Optimization of 2.45 GHz ECR ion source for the SEPIS polarized ^{3}He ion source

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Last year, we started a project to construct a bench-test device [1] allowing to check the validity of principle of the SEPIS polarized $^3He^+$ ion source [2]. Since the SEPIS source uses spin-exchange processes between a $^3He^+$ ion and polarized Rb atoms, production of $^3He^+$ ions with high intensity is of particular importance in allowing the precise nuclear polarization measurement [3] for $^3He^+$ ions populated by the spin exchange collisions. For convenience, we employed a 2.45 GHz ECR ion source with a mirror and a sextupole field generated by permanent magnets.

To optimize the performance of this ECR ion source we have measured ion currents operated with ^{3}He gas by varying parameters specific to the ECR ion source, i.e., an electric current of the analyser magnet, extraction voltage of the ECR ion source, 2.45 GHz microwave power of the ECR ion source, and ^{3}He gas flow rate plotted as a function of vacuum at a pump head of the ECR ion source. The measured results are summarized in Fig. 1 a)$\sim$d). It is found that the $^3He^+$ beam current over 100 eμA is achieved with an easy tuning. Further detailed tuning of the ECR ion source allowed us to increase the $^3He^+$ beam current over 300 eμA as a renewed record. This number is enough for our purpose to measure the ^{3}He nuclear polarization precisely. We observe that the ratio of $^3He^{2+}$ to $^3He^+$ ion current (see Fig. 1-a)) is an order of 1 % which is roughly consistent with the value obtained by our previous device operated at the same microwave frequency [4].

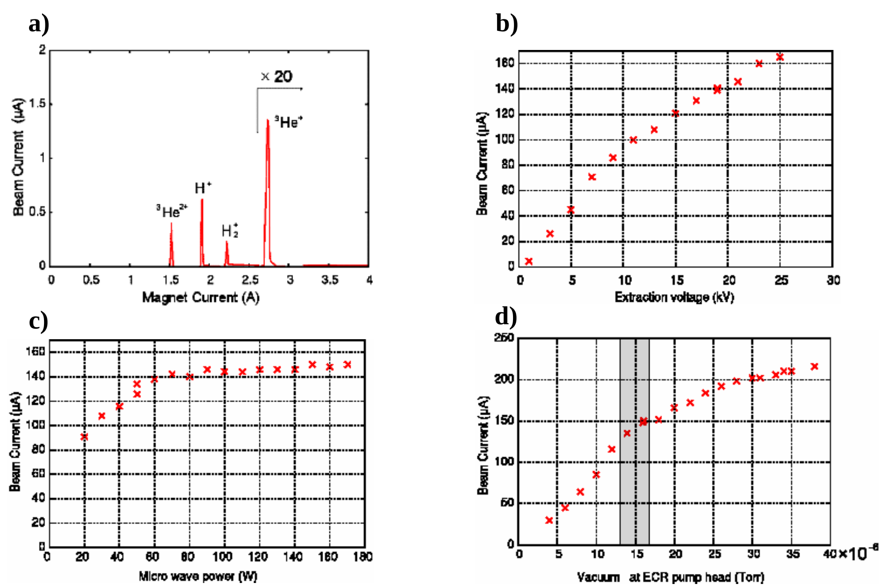

Fig. 1. Measured performances of the 2.45 GHz ECR ion source used for the bench-test device of the polarized ^{3}He ion source. a) Ion current vs. electric current of the analyser magnet (Mass spectrum), b) $^3He^+$ ion current vs. ECR extraction voltage, c) $^3He^+$ ion current vs. microwave power of the ECR ion source, d) $^3He^+$ ion current vs. ^{3}He gas flow plotted as a function of vacuum at a pump head of the ECR ion source.

References

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