

Abstract Submitted
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Spinor Bose-Einstein Condensates of Positronium¹ YI-HSIEH WANG, Joint Quantum Institute and University of Maryland , BRANDON ANDERSON, CHARLES CLARK, Joint Quantum Institute — Bose-Einstein condensates (BECs) of positronium (Ps) have been of experimental and theoretical interest due to their potential application as the gain medium of a γ -ray laser. Ps BECs are intrinsically spinor due to the presence of ortho-positronium (o-Ps) and para-positronium (p-Ps), whose annihilation lifetimes differ by three orders of magnitude. In this paper, we study the spinor dynamics and annihilation processes in the p-Ps/o-Ps system using both solutions of the time-dependent Gross-Pitaevskii equations and a semiclassical rate-equation approach. The spinor interactions have an $O(4)$ symmetry which is broken to $SO(3)$ by an internal energy difference between o-Ps and p-Ps. For an initially unpolarized condensate, there is a threshold density of $\approx 10^{19} \text{ cm}^{-3}$ at which spin mixing between o-Ps and p-Ps occurs. Beyond this threshold, there are unstable spatial modes accompanied by spin mixing. To ensure a high production yield above the critical density, a careful choice of external field must be made to avoid the spin mixing instability.

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