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Secondary bremsstrahlung dose rates from glancing-incidence targets

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Several collaborative access teams at the APS are planning to use a vertically or horizontally reflecting mirror as the first optical element in the insertion device beamlines. The scattering of the bremsstrahlung from the glancing-incidence mirrors is significantly different than that from the normal-incidence targets. The Electron Gamma Shower program (EGS4) was used to calculate the angular distribution of the scattered secondary bremsstrahlung from a copper and a silicon glancing-incidence mirror. These calculations were repeated for several glancing incidences of the beam between 0.150° to 1.50°. Pair production, positron annihilation at rest and in flight, Moliere multiple scattering, Moller and Bhabha scattering, delta ray production, Compton scattering, photoelectric effect and the continuous energy loss by Bethe-Bloch formalism were the processes simulated in this calculation. The dose at one meter away from the mirror, due to the scattered secondary bremsstrahlung, was calculated from the energy deposited in the standard ICRU tissue placed at that location. Since the EGS4 result is expressed as the dose per photon, the dose rate was obtained by multiplying the dose per photon by the total number of photons produced in unit time in the insertion device vacuum chamber. The dose rate results and their implication on the design of the first optical enclosures are presented in this paper.

This work is supported by the U.S. Department of Energy, BES-Materials Sciences, under contract No. W-31-109-ENG-38.