STATUS OF THE AGS POLARIZED NEGATIVE-ION SOURCE*

Th. Sluyters, J. Alessi and A. Kponou
Accelerator Department
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, New York, U.S.A. 11973

CONF-830591-2

In the past year the polarized H^- source has been modified for use in the Alternating Gradient Synchrotron. The objective was to produce once every second a beam of several micro-amperes in 0.5 ms pulses. This goal was recently achieved; a polarized-beam current with intensity of 7.5 μA was obtained.

The source is based on the co-linear colliding-beam principle developed by Haeberli at the University of Wisconsin.¹⁾ A polarized thermal atomic hydrogen beam collides in the interaction (solenoid) region with 40-keV neutral-cesium particles, producing the negative hydrogen ions by the charge-exchange process:

Figure 1 shows the schematic arrangement of this method. The fundamental differences between Haeberli's and the BNL source are that the BNL source is pulsed instead of d.c., and the atomic beam is cooled to about 100°K instead of a room-temperature dissociator nozzle.

Since the last status report²⁾ attention was placed primarily on developing a reliably operating, pulsed, well-focussed and aligned neutral-cesium beam. Figure 2 shows a detailed drawing of this cesium-beam line, from the cesium source to the interaction region.

*Work performed under the auspices of the U.S. Department of Energy.

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE.*

It has been reproduced from the best available copy to permit the broadest possible availability.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

MP

Cesium ion production is by surface ionization using a porous tungsten ionizer, instead of the zeolite emitter previously tried. The pulse shape is a sensitive function of the ionizer temperature (1000°C) and Cs surface coverage. The electrode geometry and applied potentials of the Mk II cesium source are shown in figure 3a. The extractor electrode is back biased to 47 kV to prevent ion emission between pulses, while the last electrode suppresses backstreaming electrons. The beam optics was studied by using SLAC Electron Trajectory Program.³⁾ The well defined emitting surface allows one to determine rather precisely the beam optical parameters for matching the source emittance to the acceptance of the interaction region. This is demonstrated in figure 3b for a 5mA cesium beam and 33.5 kV extraction voltage.

With this source we obtain after neutralization a 2-3 mA neutral cesium beam in the collision chamber, with 1.6 cm full width at half maximum. These results are in rather good agreement with the computer calculations.

A mechanical swivel was installed between the source and the neutralizer to allow aiming of the Cs beam, and proved to be essential for obtaining the maximum cesium beam in the interaction region.

Two graphite collimators were installed between the neutralizer and 90° deflector to minimize beam loading on the electrostatic deflector plates and other electrodes.

With an estimated atomic hydrogen beam density of 3×10^{11} atoms/cm³ and a 2.5 mA neutral cesium beam in the 30 cm long collision chamber, we observed a polarized negative ion beam of 7.5 μ A. The beam pulse is shown in figure 4. The width of the beam pulse at half maximum is about 0.5 ms. This width is determined by the Cs beam pulse. More details on the pulsed operation of this Cs source are given in reference 4. The smaller trace in figure 4 is the unpolarized H⁻ background produced in the ionizer. This background is less than 5%

of the total beam. In order to increase further the intensity and to improve the beam matching a new Cs source has been built. Figure 5 shows the new geometry and figure 6 the matching of a 15 mA beam of 39 kV voltage into the acceptance of the ionizer. This cesium gun is presently mounted on the polarized source for testing. With the new cesium source we expect to double the polarized beam current.

1. W. Haeberli, Nucl. Instr. Meth. 62, 355 (1968).
2. A. Kpenou, AIP Proceedings, 95, High Energy Spin Physics-1982, Brookhaven National Laboratory, p. 607.
3. G. Gammel, Polarized Proton Technical Note No. 25, BNL, 1983.
4. J. Aless, Proceedings Conference on Low Energy Ion Beam-3, Loughborough, U.K., March 28-31, 1983, BNL Report No. 32815.

- Figure 1 Schematic arrangement of the polarized negative ion source.
- Figure 2 Detailed layout of the cesium beam line, from the cesium source to the interaction region.
- Figure 3a The electrode geometry of the MkII cesium source. Typical operating voltages are indicated.
- Figure 3b Cs beam acceptance. The dots are calculated r , θ values as the exit of the entractor for a 5 mA, 33-5 keV beam. Bars on the dots illustrate thermal effects.
- Figure 4 The 7.5 μ A polarized negative hydrogen beam pulse.
- Figure 5 The electrode geometry of the improved Mk III cesium source.
- Figure 6 Cs beam acceptance. Dots are the calculated r , θ values at the exit of the extractor for a 15 mA, 39 keV.

Figure 1

Figure 2

Figure 3a

Figure 3b

Figure 4

Figure 5

Figure 6

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.