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Multiferroics versus Quantum Fluctuations in Spin-1/2 Frustrated Chains SHUNSUKE FURUKAWA, MASAHIRO SATO, SHIGEKI ONODA, RIKEN — We study interplay of the chiral spin ordering and quantum fluctuations in a spin-1/2 frustrated chain, which is the simplest model for one-dimensional multiferroic cuprates like $LiCuVO_4$ and $LiCu_2O_2$. In a Heisenberg chain, it is known that the classical helical magnetic order is suppressed by strong quantum fluctuations and valence-bond solid phases emerge. In fact, weak easy-plane spin anisotropies exist in the above materials, because of the XXZ-type anisotropy and a phonon-induced biquadratic Dzyaloshinskii-Moriya interaction. In particular, when the nearest-neighbor exchange coupling is much weaker than the antiferromagnetic second-neighbor one, our exact-diagonalization calculations combined with the bosonization analyses show that such anisotropies bring about the vector-chiral spin ordering and the associated multiferroic behavior. This chiral state is accompanied by slightly incommensurate algebraic spin correlations, which, with a three-dimensional coupling, explains the magnetic order experimentally observed in $LiCuVO_4$.

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