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Self-interfering nature of dispersive quantum shock waves in a one-dimensional Bose gas KAREN KHERUNTSYAN, S.A. SIMMONS, University of Queensland, S.N. SAADATMAND, Griffith University, D. COLAS, F. A. BAYOCBOC, JR., I.P. MCCULLOCH, University of Queensland — Shock waves represent examples of far-from-equilibrium phenomena for which fundamental understanding of the laws of emergence from the underlying many-body interactions is generally lacking. Here we study dispersive quantum shock waves in a 1D Bose gas, described by the Lieb-Liniger model and forming from a local density bump expanding into a uniform background. We show that the microscopic mechanism behind the formation of the oscillatory shock wave train is quantum mechanical interference. Our results incorporate the effects of quantum and thermal fluctuations and span the entire range of interaction strengths, from the noninteracting (ideal) Bose gas regime, through the weakly-interacting or Gross-Pitaevskii regime, to the regime of infinitely strong interactions corresponding to the Tonks-Girardeau gas of hard-core bosons. The amplitude of oscillations in the shock wave train, i.e., the visibility of interference fringes, decreases with the increase of both the temperature of the gas and the interaction strength. In both cases this is a consequence of: (a) the reduced phase coherence length in the gas, and (b) the intrinsic fluctuations in the position of the interference pattern from shot-to-shot due to quantum and thermal fluctuations.

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