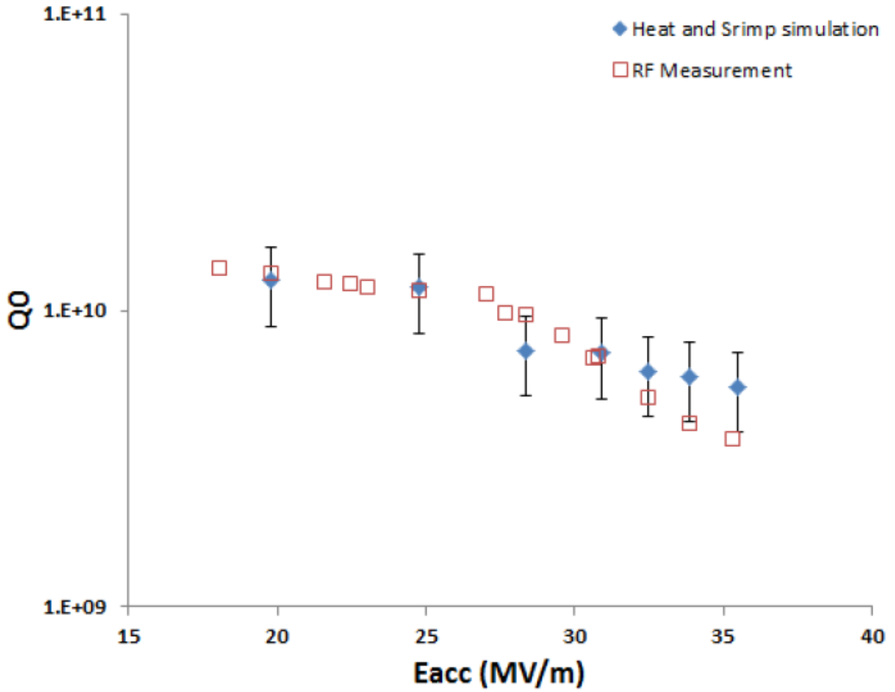
TOSCA: WP4.1 Analyses Framework & Toolbox (UHH, UR)

1 x PhD position

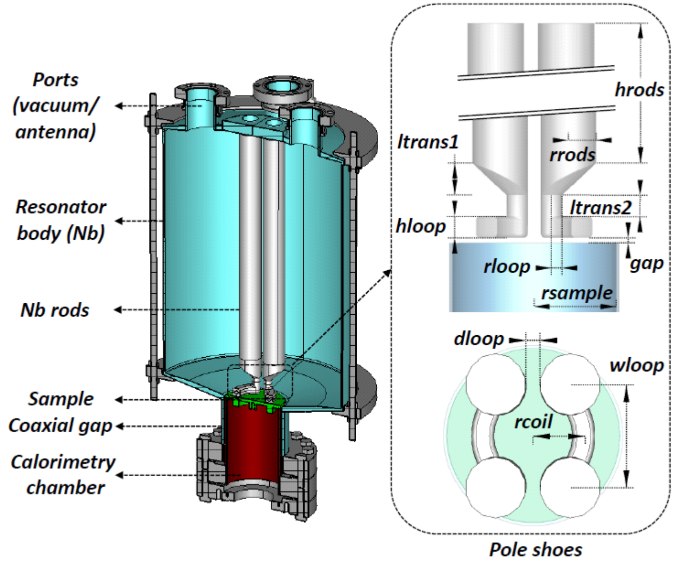
- Various measurement uncertainties exist in determining material properties such as the surface resistance of superconducting cavities or samples by obtaining Q vs. T, Q vs. E_{acc} or T vs. R_s along with the question on how to fit curves/surfaces to multiple data sets
- A general data fitting algorithm is needed to take uncertain experimental data as inputs and return resulting stochastic distributions of the surface resistance as outputs
- A novel, joint approach is needed, which allows to discuss:
  - Relations between material properties and their impact on surface resistances
  - How closely intertwined are the residual resistance and the BCS resistance?
  - How does the heating of the inner surface affect the measurement?

  incl. discussion of the χ^2 and the limitations of the fit/models
- The verification of a unified fitting model requires close cooperation with UHH
- Data from all partners would broaden the data base

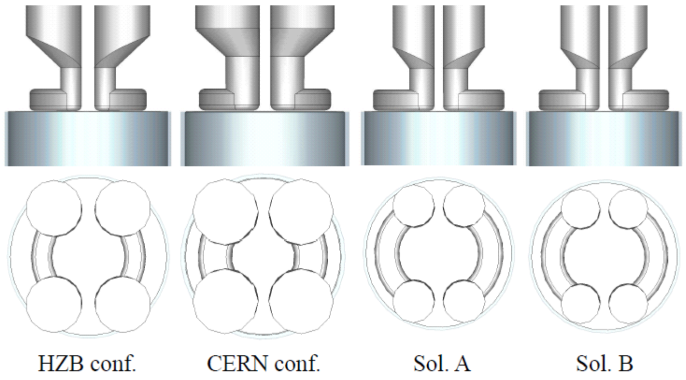


M. Ge et al Investigation of surface resistivity of SRF cavities …

TOSCA: WP4.2 Dynamic Quadrupole-Resonator Studies (UHH, HZB, CERN, UR)



