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A new electron gun for the TITAN-EBIT

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One method to improve our understanding of nuclear physics, for example the nuclear structures within atoms, is performing high-precision mass measurements of ions. Penning traps are widely used for mass spectroscopy with the lowest uncertainty and they can reach a precision of $\delta m/m \sim 1*10^{-9}$ with radioactive ion beams. This precision can be further improved by using highly charged ions (HCI) of the isotope of interest because $\delta m/m$ directly depends on the ions' charge state q. These HCIs can be created with charge breeding inside an Electron Beam Ion Trap (EBIT) where high electron current densities are used to knock out electrons of trapped ions via electron impact ionization. This boost in measurement precision has been successfully demonstrated at the TITAN facility at TRIUMF.

At TITAN, the EBIT high voltage has recently been upgraded to allow 65 keV electron beams. To better take advantage of the higher energies, we are upgrading the electron gun of the EBIT to achieve maximum current densities and therefore the shortest breeding times and the highest charge states.
In order to get the optimized setup, the electron beam properties of the electron gun were simulated using the Field Precision Trak software. With modifications to the electromagnetic optics, a compression factor of 45 for the beam radius and thereby current densities of 1800 A/cm^2 were achieved in the trapping region of the EBIT for a 1.5 A cathode at 30 keV. For maximal experimental flexibility, three cathode sizes were simulated at different beam energies. Furthermore the geometry and design will also simplify routine maintenance. We will present the results of our simulations and the new design. The new electron gun will enable us to better perform high-precision mass measurements of nuclides with short half lives.

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