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Space-charge dynamics in ultra-cold ion bunches ROBERT SCHOLTEN, DENE MURPHY, RORY SPEIRS, DANIEL THOMPSON, BENJAMIN SPARKES, ANDREW MCCULLOCH, The University of Melbourne — Cold ion sources based on photoionisation of laser cooled atoms provide a unique system for investigating Coulomb interactions within complex charged particle bunches. Space-charge driven expansion in charged particle beams is of critical importance for applications including electron and ion microscopy, mass spectrometry, synchrotrons and x-ray free electron lasers, and in electron diffraction where space-charge effects constrain the capacity to obtain diffraction information. Self-field effects are often difficult to observe because of thermal diffusion with traditional sources. Cold atom sources produce ions with temperatures of a few mK, such that subtle space-charge effects are apparent. We illustrate the capabilities through detailed investigation of a complex ion bunch shape, showing collective behaviour including high density caustics and shockwave structures arising from long-range interactions between small charge bunches.

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