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Stirring Up Excitations in Toroidal BECs¹

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The advent of experimentally realizable toroidal BECs in optical traps (*G. K. Campbell et. al., this session*) will provide not only investigations which parallel those of long studied superconducting loops but, with the unique tunability of both trap and super-fluid properties of the BEC itself, also open up new classes of experimental questions and opportunities. Here we present an outgrowth of work [1] using condensate phase rigidity to create super-currents in ring geometries by stirring, allowing simple and robust control of winding numbers, and on release of the trap center, study of the decay of high vorticity condensates. Within the ring trap itself, these studies quickly revealed new classes of elementary collective excitations created by controlled “mismatching” of the phase winding number, including dark solitons, whose life times would be a natural object of study in a such uniform environment with coherence times of up to 40 seconds, as well as novel excitations which may be thought of as combinations of soliton and vortex behavior, which we have previously called s’vortices.

[1] J. Brand and W. P. Reinhardt, *J. Phys. B*, **34**, L113 (2001).

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