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Measurement of Polarization Transfer in Møller Scattering

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Even though Møller scattering has been a subject of several precise experiments, studies of the final spin state in Møller scattering of polarized electron beams offer a unique tool for testing the fundamnetal predictions of relativistic quantum mechanics. The aim of this work was to measure the polarization transfer in Møller scattering (the ratio of the transverse polarization vector component length of the electron in the final state to the incoming-beam polarization); it is, to our knowledge, the first such measurement.

A dedicated Mott polarimeter was designed and constructed. In addition to the standard polarimeter layout, it was equipped with a tagging detector, which was used for a coincidence trigger allowing to record Møller scattering events. The reduction of background was achieved by an offline subtraction of data collected without the target in the polarimeter, as well as by event selections regarding electron energy and timing of the signals from both recorded electrons.

The beam polarization, as well as the mean polarization of the electrons in the final state of symmetric Møller scattering, were measured. The final results were calculated assuming an analyzing power value obtained from a dedicated Monte Carlo simulation. The polarization transfer was measured for two incident-beam polarization orientations with respect to the Møller scattering plane. The results were found to be in agreement with the predictions of relativistic quantum mechanics.

Primary authors: Mr DRAGOWSKI, Michal (University of Warsaw, Faculty of Physics); Dr ADAMUS, Marek (National Centre for Nuclear Research); Prof. CIBOROWSKI, Jacek (University of Warsaw, Faculty of Physics); Dr DEHN, Marco (Johannes Gutenberg-Universitat Mainz, Institut fur Kernphysik); Prof. ENDERS, Joachim (Technische Universitat Darmstadt, Institut fur Kernphysik); Dr FRITZSCHE, Yuliya (Technische Universitat Darmstadt, Institut fur Kernphysik); Dr TIOUKINE, Valery (Johannes Gutenberg-Universitat Mainz, Institut fur Kernphysik)

Presenter: Mr DRAGOWSKI, Michal (University of Warsaw, Faculty of Physics)

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