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Accelerating positronium using pulsed travelling optical lattices

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The creation of tunable beams of positronium atoms using the optical dipole force from short, pulsed accelerating optical lattices has been studied. Using the favourable polarizability-to-mass ratio of positronium we show that accelerations in excess of 1014g are possible. Simulations have been performed for several cases in which lattice beams capture a significant fraction of ground state ortho- positronium atoms in a cloud at an initial temperature of 300 K. We show that using conventional laser sources, bunches of positronium atoms can be accelerated well within the ortho-positronium vacuum lifetime of 142 ns. Kinetic energies in the eV to 100 eV range, with well-defined energy spreads and final kinetic energy, appear feasible. These parameters can be tuned using laser intensity, pulse duration or the acceleration of the lattice. We show that this approach is feasible by describing experiments that have demonstrated the acceleration of neutral argon atoms over a range of energies using accelerated optical lattices.

References

1. P. F. Barker and M. Charlton, New J. Phys. 14, 045005 (2012)
2. C. Maher-McWilliams, P. Douglas and P. F. Barker, Nature Photonics 6, 386 (2012)

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