§33. Measurement of the CHS HIBP Ion Beam Trajectory and Profile on the Magnetic Axis

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In the CHS HIBP gas scattering experiments, two main issues remain. One is that the beam trajectory calculations have not matched the experimental results. The other is the wide range of sweep voltages which yield beams that appear to be centered in the analyzer. In order to solve these problems, a gas box detector system was prepared (Fig.1). The detector is used as a primary beam detector to determine the injector side sweep voltage sets which direct the primary beam to the magnetic axis. The beam profile on the magnetic axis can then be measured. In addition, this system is used to provide a local source of helium gas into the vacuum chamber and a bias voltage can be applied to the gas box head (Fig.2). With these features, it is feasible to find the analyzer side sweep voltages set which guides the secondary beam to the energy analyzer at the correct angle, and perform a potential calibration of the energy analyzer.

Preliminary results for the primary beam trajectory and profile measurements using the gas box detector have been obtained. It was discovered that the extraction conditions typically used in the initial experiments yielded a poor primary beam focus on axis. Better parameters for extraction of the ion beam were determined by using a profile monitor in the injection beam line and a new wire detector at the bottom of the torus. The well focused beam, the full width at half maximum (FWHM) of the primary beam was about 11mm on the magnetic axis. On the other hand, gas effects have not had a serious influence on the beam orbit and profile on axis, although the beam intensity was reduced with the addition of gas (Fig.3). From these results, it was concluded that the wide range of sweep voltages is dominantly due to the large primary beam width caused by improper extract conditions. The next main result is that we have determined the injector side sweep voltages which direct the primary beam to the magnetic axis. The experimental and numerical sweep voltages sets differ by an amount that is consistent with a misalignment of the injector side beam line by about 1 degree approximately the radial direction. This result is in good agreement with gas ionization experiments and direct measurements of the beam line location which indicate that the beam line is tilted approximately 1.5 degrees from what was assumed in the numerical calculations.

In the next set of experiments, we will look for the analyzer side sweep voltages which guide the secondary beam to the detectors, and do the potential calibration of the energy analyzer.

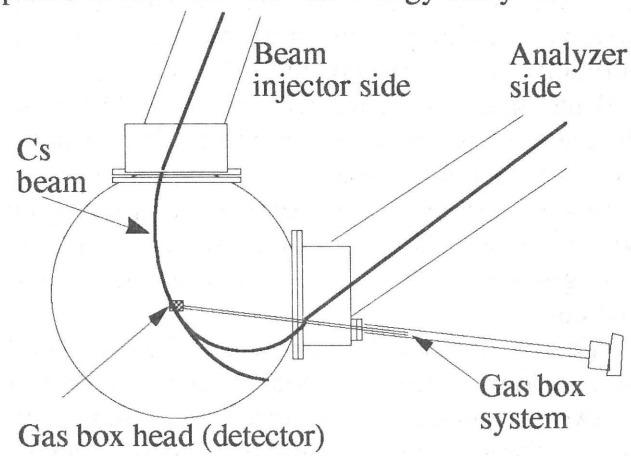

Fig. 1. Schematic of gas box system.

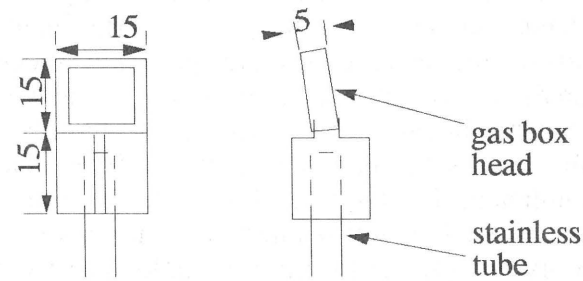

Fig. 2. Schematic of gas box head.

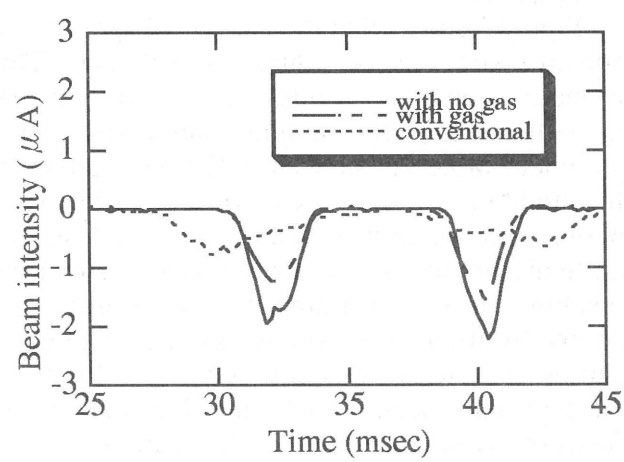

Fig. 3. Current signal of gas box detector. (with toroidal sweep)