

Abstract Submitted
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Direct visualization of strong atom–atom interactions with colliding BECs RACHEL WOOTEN, MACKILLO KIRA, University of Michigan — Macroscopic quantum properties of matter can hardly become more tangible than in the 1997 experiment¹ where an interference pattern was literally seen by imaging the collision of two BECs comprised of weakly interacting atoms. Extending such a study to strong interactions is more challenging, but feasible, following an experimental success² in rapidly quenching a BEC from weak to strong atom–atom interactions. A recently developed cluster-expansion approach³ yields a nonperturbative description of strongly interacting BECs, and it has been demonstrated to quantitatively explain⁴ experiments. Here, we generalize this method to describe collision of two BECs and a simultaneous quench of atom–atom interactions. We will present how the resulting quantum many-body interactions enhances spatial bunching of the atoms which can be literally seen as dramatic, macroscopically-visible changes in the interference pattern. Consequently, future experiments should easily access many-body correlations via such an imaging.

¹M. R. Andrews, *et al.*, *Science* **275**, 637 (1997).

²P. Makotyn, *et al.*, *Nat. Phys.* **10**, 116–119 (2014).

³M. Kira, *Ann. Phys.* **356**, 185–243 (2015).

⁴M. Kira, *Nat. Commun.* **6** 6624 (2015).

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