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Power management, coherence and photon propagation for ESRF-EBS beamlines

Synchrotron facilities worldwide, including the ESRF, are adopting the fourth-generation storage ring, Extremely Brilliant Source (EBS). The EBS utilizes long undulators (~2 m) with short magnetic periods (< 20 mm) of in-vacuum cryogenic permanent magnets (CPUM) to enhance brilliance and coherence. However, this leads to high power deposition on beamline components, necessitating an evaluation of heat-induced deformations' impact on photon beam properties. This study introduces simulations and tools developed by the ESRF Mechanical Engineering Group to tackle EBS beamline challenges.

OASYS (Orange Synchrotron Suite), an open-source and user-friendly platform introduced in 2013, facilitates x-ray optics modeling [1]. Power transport calculations in OASYS combine XOPPY and ray-tracing algorithms for various optical components. Finite element simulations in ANSYS model heat-load-induced deformations, which are then integrated into OASYS using a dedicated widget. Photon transport simulations employing SHADOWOUI or WOFRY analyze the effects on beam properties. For example to investigate heat-load effects on crystal and multilayer monochromators.

ESRF has developed customized, open-source OASYS widgets (some are included in the official release). These widgets cater to EBS beamlines, allowing fast power transport calculations for tasks such as obtaining power density peaks based on undulator gaps and modeling beamline attenuators.

[1] https://oasys-kit.github.io/

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no

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