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Radio frequency design and analysis of quasi-waveguide multicell deflecting cavities for the production of picosecond-long x-ray pulses for Elettra 2.0

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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 spectroscopy analysis of matter in the linear response regime. As part of the upgrade of the Elettra 2.0, two radio frequency deflecting cavities 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. The detailed EM analysis, including HOM damping, particle tracking through the field, thermal & mechanical simulations are presented. This article reports both static and dynamic thermal loads and the conceptual design for “0 boil off” cavity cool down at 4.2 K or lower.

Footnotes

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