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Quantum effects in cold-atom breathers[1] VLADIMIR YUROVSKY, Tel Aviv Univ., MAXIM OLSHANII, UMass Boston, BORIS MELAMED, Tel Aviv Univ. — The one-dimensional (1D) Gross-Pitaevskii equation (GPE) has exact oscillatory solutions — breathers — predicted by the inverse scattering transform. In the mean-field approximation, they are formed from bright solitons by four-fold quench of the attractive interaction strength. Here, we address quantum counterparts of the breather states, applying the same quench to the Lieb-Liniger-McGuire model (the quantum version of the 1D GPE). Using exact Bethe-ansatz solutions for up to $N = 20$ atoms, we find that the quench leads to formation of all multi-soliton (multi-string) states, possible for $N = 20$, while two-soliton pairs dominate. The calculated fidelity exhibits a damped oscillatory dynamics. One of the decay mechanisms — dephasing due to non-equidistant energy spectrum of the two-soliton states — is expected to be suppressed at large N. In addition, the dephasing due to the solitons' kinetic energy spread leads to decay of the fidelity oscillation amplitude by half in the course of ~ 2.5 classical soliton periods for $4 \leq N \leq 20$. The results suggest a possibility of observation of macroscopic quantum effects.

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Vladimir Yurovsky
Tel Aviv Univ

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