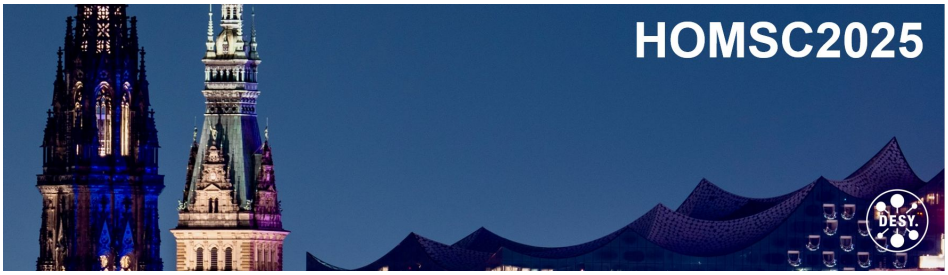

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Radio frequency design ad higher mode analysis of superconducting Quasi-Waveguide Multi-cell Resonator crab cavities for the production of picosecond X-ray pulses for Elttra 2.0

Tuesday 7 October 2025 16:30 (30 minutes)

Picosecond-long X-ray pulses of moderate intensity and high repetition rate are highly sought after by the light source community, especially for time-resolved fine spectroscope analysis of matter in the linear response regime. As part of the upgrade of the Elettra 2.0, two radio frequency deflecting cavities with slightly different frequencies will be installed to produce time-dependent orbit deflection to a few dedicated electron bunches with no effect on the regular bunches. This paper reports the radio frequency design of super-conducting deflecting crab cavities operating at 3.0 and 3.25 GHz. The design is based on a Quasi-waveguide Multicell Resonator (QMiR), firstly developed for Advanced Photon Source, which uses a trapped dipole mode for the crabbing of the bunches. QMiR has heavily loaded Higher Order Modes (HOMs) resulting in a sparse HOMs spectrum thus eliminating the need for HOMs couplers simplifying the cavity mechanical design. Results of the detailed electromagnetic analysis, including HOM damping, particle tracking through the field map, thermal and mechanical simulations are presented. The material chosen for the construction of the deflecting cavities is pure Nb. This article reports both static and dynamic thermal loads. A conceptual design for “0 boil off” cavity cool down at 4.2K or lower is presented.

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