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THE INTEGRATION OF IMPROVED MONTE CARLO COMPTON SCATTERING ALGORITHMS INTO THE INTEGRATED TIGER SERIES

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The Integrated TIGER Series (ITS) is a software package that solves coupled electron-photon transport problems. ITS performs analog photon tracking for energies between 1 keV and 1 GeV. Unlike its deterministic counterpart, the Monte Carlo calculations of ITS do not require a memory-intensive meshing of phase space; however, its solutions carry statistical variations. Reducing these variations is heavily dependent on runtime. Monte Carlo simulations must therefore be both physically accurate and computationally efficient. Compton scattering is the dominant photon interaction above 100 keV and below 5-10 MeV, with higher cutoffs occurring in lighter atoms. In its current model of Compton scattering, ITS corrects the differential Klein-Nishina cross sections (which assumes a stationary, free electron) with the incoherent scattering function, a function dependent on both the momentum transfer and the atomic number of the scattering medium. While this technique accounts for binding effects on the scattering angle, it excludes the Doppler broadening the Compton line undergoes because of the momentum distribution in each bound state. To correct for these effects, Ribbefor's relativistic impulse approximation (IA) will be employed to create scattering cross section differential in both energy and angle for each element. Using the parameterizations suggested by Brusa et al., scattered photon energies and angle can be accurately sampled at a high efficiency with minimal physical data. Two-body kinematics then dictates the electron's scattered direction and energy. Finally, the atomic ionization is relaxed via Auger emission or fluorescence. Future work will extend these improvements in incoherent scattering to compounds and to adjoint calculations.

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