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Study on HOM Damping Effects in SRF Cavities of the BESSY VSR Project

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The BESSY VSR project is a future upgrade of the 3th generation BESSY II light source. The key feature of the project is the simultaneous storage of long (ca. 15 ps) and short (ca. 1.7 ps) electron bunches under "standard" user optics. This challenging goal requires the installation
of SRF higher harmonic cavities of the fundamental 500MHz at two different frequencies.

Therefore four new SRF cavities (2x1.5 GHz and 2x1.75 GHz) are considered and currently are in the design stage. These cavities will operate in CW mode at high field level (E_acc =20 MV/m).

The combination of these factors with a high beam current (Ib =300 mA) make the cavity design a challenging goal, since stable operation must be ensured. Thus special attention must be paid to the damping of HOMs excited by the beam that may otherwise lead to coupled bunch
instabilities.
The technique for calculation of RF power propagation of HOMs excited by the circulating beam in SRF cavities will be presented. The method makes use of long range wakefield
simulations using the CST wakefield solver and an external post-processing of the port signals.

The calculations were performed for different bunch filling patterns of the BESSY VSR project.
The RF power of propagating HOMs is obtained by spectral weighting of port signals (single bunch) with bunch train spectrum. In this manner the cavity resonances excited by the periodic bunch pattern will be detected. The evaluation procedure is used for the calculation of the expected HOM powers (broadband) to be absorbed in the RF loads and of the efficiency of HOM dampers in terms of power flow balance between FPC, HOM waveguides and beampipes
supplied to the SRF cavities. Effects of geometry optimizations of the damping waveguides and the fundamental-power-coupler will be presented as well.

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