Detailed X-ray Brightness Calculations in the Sirepo GUI for SRW

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The brightness and coherence of modern light sources is pushing the limits of X-ray beamline design. The open source Synchrotron Radiation Workshop (SRW) provides physical optics based algorithms for correctly simulating such beamlines [1,2]. We present new SRW capabilities to calculate source brightness and related quantites for undulators, wigglers and dipoles. The Sirepo cloud computing framework [3] includes a browser-based GUI for SRW [4,5]. In addition to high-accuracy wavefront simulations, the Sirepo interface now supports analytical calculations for flux, photon beam size, divergence and photon brightness. An example of these new capabilities is presented in Figure 1. We have included the effects of detuning from resonance and electron beam energy spread, which can be important in realistic operational conditions. We compare our results to features previously available in the Igor Pro interface to SRW, to analytical formulae available in the literature, and also to the results of simulated wavefront propagation. Differences between the various approaches are explained in detail, so that all the assumptions, conventions and ranges of validity can be better understood.
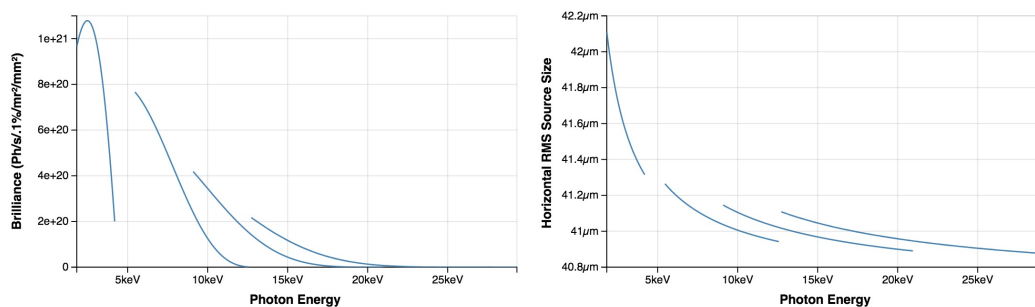
Calculation of brightness and photon source sizes from undulator radiation in Sirepo. The electron beam source represents the design values for the NSLS-II low-beta section with a horizontal emittance of 0.9 nm and b=1.84m. The undulator has a period of 20 mm, a length of 3m, and a maximum K value of 1.828. An electron beam current of 500mA has been assumed.

References

[1] O. Chubar and P. Elleaume, Proc. of EPAC-98, pp. 1177-1179 (1998).

[2] O. Chubar et al., this conference.

[3] The Sirepo source code repository,https://github.com/radiasoft/sirepo

[4] The public Sirepo/SRW server,https://sirepo.com//srw

[5] M. Rakitin, O. Chubar, P. Moeller, R. Nagler, D. Bruhwiler, Proc. Adv. Comp. Meth. X-Ray Optics IV, 103880R (2017).