A Stern-Gerlach Source for Intense and Bright Beams of Negative Polarized Hydrogen Ions $^{\diamond}$

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The new source for intense and bright beams of negative polarized hydrogen ions, a Stern-Gerlach source with ECR ionizer and cesium charge exchange unit, produced in the laboratory stable electron polarized deuterium beams with intensities above 10 μA. Fig. 1 shows a testrun over 18 hours. The negative ion beam was mass-analyzed using a compact Wien-Filter with an acceptance similar to that of the tandem accelerator.

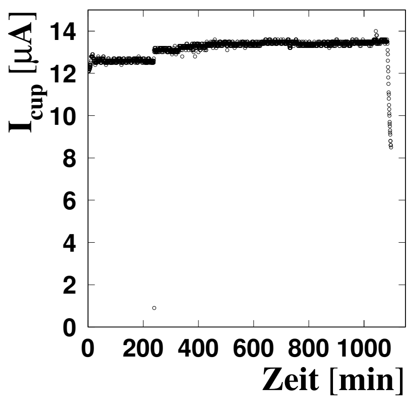

Fig. 1: D_1^- ion beam intensity in [μA] against time in [min.].

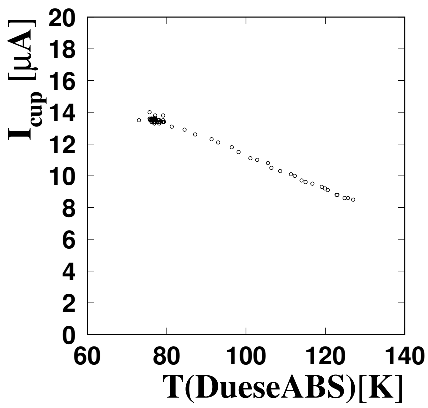

Fig. 2: D_1^- ion beam intensity in [μA] against temperature of the dissociator nozzle.

After 1100 min. the nozzle temperature of the ABS dissoziator was intentionally heated from 80 K to 130 K creating a decrease in beam intensity. The working point of 80 K is defined by cooling the nozzle with liquid nitrogen. Presently, deeper temperatures are not accessible. The linear dependence of beam intensity with temperature in fig. 2 indicates a potentially higher beam output at lower nozzle temperatures than 80 K. For details see ref. [1].

For deuterium the beam intensity will reduce in nuclear polarized mode by $\frac{1}{3}$ to about 8 μA. In [2] nuclear polarisations of >80 % and 76 % are estimated for negative deuterium and hydrogen ions, respectively. The main components of depolarization occur due to the relatively low holding B-fields during charge exchange in the ECR ionizer and the cesium vapour target (B_{hold}=0.875 and 1.0 kGauss, $B^H_{hyperfine}$=0.507 kGauss).

The performance of the cesium vapour target is shown in fig. 3. The decrease of the incoming positive deuterium ion beam with increasing vapour density (= increasing cesium temperature) starts at 150 C, at temperatures of about 270 C the positive beam vanishes completely. Negative ions start to built up around 220 C. The negative ion beam increases up to about 310 C where saturation occurs at a cesium area density of $10^{15}\frac{at}{cm^2}$. The efficiency for double charge transfer $D^+ \rightarrow D^-$ lies above 20 %. For a theoretical description of the cesium vapour target see [2].

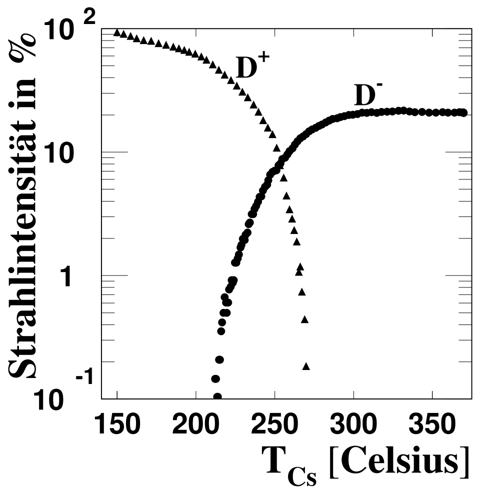

Fig. 3: D_1^+ and D_1^- beam intensities against cesium temperature. The intensities are given in units relative to the maximum positive beam intensity of 59 μA.

In November 1999 we started to install the source as injector for the tandem accelerator on the high voltage platform. First polarized beams are expected for April 2000.

References

[1] A. Ludewig, Zulassungsarbeit, LMU München, 2000
[2] C. Pertl, Zulassungsarbeit, LMU München, 2000

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