Construction of a bench-test device for polarized ^{3}He ion source (SEPIS) based on the spin-exchange collisions

M. Tanaka[1], Y. Takahashi[2], T. Komeno[3], C. Inaba[3], T. Shimoda[3], H. Izumi[3], T. Furukawa[3], K. Hachisuka[3], M. Ohira[3], M. Yosoi[4], and K. Takahisa[2]

[1]*Kobe Tokiwa College, Ohtani-cho 2-6-2, Nagata-ku 653-0838, Japan*

[2]*Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*

[3]*Department of Physics, Graduate school of science, Osaka University, Machikaneyama-cho 1-1, Toyonaka, Osaka 560-0043, Japan*

[4]*Department of Physics, Graduate school of science, Kyoto University, Kitashirakawa Oiwake-cho, Sakyo-ku, Kyoto 606-8502*

A novel idea to achieve production of polarized $^3He^{2+}$ beams with high intensity and high polarization was proposed through the basic study on the polarized ion sources over the decade. The principle of polarization is to use an unexpectedly large spin-exchange cross section between $^3He^+$ and Rb atom at low incident energy region ($\leq$ 3keV) [1]. We name the polarized ion source based on this principle "SEPIS", i.e., Spin Exchange Polarized Ion Source. The aim of present work is to experimentally check the validity of above principle.

For this purpose, we have constructed a bench-test device as shown in Fig. 1. An outline of the device is as follows: An unpolarized $^3He^+$ ion is produced by a 2.45GHz ECR ion source [2] and extracted with a potential of $\sim$ 19 kV. The $^3He^+$ ion is introduced to a Rb vapor cell after momentum analysis with a bending magnet. To enable the spin exchange collisions at low energies ($\leq$ 3 keV) a high voltage (up to $\sim$ 19 kV) is applied to the Rb cell. The polarized $^3He^+$ ion out of the Rb cell, where the multiple spin exchange collisions occur between Rb atoms polarized by optical pumping and the incident $^3He^+$ ion, is then energy analysed by an electrostatic analyzer. Two sets of Helmholtz coils (see Fig. 2) are used for ensuring the spin direction unchanged. The polarized $^3He^+$ ion is finally introduced to a polarimeter [3] where the produced nuclear polarization is measured.

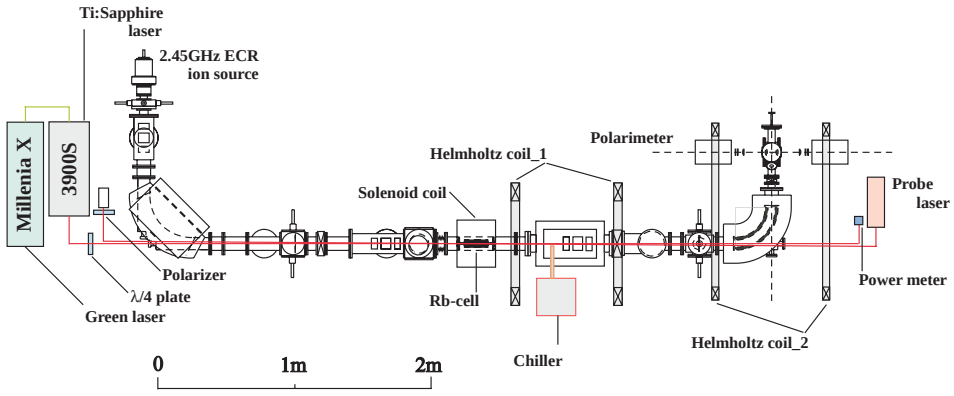

Fig. 1 A schematic layout of the bench-test device for checking the validity of SEPIS principle.

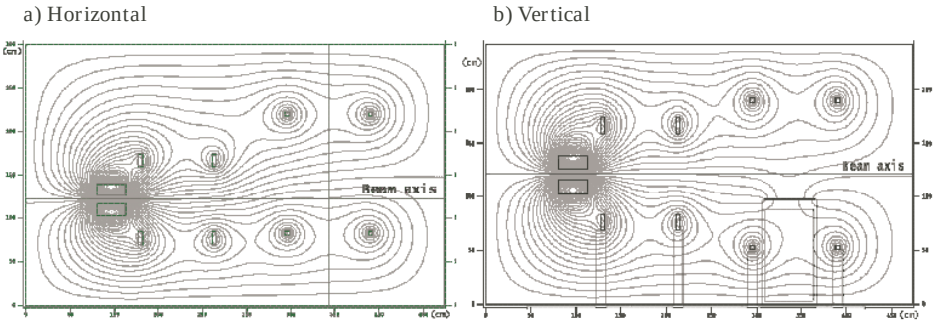

Fig. 2 Lines of force distributions of the magnetic field created by a combination of Graser lens and two sets of Hermholtz coils. a) Distribution in the horizontal plane, b) Distribution in the vertical plane.

References

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