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Studies of relativistic effects in the deuteron breakup reaction

One of the long-standing question facing nuclear physics is understanding the forces acting between nucleons. In a medium energy range the properties of such system are successfully modeled with the use if realistic potentials, supplemented with the three-nucleon force (3NF) models, Coulomb force etc. In recent years the more fundamental approach based on chiral effective field theory become a hot topic in nuclear physics. Few-nucleon systems are ideal laboratories for testing this theoretical approaches. Experimental investigations of the deuteron breakup reaction (d+p⟶p+p+n), the simplest 3-body system, support very strongly existence of 3NF effects [1, 2] and the Coulomb interaction between protons [3].
At higher energies, around 200 MeV/A, also relativistic effects start play important role in the system dynamics [4]. The relativistic treatment of the three-nucleon system has been recently developed [5, 6]. Those effects can significantly increase or decrease, depending on the phase-space region, the breakup cross section. While at 65 MeV/A the influence of relativistic effects are rather moderate, at 200 MeV/A they can change the cross section even by a factor of 2. The existing database for the breakup reactions at higher energies is very scarce [7, 8]. With such limited database, it is not possible to draw more general conclusions concerning the role of the relativistic effects and their mutual interplay with other aspects of three-body dynamics.
In order to test the predictions the new experiment at 200 MeV proton beam has been performed at the Cyclotron Center Bronowice in Kraków (Poland). It focuses on selected configurations of the breakup protons, where only the relativistic effects play important role, as suggested by the theoretical findings [5]. The data have been collected with the use of the KRATTA [9] detectors and solid CD2 (deuterated polyethylene) target. Results of this measurement will allow one to verify the state-of-the-art theoretical calculations for deuteron breakup process. In this contribution we would like to present the first results of our experiment.

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