Generation of bright solitary waves and experimental tests of mean-field theory in attractive Bose-Einstein condensates

T. P. Billam

Department of Physics, Durham University, South Road, Durham DH1 3LE, UK
Tel: +44 (0)191 3343759, email: t.p.billam@durham.ac.uk

Abstract:

Bright matter-solitary waves in attractive atomic Bose-Einstein condensates are an intriguing example of nonlinear wave phenomena with potential applications in metrology and the study of atom-surface interactions. Several experiments to date have produced bright solitary waves and shown them to be relatively robust, but multiple bright solitary waves have only been produced by processes involving collapse of the condensate [1,2]. Such processes are difficult to precisely control and unlikely to reliably generate the specific and reproducible states needed for matter-wave interferometry experiments using multiple solitary waves.

We consider phase imprinting and interference-based methods to reliably split the ground state of an attractive BEC into multiple solitary waves without inducing collapse. The relative phases and outgoing velocities of the generated solitary waves can be precisely controlled, and a harmonic confining potential leads to subsequent periodic re-collisions of the waves at the trap center [3]. Observation of these re-collisions provides a way to experimentally address the much-discussed issue of the importance of beyond-mean-field effects in solitary wave-solitary wave collisions [4,5], and could be accomplished using configurations such as the Durham ^{85}Rb experiment.

References:

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