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## The Extraction of Both Positive and Negative Ions from a Modified Volume Cusp H- Ion Source

The TRIUMF licensed H<sup>-</sup> ion source is known to produce 15 mA of H<sup>-</sup> ions, but some applications, such as those using higher energy research cyclotrons, require the injection of both positive and negative ions. Furthermore, when using a tandem accelerator, there would be a benefit in using an ion source that can directly extract H<sup>-</sup> and He<sup>+</sup>. In this case, a charge exchange chamber would only have to be used with the He beam to create He<sup>-</sup>. In this paper we present the conversion of the H<sup>-</sup> ion source to allow for the extraction of both positive (He<sup>+</sup>, H<sup>+</sup>, H<sub>2</sub><sup>+</sup> and H<sub>3</sub><sup>+</sup>) and negative (H<sup>-</sup> and D<sup>-</sup>) ions by the addition of a suppression electrode and other modifications to be described. Up to 3 mA of protons and 2 mA of He<sup>+</sup> can be extracted when using positive extraction power supplies and up to 5 mA of H<sup>-</sup> can be extracted when the polarity of the power supplies switched to negative extraction. We study how the ion source parameters affect the proton fraction and we look at the influence of the magnetic filter field in the plasma chamber. Finally, we present the results of the extraction with the RF powered version of the ion source.

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