Beam Properties of the ANKE Atomic Beam Source

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The polarized atomic beam source (ABS) [1] will be utilized in future experiments at the magnetic spectrometer ANKE to feed a storage cell gas target.

Investigations of the polarized atomic beam intensity have been carried out under various conditions using a compression tube located such as to match the position of the storage cell feeding tube (10 mm diameter, 100 mm length) in future experiments. The obtained absolute beam intensity as a function of the nozzle temperature is shown in Fig. 1. The maximum of $(6.9 \pm 0.3) \cdot 10^{16}$ H atoms per second is achieved around 72 K at primary H_2 flow of 1 mbar·l/s, O_2 admixture of 0.1% and 300 W dissociator power. The measured slope is reproduced well by the result of a trajectory calculations [5], which assumed a constant degree of dissociation, verified through earlier measurements. The discrepancy at lower temperatures may be explained by increasing intra-beam and rest-gas scattering, which is not taken into account in the simulations. The present results are compared with the maximum intensities given for the sources operated at HERMES (DESY) [2], PINTEX (IUCF) [3], and the polarized ion source at tandem accelerator in Munich, Germany [4]. In addition to the absolute beam intensity the atomic beam profile has been measured. These studies were carried out with a compression tube of 5 mm diameter and 50 mm length at two positions: 300 mm (1) and 337 mm (2) behind the last magnet. Figure 2 shows the *xy*-distribution of the pressure in the compression volume measured 300 mm behind the last magnet. Both measured distributions (1) and (2) can be reproduced by assuming gaussian beam profiles with $\sigma_1 = 2.85 \pm 0.42$ mm and $\sigma_2 = 2.95 \pm 0.43$ mm, respectively.

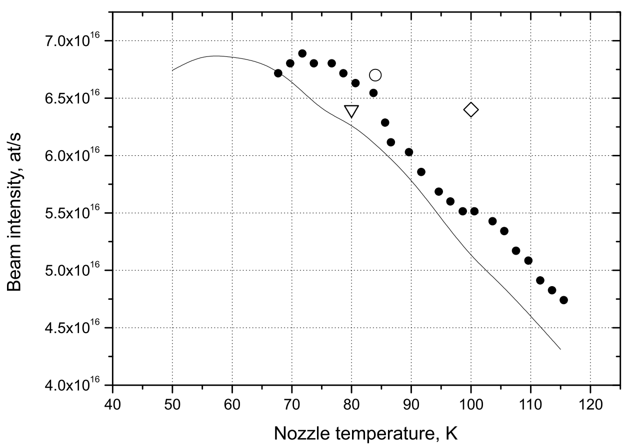

Fig. 1: Absolute beam intensity as a function of the nozzle temperature. For comparison, data from the HERMES ABS (◇) and PINTEX (○) ABS and Munich ion source (▽) are shown on the figure. The solid line represents results of simulations (scaled).

A medium and a weak field rf-transition unit (MFT, WFT) have been designed and built at the University of Erlangen [6]. The MFT is currently being tested and an efficiency of 0.90 ± 0.05 has been measured for the 2-3 transition with the compression tube.

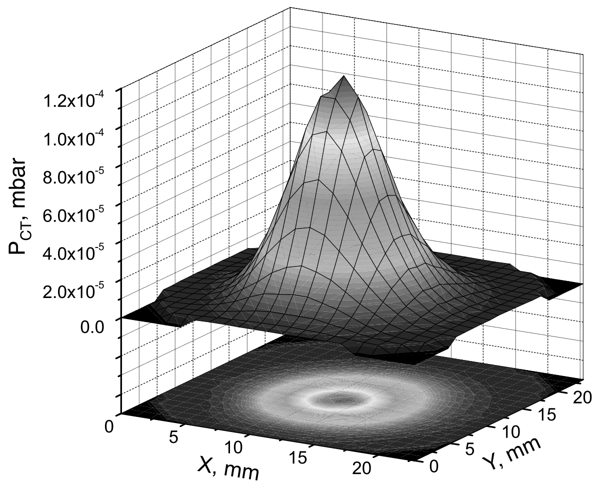

Fig. 2: *xy*-distribution of the pressure in the compression volume measured with a narrow (5 mm diameter) compression tube 300 mm behind the last magnet.

For future experiments at COSY with polarized internal targets a Lamb-shift polarimeter has been designed, built and tested at the University of Cologne [7]. In order to complete the commissioning of the polarimeter with a polarized beam, it has been installed at the ABS. Measurements of the nuclear polarization of the atomic hydrogen beam, produced by the MFT unit, yield a value of $P_z = 0.889 \pm 0.009$. A first measurement of the vector and tensor polarization of the deuterium beam has been performed.

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