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Spiral Bose Fireworks: parametric amplification of vortex states HAN FU, JOOHEON YOO, LEI FENG, CHENG CHIN, KATHRYN LEVIN, University of Chicago — Periodic modulation of the two-body interaction in a Bose condensate has led to the interesting observation of "Bose fireworks" [Nature 551, 356 (2017)]; these were later shown to be well captured by our time-dependent Gross-Pitaevskii simulations [Phys. Rev. Lett. 121, 243001 (2018)]. The goal of these experiments is to unravel the structure of an unknown condensate through parametric amplification. To fulfill this, we discuss simulated emission patterns of complex initial states and find intriguing jet trajectories. Spiral jets are seen when vortices are imprinted into the initial condensate. This story, interestingly, can serve as a quantum version of the water beam emission by a sprinkler. We show how one can extract from the spiral pattern information such as the vortex winding number and condensate size. Using this "phase-tomography" philosophy, we also study other cases such as divided condensates so that one half is phase-shifted relative to the other. We present a general analytical formalism to describe this amplification process, which in some sense is reminiscent of established procedures in particle physics.

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