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Development of a novel ion trap for laser spectroscopy

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A novel radio-frequency (RF) ion trap based on planar printed-circuit board (PCB) electrodes was designed and simulated. This device would serve as a commercial ion cooler and buncher that delivers a low emittance ion bunch to laser spectroscopy experiments, such as the Collinear Resonance Ionisation Spectroscopy (CRIS) experiment in ISOLDE at CERN.

The ions inside the trap were cooled by collisions with a He buffer gas at a pressure of 10^{-2} mbar. The simulations included injection optics and extraction optics. The former consisted of an electric quadrupole triplet and a series of electrodes that decelerated and focused the ion beam inside the trap. The latter was an arrangement of cylindrical and conical electrodes used to deliver a pencil-like beam. The transmission efficiency and the emittance of the beam were computed at multiple stages of the beamline. It was found that, under certain conditions, the field due to planar electrodes successfully approximated an ideal quadrupole field and yielded nearly full transmission efficiency.

Lastly, the preliminary stage of the building and testing of such ion trap with printed-circuit boards is presented. The limits of this design are outlined as well as future improvements.

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