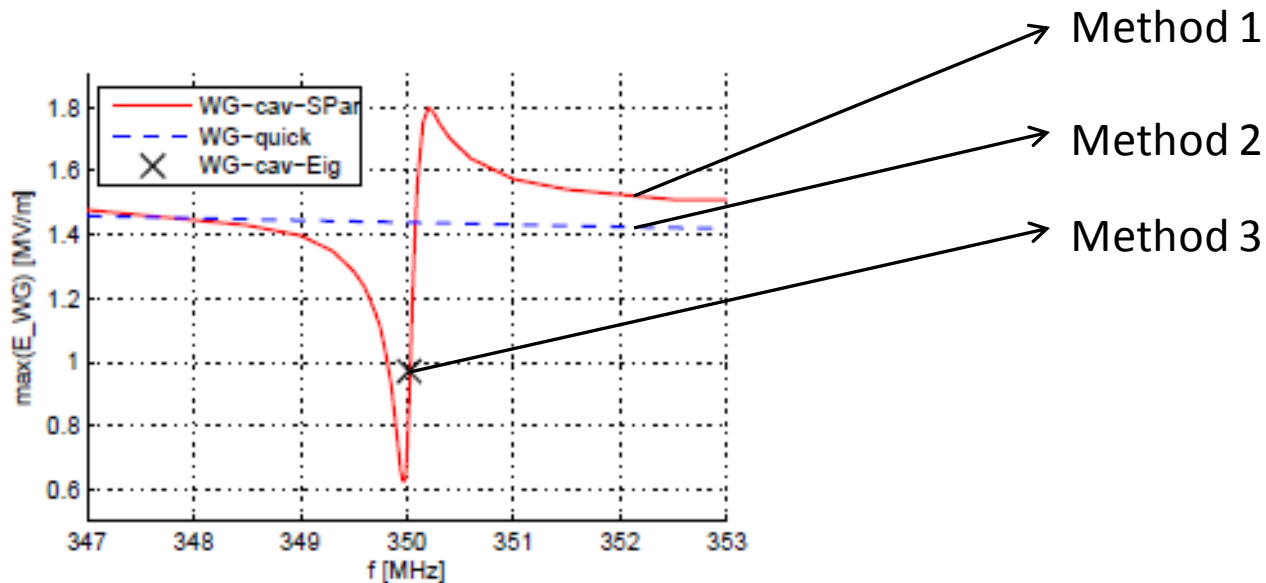
Simulation Methods

- Simulating the reflection coefficient of the whole structure
 - Resonant frequency, coupling factor and Q value
- Eigenmode simulations on the complete structure
 - For $\beta \approx 1$, peak fields and losses are a good estimation of the real case
- S Parameters calculation of the simplified structure
 - Less time cost in optimizations

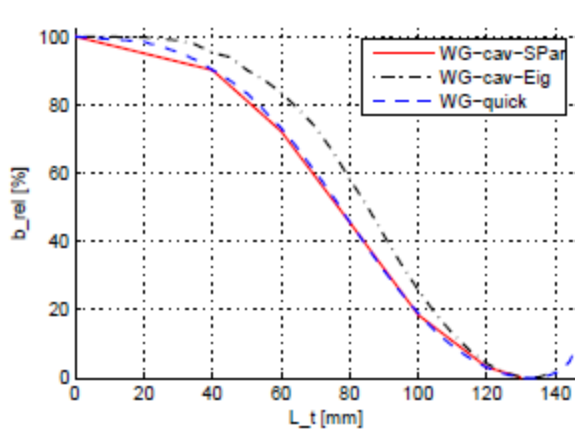


Design Procedure

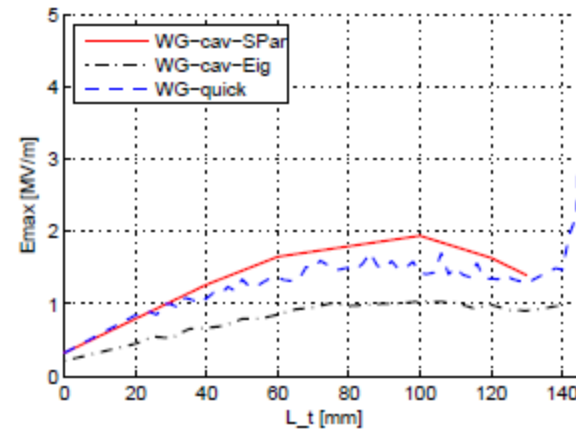
1. Finding the optimal position for the tuner monitoring the coupling factor, the losses and the maximum fields (using method 3)
2. Using method 1 and 2, the final position is completely characterized



