STATUS OF THE NOVOSIBIRSK CRYOGENIC ATOMIC BEAM SOURCE.

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A cryogenic Atomic Beam Source having five superconducting sextupoles has been manufactured to feed by polarized deuterium atoms an internal storage cell target at the VEPP-3 electron ring. The results of the first test of the ABS are presented. The flux of polarized deuterium atoms 6.4×10^{16} at/sec was measured by compression tube having the same dimensions as the inlet tube of the storage cell.

Introduction

A cryogenic ABS has been designed in order to achieve a substantial increase of the luminosity of the experiment on elastic and inelastic 2 GeV electron scattering from internal polarized deuterium target at the VEPP-3 electron storage ring [1].

Experimental apparatus

One of the principal innovation of the source is the optical system including five superconducting sextupoles.The dimensions of the magnets and their positions along the source axis are shown in Table 1.

These placement of the magnets allow to provide an achromatic focusing of the atoms into the storage cell feed tube and to get a good selection with a medium field RF transition. The main measured parameters of the magnets are presented in the Table 2. Details of the manufacture procedure of the magnets and magnetic field measurements can be found in Ref [2].

A thermal atomic deuterium beam is produced by RF dissociator followed by a liquid nitrogen cooled aluminum nozzle. A 5kW RF generator operated at 16 MHz was used to get a discharge, supplying 250 - 400 W power depending on the gas throughput. The degree of dissociation was found to be in the range about 90 percent and almost constant for the range of a gas flux up to 1.5 stcc/sec [3].

Table 1: The positions of the magnets along the source. Two values of the radius and the magnetic field corresponded to the entrance and the exit of the magnet were used for ray tracing calculations.

	inner diameter [cm]	B field [T]	length [cm]	position [cm]
nozzle	0.2	—	—	0
1 magnet	1.4–2.2	3.2–3.7	4.5	6
2 magnet	2.5–3.6	4.2–4.3	9.0	12.5
3 magnet	4.4–4.4	4.6–4.6	7.5	24.5
4 magnet	4.4–4.4	4.6–4.6	7.0	76.0
5 magnet	4.4–4.4	4.6–4.6	12.5	114.0
inlet tube	2.0	—	35.0	137.5

Table 2: Results of the field measurements for three magnets. The gradient was calculated from the magnetic field measured at a single point assuming a quadratic dependence of the magnetic field on radius.

	max. current [Ampere]	B field [T]	radius [cm]	gradient [T/cm]	cur.density [kA/cm^2]
1 magnet	270	3.1	0.9	6.9	64
2 magnet	250	4.0	1.5	5.3	64
3 magnet	513	4.8	2.2	4.4	49

Results of the measurements

The very first beam intensity measurements were performed by using a vacuum gauge placed at the end of the compression tube having a length and diameter 35 cm and 2 cm respectively. A vacuum gauge was calibrated during the intensity measurements by injection of certain amount of molecular deuterium. Accuracy of the intensity measurements was better than 5 percent.

Figure 1 presents the intensities of the beam measured by compression tube: left picture – beam intensity as a function of the currents through the coils of the magnents (I_1 - current in the coils of the first and second magnets, I_2 - current in the coils of the another three magnets); right picture – beam intensity versus the gas throughput (pressure $1 \times 10^{-4} Torr$ corresponds to gas throughput $1.15 mbar \times l/sec$). These measurements have shown that the

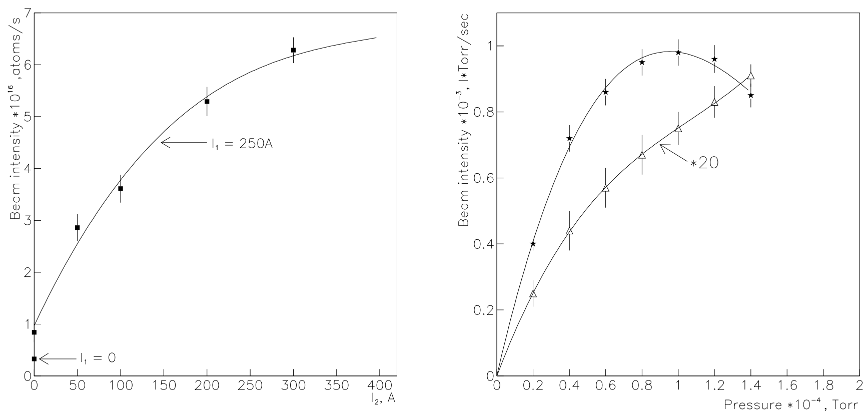

Figure 1: Intensities of the beam, full stars - magnets are ON, empty triangles - magnets are OFF.

intensity $6.4 \times 10^{16} atoms/sec$ for polarized deuterium could be obtained for given geometry of the storage cell. The futher improvement of the beam intensity is expected with the optimization of the nozzle temperature and another parameters of the source.

The operation of the cryogenic ABS with hydrogen is being considered and test will be performed in nearest future.

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