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Ring Dark Solitons in Bose-Einstein Condensates BRYAN NELSEN, Georgia Southern University, MARK EDWARDS, Georgia Southern University and NIST, LINCOLN CARR, JILA, CHARLES W. CLARK, NIST — The time-independent Gross–Pitaevskii equation describing a Bose–Einstein condensate confined in a cylindrical box admits "ring solutions."[1] These solutions consist of a central vortex line surrounded by concentric nodal rings. We have studied the time evolution of the ring solutions having one node between the vortex line at $\rho = 0$ and the box wall and which have had a phase mask placed across the node. This phase gradient mimics the phase jump exhibited by a dark soliton in motion. Our study has been carried out by solving the time–dependent Gross–Pitaevskii equation using a Crank–Nicolson propagator. The initial conditions were generated using a shooting algorithm that needed a power series solution of the time–indepedent Gross–Pitaevskii equation to find the solution away from the singularity at the vortex line. We find that, in general, these systems behave like dark or gray solitons where the node exhibits radial oscillations. We shall present results for various phase gradients and winding numbers and comment on the possibility of observing these phemomena in laboratory Bose–Einstein condensates.

[1]L.D. Carr and C.W. Clark, cond–mat/0408460

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