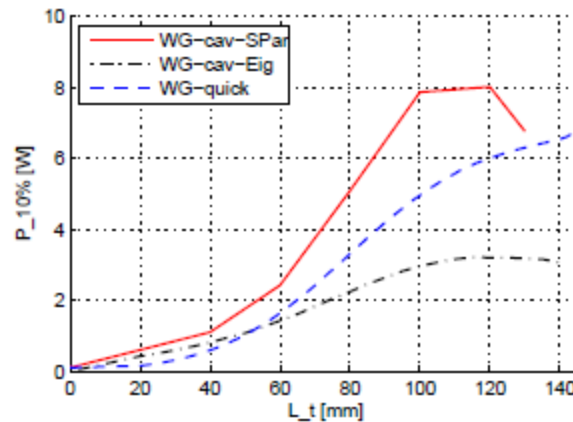
Simulation Results



Reduction of the coupling factor, as a function of the tuner penetration



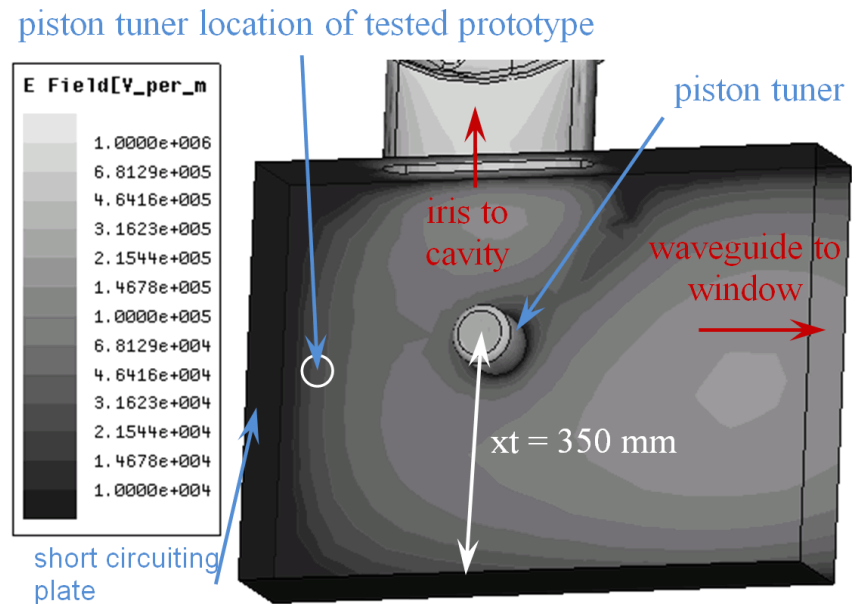
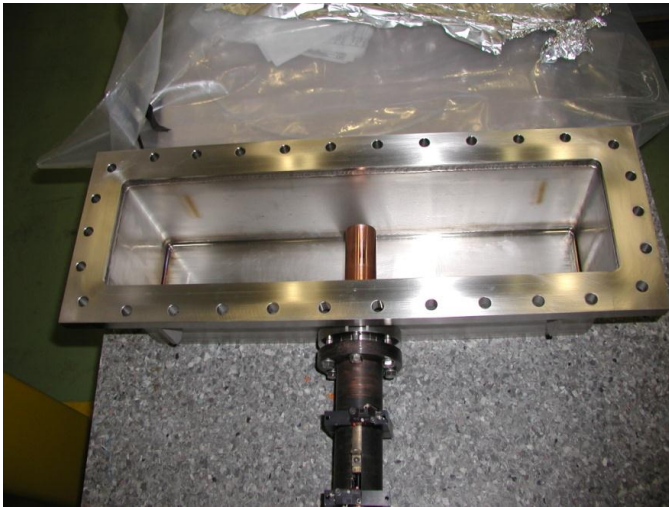
Maximum electric field (in WG coupler), as a function of the tuner penetration