Cross-sectional view of the HZB-QPR



Various pole-shoe designs of the QPR

- The already existing QPR configurations at CERN and HZB suffer from certain instabilities in functioning, which reveal within the measurement procedure of the surface resistance for the third operating mode
- This requires a deeper study in time domain of the dynamic Lorentz force detuning and the microphonic effect under electromagnetic-stress-heat coupling with uncertain geometrical and material parameters
- Input variations will be modelled by the Polynomial Chaos expansion technique embedded in the stochastic collocation method in order to provide reliable and predictable simulation results
- This analysis allows us to acquire a profound insight into the physics of QPRs and enables identifying the most influential input parameters, which affect the performance of the QPRs
- This knowledge is of high relevance for future re-designs of already existing QPRs such that the measurement accuracy will be improved while observed bias will be mitigated

1 x Post Doc position

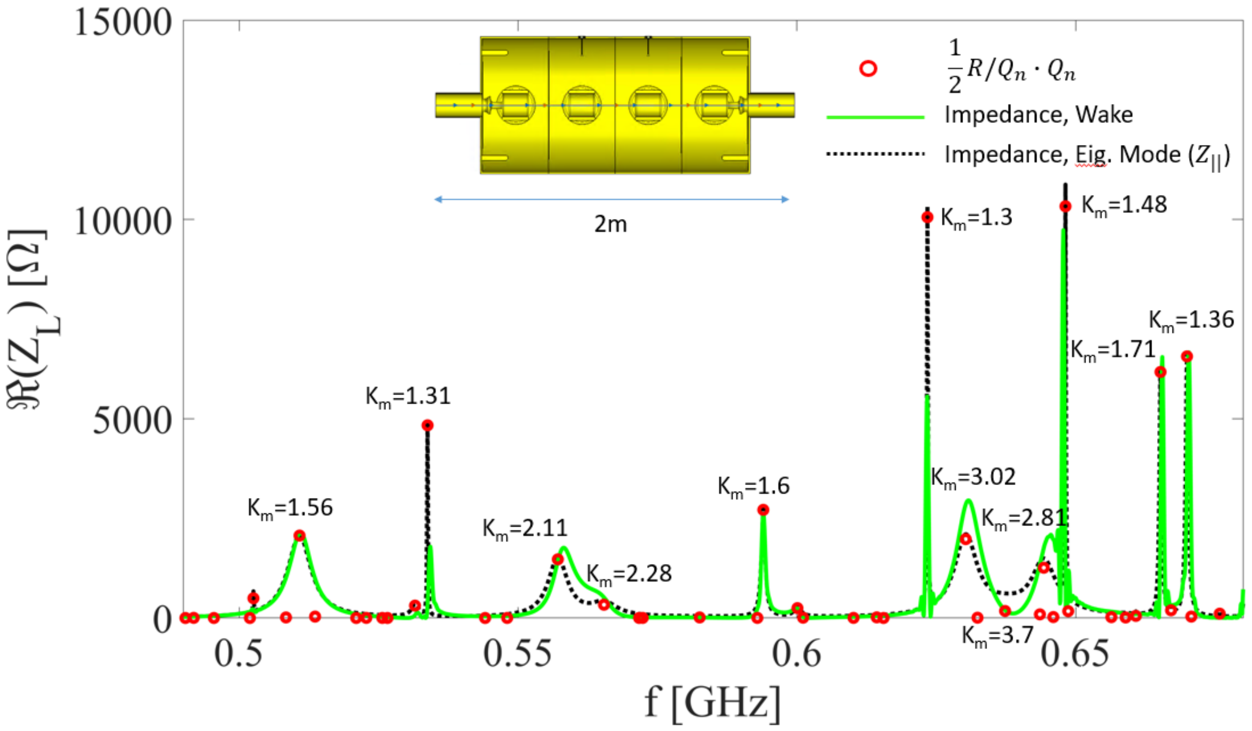
TOSCA: WP4.3 Beam impedance calculation from non-orthogonal eigenmodes in lossy structures (CERN,UR)

- Usually, the beam coupling impedance is calculated by taking the Fourier transform of the wake potential (computed in time-domain)
- The impedance could also be approximated from the superposition of the eigenmodes' impedances, where each mode is represented by a simple RLC circuit

$$Z_{\|,n}(\omega) = \frac{1}{2}\frac{R/Q_{\|,n} \cdot Q_n}{1 + jQ(\omega/\omega_n - \omega_n/\omega)}$$

- A difference is observed between the results of the two approaches for heavily damped modes in the SPS cavities (modes with very low quality factor)
- The underlying reasons for this difference have to be investigated, and a new method for the calculation of beam coupling impedance from the non-orthogonal eigenmodes in lossy structures shall be proposed being broadly applicable

1 x Post Doc position



$k_m = \|x_m^*[x_1 \ \dots x_n]\|_1$ where x_i is the i-th eigenvector