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Interference and dephasing dynamics in low dimensional condensates.[1]

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Interacting condensates in one and two dimensions are subject to strong phase fluctuations, that prohibit the establishment of long range order. I will describe how these fluctuations affect the interference between two condensates. I will show that the average fringe contrast of interfering independent condensates scales as a non trivial power of the condensate size (or imaging area), which depends on the decay of spatial phase correlations within each condensate. For one dimensional systems I will also derive the full quantum distribution of the interference contrast. Measurement of this quantity lends access to highly non local quantum correlations. I will then discuss a matter wave interferometer, in which two condensates are initialized with a well defined relative phase. This phase is gradually randomized in the subsequent quantum dynamics. For weakly interacting one dimensional systems we derive an exponential decay of the phase coherence, at a rate that depends on the interaction strength and on hydrodynamic parameters. In two dimensions we find power law dephasing. This result is invalidated for sufficiently strong interactions in a way that may signal the emergence of a new regime of non equilibrium quantum dynamics.

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