Elementary excitations of antiferromagnetic spin-1 bosons in an optical lattice

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We study elementary excitations of spin-1 bosons with antiferromagnetic interaction in an optical lattice by applying the Gutzwiller approximation to the spin-1 Bose-Hubbard model. There appear various excitations with spin degrees of freedom in the Mott-insulator (MI) phase as well as in the superfluid (SF) phase. The ground state in the MI phase shows a remarkable parity effect in which even fillings stabilize the MI state due to formation of spin-singlet pairs[1,2]. We find that excitation spectra in the MI phase exhibit characteristic features that reflect the even-odd parity effect of the ground state. We clarify evolution of elementary excitations across the quantum critical point of the SF-MI transition.

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