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Extraction of Coulomb crystals with limited emittance growth

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Laser Doppler cooled ion traps can produce stationary bunches of ions with extremely low velocity spread (0.6 m/s RMS) and emittance ($10e-13$ m normalized). This corresponds to temperatures of a few milli-Kelvin and allows the ions to settle into a fixed lattice analogous to a solid crystal, but with the Coulomb repulsion balanced by the trapping force, rather than a chemical bond. Extraction of such a bunch into a beamline could provide a new regime of ultra-low emittance beams if the emittance is preserved through the extraction operation. This paper shows that extraction from the ion trap and initial acceleration does not cause drastic growth, thus preserving the ultra-low emittance nature of the bunch. Techniques for compensating coherent 'emittance growth' effects such as nonlinear bunch distortion are also investigated.

Footnotes

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