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S-Matrix Calculations of Compton Scattering from Bound Electrons

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Compton scattering is one of the fundamental processes in light–matter interaction in which an incoming photon is inelastically scattered off an electron. In the energy range from a few keV to several MeV, Compton scattering makes a significant contribution to the light-atom coupling. It therefore has a wide range of important applications across various fields of modern science, from radiotherapy in medicine to X-ray polarimetry. The latter is of particular interest to the SPARC collaboration, where the development of Compton polarimeters is a key objective. In this context, we present theoretical studies of Compton scattering from bound electrons, with special emphasis on polarization effects. In particular, we discuss calculations within the framework of S-matrix theory and independent particle approximation (IPA). To perform these calculations, a program was developed to numerically solve the radial Dirac equation efficiently and accurately for a bound electron in the central potential of its nucleus, which is approximated by a Coulomb potential. Based on this, detailed calculations of the doubly differential cross section (DDCS) and the polarization behavior of the outgoing photon can be carried out across a wide range of energies and for arbitrary polarization states of the incoming photon beam.

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