Operation of the HERMES Polarised Hydrogen Target in 1996 Data Taking ◇

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In the beginning of 1996 the operation of the HERMES polarised hydrogen target assembly had been tested for the first time in a preliminary installation [1]. End of January the assembly (a schematic is shown in fig.1)

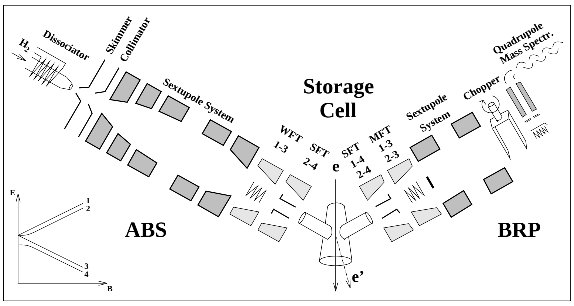

Fig. 1: Scheme of the HERMES polarised hydrogen target assembly.

was moved to the east hall of the HERA ring replacing the polarised ^3He target, which had been used for the 1995 data taking. In April we had full operation under remote control and the access to the ring was closed.

During data taking of semi inclusive deep inelastic scattering of longitudinally polarised 27 GeV positrons - from April 1996 to end of November 1996 - the assembly worked reliably as an internal target of polarised protons with an areal density of 0.7×10^{14} atoms per cm^2 and an average polarisation of the atoms near 92 %. The sign of the proton target polarisation was reversed in time intervals of typically 45 sec: Depending on the operation of the adiabatic RF transitions (WFT 1-3 or SFT 2-4) following the Stern Gerlach atomic beam source (ABS) [2–4] atoms in two hyperfine states states (1, 4) or (2, 3) are injected into the Drifilm coated target storage cell. The Breit Rabi Polarimeter (BRP) [5–8] provides continuous information on the polarisation of the atoms in the target.

The target cell used in 1996 HERMES data taking turned out to have a larger effective atom wall interaction than the one used in the tests. Correspondingly, at a cell temperature of 100 K and a magnetic holding field of 335 mT (working point) the proton polarisation of the atoms was only 92 %.

The increased atom wall interaction shows up most significantly if the ABS RF transitions are switched off: The electron polarisation of the atoms entering the storage cell is 99 %. Due to wall relaxation in the cell we observe in the BRP probe beam an electron polarisation of the atoms of 35 % only. The much higher proton polarisation results from decoupling in the strong magnetic field. The correlation of proton and electron polarisation is in quantitative agreement with respective calculations.

In the first days of 1997 the cell had been exchanged to a new one: the atomic proton polarization was 97 % and electron polarisation was high too.

The effect of depolarisation due to the time dependent magnetic fields from the HERA-beam bunches has been studied [9] quantitatively. As function of the magnetic holding field resonant transitions between states 1-2 or 3-4 have been observed (fig.2), if harmonics of the bunch frequency fit the energy difference between the respective hyperfine states. The observed resonant structure of the countrate in the BRP shows the effect of these transitions on target atoms prepared in states 3 and 4.

The resonant shapes are quantitatively reproduced within reasonable model assumptions. At the working point at 335 mT resonant depolariation is negligible. On resonance depolarisation is up to 20 %, depending on beam intensity.

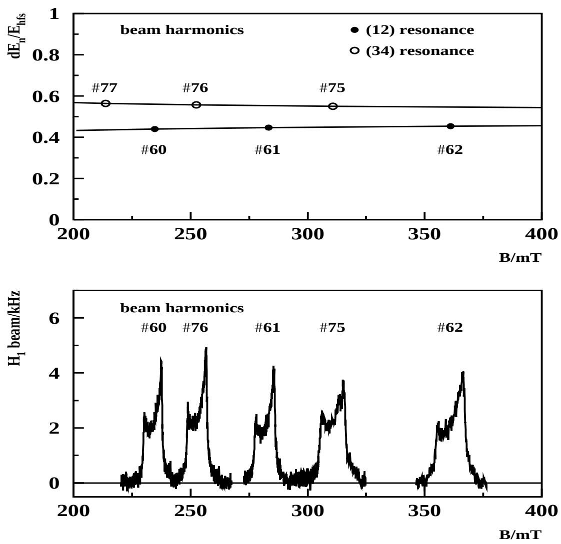

Fig. 2: Calculated and observed position of beam induced resonances.

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