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Coupling of codes for modeling high-energy-density conditions in fourth generation light sources

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As previously described*, high-intensity beams of ultra-bright light sources present new machine protection concerns by creating high-energy-density (HED) conditions in beam-intercepting components. Simulating these HED conditions required us to develop a method for coupling three codes for particle dynamics (elegant), particle-matter interaction (MARS/FLUKA), and hydrodynamics (FLASH). This paper discusses the recent advancements made toward this effort including the use of phase and temperature dependent thermal properties such as thermal conductivity and specific heat, transition from MARS to FLUKA, and improved liquid phase dynamics. For benchmarking purposes we compare simulation results with experimental data collected during the final run of the Advanced Photon Source (APS) ring as well as observations of collimator surface damage following the first user run of the upgraded machine. This methodology is also used to make predictions of collimator damage in future APS-Upgrade (APS-U) runs and to examine locations where synchrotron radiation may lead to HED conditions.

Footnotes

- J. Dooling et al., PRAB, vol. 25, p. 043 001, 2022. doi:10.1103/PhysRevAccelBeams.25.043001

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