ATOMIC BEAM TYPE POLARIZED ION SOURCE AT RCNP AVF CYCLOTRON

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Abstract

An atomic beam type polarized ion source for the RCNP AVF Cyclotron had been built and have been used succesfully for experiments about 1000 hours. At the exit of the source, ∿10μA of polarized beam is obtained now.

Characteristics of the source and a future plan of improvements are presented.

The overall feature of the source is shown in fig. 1. It consists of RF dissociator, sextuapole magnet, RF transition unit and strong field ionizer. Characteristics and ordinary operating condition of the source are as follows.

RF power of 350∿400 W was supplied to the dissociator with gas flow of ∿1 torr ℓ/s. Water cooling of the nozzle part of the quartz vessel was very effective to get a high intensity atomic beam. The sextuapole magnet which separates atomic states is 40 cm long and its magnetic gap is longitudinally tapered from 7 mmϕ to 16 mmϕ. Three units of RF transitions can be adopted to achieve pure vector polarization of both sign and variable combinations of vector and tensor polarization. Until now only one unit (weak field transition) has been adopted to produce vector polarization of proton and deuteron. The strong field ionizer is similar to that described by Glavish. A hollow electron beam passes down the inside of the cyclindrical electrodes. It is confined by a magnetic field of 1500 G produced by a solenoid. Now the longer ionizer than the before is installed which has 24 cm long ionization

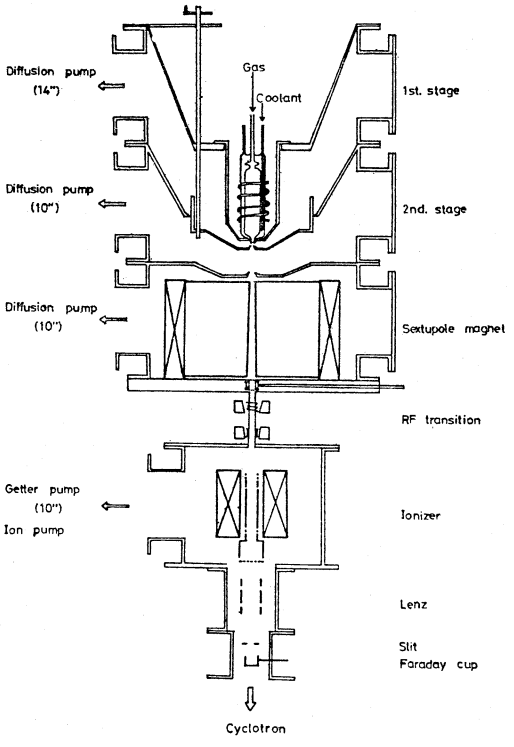

Fig. 1. Polarized ion source, Schematic diagram.

column and ionization officiency is $3\sim4\times10^{-3}$.

The sign of the polarization can be switched every few seconds by changing the direction of the solenoid field. Optimum condition is not the same at each direction of the field. Other RF transition units which are to be adopted near future enable to operate the ionizer at optimum condition.

Vacuum system is powerful and pressures are 2×10^{-4} torr at the first stage, 2×10^{-6} at the sextuapole magnet section and 2×10^{-7} at the ionizer at ordinary operating conditions.

The source has been operated for more than 1000 hours for experiments with good stability. The beam intensity is $6\sim10$ μA at the exit of the source and $30\sim50$ nA at the target and polarization is $\sim70\%$ for proton and $\sim50\%$ for deuteron typically. Problem in the operation is that oil of the first diffusion pump must be changed about every 100 hours.

Taking in to account the recent development of the EBIS, the test bench of the ionizer was constructed to study the ionizer and get higher intensity beam with better emittance and now being tested. Numerical calculations are also now undertaken to optimize the electron gun and ion extraction electrodes.

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