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# 52 - Electron plasma studies for a cooler Penning trap at TITAN

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The TITAN facility at TRIUMF performs mass measurements of rare isotopes, e.g. to test the standard model. Charge breeding the radionuclides can increase the attainable measurement precision; however, it may increase the ions' energy spread, thereby negatively impacting the mass measurement. To leverage the full benefits of Penning trap mass spectrometry with highly charged ions we are implementing a cooler Penning trap (CPET) into the TITAN system. In CPET the charge-bred ions will be trapped with an electron plasma in a nested potential and sympathetically cooled. The ion cooling rate and the lowest attainable ion temperature critically depend on the electron density distribution and the impact of the electron space charge on the effective trapping potential.

Electrons will be injected into the 7T magnetic field, undergo cyclotron radiation cooling, and form a room-temperature plasma at the trap centre. To study the plasma behavior we simulated it with the particle-in-cell code WARP. A limiting factor for simulations on electron plasmas in high magnetic fields are the extremely small time steps needed to sample the fast cyclotron gyro-motion. By using WARP's Drift-Lorentz particle mover the time steps could be increased above the electron cyclotron period reducing the required computation times by more than two orders of magnitude. We initialized the electrons as a cylindrical column along the magnetic field axis with a thermal velocity distribution and let them evolve into a near-equilibrium state. We simulated the resulting electron density and distribution for several potential shapes. From these results we evaluated the space charge and its effect on the trapping potentials as well as the confinement limits of the electron trap. We determined suitable trapping potentials for plasmas with different numbers of electrons. These simulation results will enable a fine tuning of the voltages applied to the trap electrodes for optimal cooling performance.

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