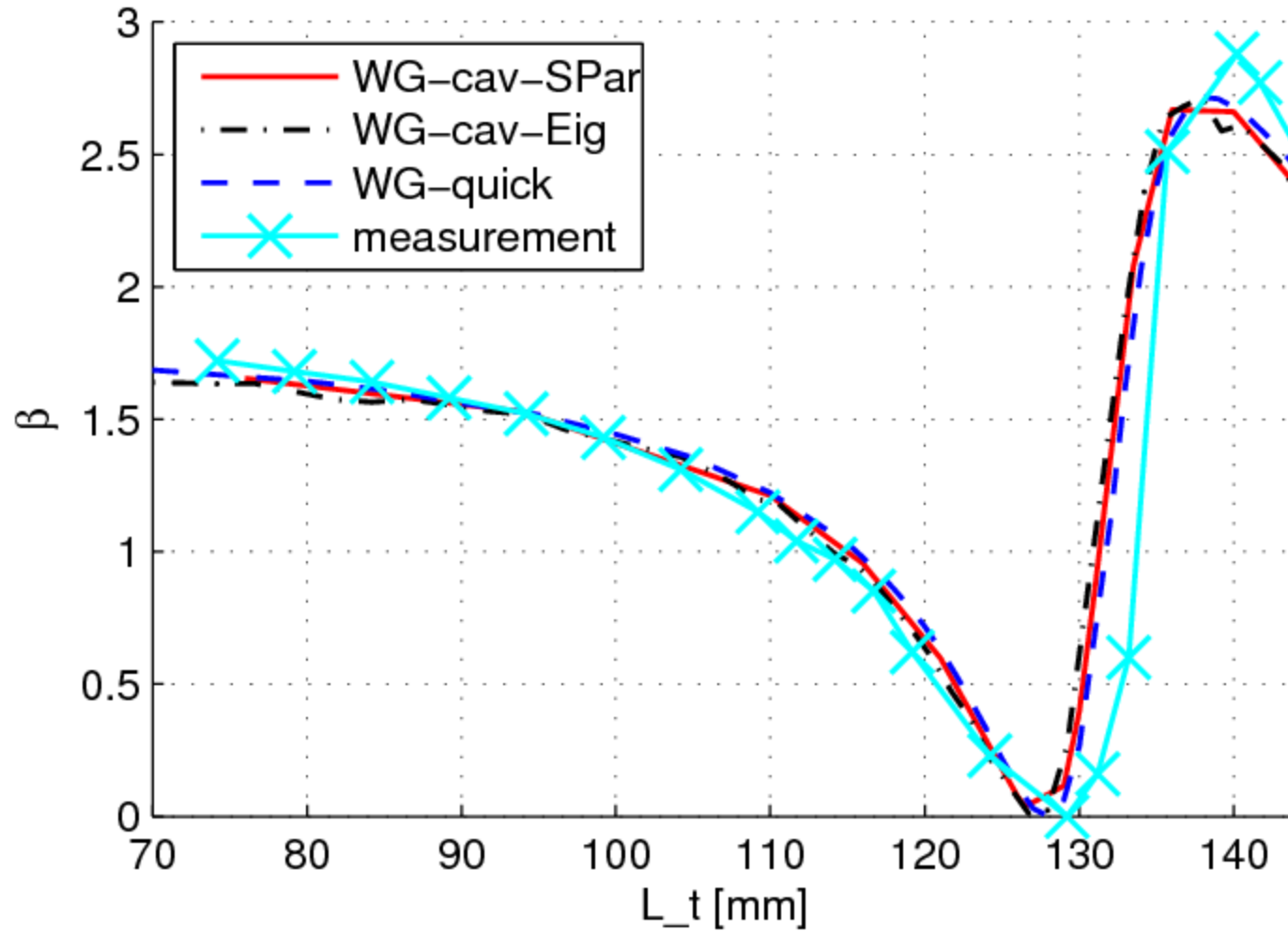
Tuner losses for a duty cycle of 10%, as a function of the tuner penetration

Tests on the prototype (1)

- Different tuner position for the test: coupling factor could be varied beyond the full range.
- Matching the cavity was very easy (reflection coefficient below -30 dB)
- During high power measurements (up to 1.1 MW), no difficulties were observed.



Tests on the prototype (2)



Conclusions

- Simple alternative to the waveguide T connection
 - Mechanically easier, it simplifies the RF matching and it allows adaptation during operation
- Three simulation methods have been used during design
- Prototype tuner has been successfully tested