# Measurement of the Polarization of Hydrogen Atoms Stored in the HERMES Target Cell ◇

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In 1995 in a preliminary installation the HERMES target polarimeter, following the Breit Rabi scheme, compare refs. [1–5], the HERMES atomic beam source (ABS) [6] and the HERMES target arrangement [7] had been operated as an integer apparatus for the first time.

The flux of the atomic beam, injected into the target cell, has been determined to 6.2 $10^{16}$ polarized hydrogen atoms per second. At a target cell temperature of 150K and with a longitudinal magnetic guiding field of 3870 Gauss we measured for the hydrogen atoms in the target cell the polarization of the protons as 93% and -93% respectively, depending on the high frequency transitions in the atomic beam source.

These data of operation satisfy the conditions for the use of this target in the 1996 runs of HERMES, that is the measurement of deep inelastic scattering of 27 GeV polarized positrons from polarized hydrogen. From measurements with these longitudinally polarized particles semiinclusive data of the spin structure function of the proton are expected.

The preliminary installation in the Jade hall was needed to avoid interference with the 1995 data taking of HERMES from the polarized helium 3 target. In these measurements precise data for the determination of the spin structure function $g_1(x)$ of the neutron have been taken.

In January 1996 the polarized hydrogen target arrangement has been moved to the HERMES target site position in the East hall of the HERA ring, start of data taking is expected with availability of the HERA beam in june 1996.

The work of the Munich group concentrated on the installation of the Breit Rabi polarimeter, on studies of the understanding of this polarimeter [5] and a number of technical improvements [4] and [8].

The RF transitions have been modified: the gradient coils are new, the feed back systems for the control of the RF amplitudes are complete now. Parts of the quadrupole mass spectrometer for single ion counting of the detected particles have been replaced. For the ion detection channeltrons are used which provide better signals. In combination with the chopper system, this enhances the redundancy in the detection of beam events. The vacuum system has been improved in several respects.

A computer controlled cycle organizes data taking swiching between four different adiabatically working RF transitions, which provide interchange of the substate population of each of the hyperfine states, which is focussed into the detector, with the population of each of the hfs states, which is defocussed by the Stern Gerlach sextupole magnet system and thus not detected [9]. To correct the chopped signals against background, the cycle includes data taking with the quadrupole mass spectrometer set also on the detection of ${H_2}^+$, $H_2O^+$ etc. For the calibration of the efficiencies of the adiabatic RF transitions (assumed as 1.00 in the present, preliminary evaluation, otherwise the target polarisations obtained are even higher) a device to provide definite polarization of the beam, injected into the polarimeter, has been designed: A setup with an additional moveable sextupole magnet of permanent material [10], acting as a magnet, which rebuilds the electron polarization [4], is under construction. Also an additional quadrupole mass analyzer system has been constructed and is now installed in a location appropriate to determine from a chopped probe beam the degree of dissoziation of the atoms in the target cell.

Modelling most of the processes relevant for the analysis of earlier experiments on the test bench [5] provided rather complete understanding of the relative contributions of the various depolarizing processes, comp. [11–14]. Accordingly, under HERMES working conditions weak depolarization in the 1.5% range will result from spin exchange collisions. Predictions of weak depolarisations due to electron beam interaction and recombination to molecular hydrogen remain to be veryfied experimentally. First studies from NIKEF indicate, that nuclear polarization remains when deuterim atoms recombine to deuterium molecules in strong fields.

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