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Nucleon Polarizabilities from Few-Nucleon Systems

An Update Low-energy Compton scattering probes the nucleon's two-photon response to electric and magnetic fields. It tests the symmetries and strengths of the interactions between constituents, and with photons. For convenience, this energy-dependent information is often compressed into the two scalar dipole polarizabilities α_{E1} and β_{M1} at zero photon energy. In addition, spin polarizabilities are particularly interesting since they parametrize the stiffness of the spin in external electro-magnetic fields (nucleonic Faraday effect) and probe the spin-dependent pion-nucleon interaction. Combined with emerging lattice QCD computations, polarizabilities provide stringent tests of chiral symmetry and hadron structure. Compton scattering in light nuclei also tests the chiral symmetry of the charged pion-exchange contribution to nuclear binding. %This talk focuses on the first-ever description of 4He. It uses the transition-density formalism, an efficient and general method for calculating interactions of external probes with light nuclei. One- and two-body transition densities that encode the nuclear structure of the target are evaluated once and stored. They are then convoluted with an interaction kernel to produce observables. The same densities can be used with different kernels for any reaction in which a probe interacts perturbatively with the target. The method exploits factorization between nuclear structure and interaction kernel in Chiral EFT at energies $\sim m_\pi$. It takes full advantage of the numerical power of modern few-nucleon methods, is markedly more computationally efficient and applicable to a wide array of nuclei and reactions. %The 4He Compton results converge well order-by-order and are in good agreement with the data between 50 and 90 MeV, with the expected residual dependence on the NN and 3N potential. However, data appear noisier than the reported experimental uncertainties allow for, so an extraction of the polarizabilities is not attempted.

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