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Matter-wave quantum interference in the Hong-Ou-Mandel setup
ROBERT LEWIS-SWAN, KAREN KHERUNTSYAN, Univ of Queensland — We propose an experiment to realize a matter-wave analog of the optical Hong-Ou-Mandel (HOM) effect [1]. This is achieved by utilizing a pair of colliding Bose-Einstein condensates of ultracold atoms to generate a scattering halo of pair-correlated atoms via spontaneous four-wave mixing, analogous to optical parametric down-conversion used in the optical experiment to generate pairs of indistinguishable photons. Coupling the pair-correlated atoms by a π and $\pi/2$ Bragg pulse realises the atom-optics analogs of mirror and beam-splitter elements of the optical HOM interferometer. We use a stochastic (positive-P representation) Bogoliubov approach to simulate the full dynamics of the experiment and by proposing a measurement protocol appropriate for the multimode nature of the scattering halo we predict a HOM-dip visibility of $\sim 69\%$ [2], indicating strong quantum correlations between the scattered atoms and paves the way for a possible demonstration of a Bell inequality violation with matter-waves in a related Rarity-Tapster setup [3].

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[2] R. J. Lewis-Swan and K. V. Kheruntsyan, arXiv:1312.3933;
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