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An analysis of the breakdown of the relativistic factorized-form expression for Compton scattering doubly differential cross sections L.A. LAJOHN, R.H. PRATT, University of Pittsburgh — The factorizable form of the relativistic impulse approximation (RIA) expression for Compton scattering doubly differential cross sections (DDCS), an expression that is used to obtain the Compton profile from DDCS, and then the bound electron momentum distribution, loses its validity for K-shell ionization of moderate to high nuclear charge Z atoms. This factorizable expression again has the nonrelativistic form DDCS=KJ, where K is a kinematic factor and J represents the Compton profile; it can overestimate the Compton peak magnitude by as much as 50% for K-shell ionization as Z becomes large. In this study we have evaluated the error due to using this factorizable RIA expression for DDCS, as a function of Z, scattering angle θ, and incident photon energy ω_i. We provide an explanation for why this approximation breaks down as J becomes broader with increasing Z. We show, and explain why, the magnitude of this error is proportional to Z^2 for all ω_i and θ for low to moderate Z, and still for all Z when θ is between 0° and at least 35° if $\omega_i < 1$ MeV. These results provide useful information for when one can use this factorizable RIA expression for DDCS and also how the expression can be corrected when it fails.

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