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Extensive high precision studies of proton deuteron breakup reactions at COSY

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The rich kinematical region in proton deuteron breakup reactions at low to intermediate energy offers a versatile laboratory for the chiral effective field theory, the modern theory of nuclear forces. Presently the spin structure of the three nucleon continuum exhibit disparate results when comparing experimental data to theoretical predictions based on two-nucleon potentials either with or without three nucleon interactions. The inclusion of three-nucleon forces in the calculations does not consistently improve the agreement between data and theory. Precise measurements of most of the spin observables over large areas of phase space would give necessary constraints for advancing the understanding of the strong interaction in this non-perturbative regime. To this aim we plan an experiment at the COSY cooler synchrotron and storage ring, measuring proton deuteron breakup reactions at proton beam energies from 30 to 50 MeV. This is an ideal energy range for testing the predictive power of chiral effective field theory and for providing a data base for the characterization of the non-vanishing contributions from the chiral three-nucleon force appearing at third and fourth order. Furthermore there are only few and limited
polarization data available in this kinematical region.

The requirement for high precision measurements is met by the access to the newly installed PAX low-beta target section at COSY. The setup comprises an atomic beam source, a breit-rabi polarimeter and the design of a new multipurpose detection system, consisting of double sided silicon strip sensors in a barrel-type arrangement.
The five-dimensional phase space will be extensively explored both in the planning stage and for the final analysis of the experiment, using pre-calculated theoretical grids and the so called sampling method developed specifically for the investigation of three-particle final states. A close collaboration with the theory groups of IKP in Jülich and at Bochum and Bonn Universities is a precondition and has been initiated.

A brief overview of the field will be given. The PAX experimental setup will be described and theoretical predictions with sensitivity studies for specific spin observables will be presented.

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