Contribution ID: **1** Type: **Oral presentation**

Higher Order Mode and Cavity Studies at the University of Rostock since HOMSC16

Wednesday, 3 October 2018 11:30 (30 minutes)

The characterization of higher order modes in chains of superconducting cavities with couplers is a challenging task that is typically accomplished using high-performance computers in combination with dedicated software packages. During the last years, an alternative approach has been developed at the University of Rostock. It is referred to as State-Space Concatenations (SSC) and allows for the determination of eigenmodes of cylindrically asymmetric cavity chains using desktop workstations instead of high-performance computers. SSC is based on model-order reduction approaches in combination with concatenation techniques. Since 2016, the scheme was used to characterize the cold string for the BESSY VSR project, which is currently in the design phase at Helmholtz-Zentrum Berlin. In addition to the pure application of SSC, the method is further developed to accurately compute the external quality factors in presence of open hollow waveguides. Furthermore, first attempts have been made to include surface losses into the formulation by using perturbation approaches.

Within the framework of CERN's future circular collider (FCC) study, a lepton collider is foreseen in order to make precise studies on the Z, W, H and ttbar particles. The Z-machine has ampere-class beam current with relatively low voltage and the ttbar has a beam current in the range of few milliamps and a total voltage of around 10.93 GV. A dedicated research is conducted to find suitable cavity designs and HOM couplers for different operating modes of FCC-ee.

Further, a normal conducting deflecting cavity is being designed to act as a beam separator for the ELBE accelerator at Helmholtz-Zentrum Dresden-Rossendorf. The basic design of the cavity is similar to the double quarter-wave crab cavity for CERN. Optimization of the cavity design led to a smaller cavity aperture, which would significantly reduce the total RF power requirement. However, it is expected that the reduction of the cavity aperture will have a strong effect on the wakefield generated by the electron bunches in the cavity. Simulations were carried out to know the wakefield effect on the cavity. The results from the study support our selection of the cavity aperture.

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Session Classification: Design of SRF Cavities and HOM Damping Schemes