Polarization effects in elastic proton-electron scattering

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Résumé

The experimental observables for the elastic reaction induced by protons on electrons are calculated in the Born approximation assuming one photon exchange. The elastic electron proton scattering has been widely studied. The scattering of proton on electrons at rest is more complicated, as one cannot neglect the electron mass and the transferred momentum is very small, even at incident energies in the GeV region. Liquid hydrogen targets are considered as proton targets, but any reaction on such targets involves also reactions with atomic electrons, which can be considered at rest. The interest in inverse kinematics (proton projectile on electron target) is related to two possible applications: - beam polarimeters, for high energy polarized proton (antiprotons) - polarized antiprotons beams. The differential cross section and polarization observables have been derived assuming one photon exchange and numerical estimations are given for spin correlation coefficients, polarization transfer and depolarization coefficients, in a wide kinematical range. Our results confirm that it is not possible to obtain sizable polarization of the antiproton beam in an experimental set up where antiprotons and electrons collide with small relative velocities. On the other hand, the polarization of the scattered proton has large values at high energies of the proton beam (in the GeV range). Our suggestion is to consider an experimental set up where high energy protons collide with polarized electron target at rest.

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