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Efficient generation of many-body singlet states of spin-1 bosons[1]

WENXIAN ZHANG, HUANYING SUN, PENG XU, School of Physics and Technology, Wuhan University, Wuhan, Hubei 430072, China, HAN PU, Department of Physics and Astronomy, Rice University, Houston, Texas 77251, USA — A quantum many-body spin singlet state is theoretically predicted as the ground state of an antiferromagnetically interacting spin-1 bosons at zero magnetic field. This fragile state would be broken even in a tiny magnetic field of microGauss. We develop an efficient stepwise adiabatic merging (SAM) method to generate many-body singlet states in antiferromagnetic spin-1 bosons in optical lattices with double-well arrays, by adiabatically ramping up the double-well bias. With an appropriate choice of bias sweeping rate, the SAM protocol predicts a fidelity as high as 90% for a sixteen-body singlet state and even higher fidelities for smaller even-body singlet states in a magnetic field of a few tens milliGausses. During their evolution, the spin-1 bosons exhibit wonderful squeezing dynamics, manifested by odd-even oscillations of the experimental observable of generalized squeezing parameter. The generated many-body singlet states may find practical applications in precision measurement of magnetic field gradient.

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