Maximum Contrast Condensate Interference

C. H. Carson, Y. Zhai, P. F. Griffin, E. Riis and A. S. Arnold
Department of Physics
University of Strathclyde
107 Rottenrow, Glasgow G4 0NG
photonics.phys.strath.ac.uk
e-mail: aidan.arnold@strath.ac.uk

Abstract

We use magnetic levitation and a variable-separation dual optical plug to obtain clear spatial interference between two BECs axially separated by up to 0.25 mm. Fringes are observed using standard (i.e. non-tomographic) resonant absorption imaging [1]. The 'magnifying' effect of a weak inverted parabola potential on fringe separation is observed and agrees well with theory. With 160 ms levitation we can observe single-shot interference contrasts as high as 95% (see Figure 1 absorption image below), close to the theoretical limit due to pixellation of the sinusoidal fringes on our CCD camera. Interference patterns with fringe periods of 85 μm (individual de Broglie wavelengths of 170 μm) are possible with 200 ms levitation. We are currently looking into other methods and geometries to split the BEC, one of these methods is to RF dress [2] our Ioffe-Pritchard trap [3] which would split the condensate radially [4]. Phase fluctuations are an inherent property in highly elongated BECs at finite temperature [5] which can degrade interferometry. Our long time-of-flight enables new levels of sensitivity to these fluctuations.

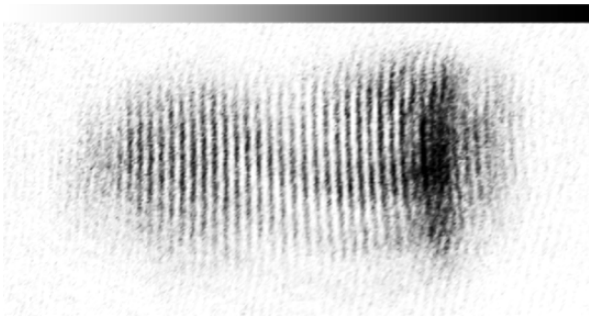

Figure 1: High contrast (95%) interference fringes between two initially separated condensates after 160 ms time-of-flight.

References

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