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Momentum-space engineering of Bose-Einstein condensates[1]
BRANDON BENTON, JEFFREY HEWARD, Georgia Southern University, MARK EDWARDS, Georgia Southern University and NIST, CHARLES CLARK, Joint Quantum Institute and NIST — We show how the momentum distribution of gaseous Bose–Einstein condensates can be shaped by applying a sequence of standing–wave laser pulses. We present a theory, whose validity was demonstrated in an earlier experiment,[2] of the effect of a two–pulse sequence on the condensate wave function in momentum space. We generalize the previous result to the case of N pulses having arbitrary pulse areas and separated by arbitrary time intervals and show how these parameters can be engineered to produce a desired final momentum distribution. We find that several momentum distributions, such as single–state distributions or a range of momentum states which are important in initial state selection in atom–interferometry applications, can be engineered with high fidelity with two or three pulses. We present several examples of such distributions and show how the fidelity improves as more pulses are added. We also give some ideas of how these momentum distributions can be applied to atom interferometry.

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[2]L. Deng, et al., PRL **83**, 5407 (1999)

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