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Hadron Physics using Polarized Antiprotons

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The PAX collaboration has recently proposed to use an internal polarized hydrogen storage cell gas target in the Antiproton Decelerator ring (AD) of CERN to determine for the first time the two total spin–dependent pbar-p cross sections σ1 and σ2 at antiproton beam energies in the range from 50 to 450 MeV [1]. The data to be obtained are of interest in itself for the general theory of pbar-p interactions and will provide a first experimental characterization of the spin- dependence of the nucleon-anti-nucleon potential. Furthermore, the data are required to define the optimum parameters of a dedicated Antiproton Polarizer Ring (APR), that shall be used to feed a double–polarized asymmetric pbarp collider with polarized antiprotons. Such a machine has been recently proposed by the PAX collaboration for the new Facility for Antiproton and Ion Research (FAIR) at GSI in Darmstadt, Germany [2].
The availability of an intense beam of polarized antiprotons will provide access to a wealth of single– and double–spin observables, thereby opening a new window to QCD spin physics at FAIR. A recent measurement at COSY revealed that ep spin–flip interactions provide insufficiently small cross sections to depolarize a stored proton beam [3]. Therefore, this measurement rules out the use of polarized positrons to polarize an antiproton beam by e+pbar spin–flip interactions. The approach favored by PAX to provide a beam of polarized antiprotons is based on spin filtering, using an internal polarized hydrogen gas target — a method known to work for stored protons [4]. We are aiming to improve intensities of polarized antiproton beams by at least ten orders in magnitude compared to what has been achieved hitherto. In a first step, the equipment necessary for the experiments at AD will be commissioned and tested at COSY, which implies to carry out spin-filtering measurements with stored protons [4].
Provided antiproton beams with a polarization around 20% can be obtained with a dedicated APR, the High Energy Storage Ring for antiprotons at FAIR could be converted into a double–polarized asymmetric pbar-p collider by implementation of an additional COSY–like ring. In this setup, antiprotons of 3.5 GeV/c would collide with protons of 15 GeV/c at c.m. energies of sqrt(s)≈sqrt(200) GeV, with a luminosity in excess of 10^31 cm^−2s^−1. The PAX physics program proposed for FAIR [2] has been highly rated by various committees [5]. It includes foremost a first direct measurement of the transversity distribution of the valence quarks in the proton, and a first measurement of the moduli and the relative phase of the time–like electric and magnetic form factors GE,M of the proton.
The talk will give an overview about the status of the project.
References:
[1] AD Proposal SPSC-P-337, Measurement of the Spin-Dependence of the pbar-p Interaction at the AD-Ring; PAX Collaboration, spokespersons: P. Lenisa (Ferrara University, Italy) and F. Rathmann (Forschungszentrum Jülich, Germany), available from http://www.fz-juelich.de/ikp/pax.
[2] Technical Technical Proposal for Antiproton–Proton Scattering Experiments with Polarization, PAX Collaboration, spokespersons: P. Lenisa (Ferrara University, Italy) and F. Rathmann (Forschungszentrum Jülich, Germany), available from http://lanl.arxiv.org/abs/hep-ex/0505054. An update of the proposal is available from the PAX website at http://www.fz-juelich.de/ikp/pax.
[3] D. Oellers et al., Phys. Lett. B 674, 269 (2009).
[4] F. Rathmann et al., Phys. Rev. Lett. 71, 1379 (1993).
[5] COSY Proposal 199, Spin-filtering Studies at COSY, PAX Collaboration, spokespersons: M. Nekipelov, and Chr. Weidemann (both Forschungszentrum Jülich, Germany), available from http://www.fz- juelich.de/ikp/pax.
[6] Reports from different committees can be found in the News section of the PAX website at http://www.fz-

juelich.de/ikp/pax.

Primary author: Prof. RATHMANN, Frank (Institut für Kernphysik, Forschungszentrum Jülich, 52425 Jülich, Germany)

Co-author: FOR THE PAX COLLABORATION

Presenter: Prof. RATHMANN, F.

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