

Abstract Submitted  
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**Interacting Bright Solitons in Trapped BECs: Mean-Field Theory and Way Beyond**<sup>1</sup> WILLIAM REINHARDT, University of Washington, Seattle — Bright multi-soliton trains have been experimentally observed in harmonic traps,<sup>2</sup> in experiments made especially difficult by the fact that a too-bright soliton (or ground state of an attractive BEC) will self destruct in 3D. These are fascinating systems as, as recently pointed out,<sup>3</sup> usual mean-field descriptions via the NLSE (or GP) equation, will often fail, as many-body effects may play a crucial role. Here we discuss 4 regimes of the statics and dynamics of double-bright-soliton systems by giving an overview of the full energy correlation diagram in a two (non-linear) mode description. 1) Strongly trapped soliton pairs are found to be quite well described by GP, and also via two mode, dynamics, up-holding prior theoretical analysis of existing experiment.<sup>4</sup> Separated soliton pairs may be: 2) Schrödinger cats; 3) fully fragmented; or, 4) decohering<sup>5</sup> wave packets if followed via two-mode dynamics, using coherent mean-field (GP) initial conditions, and end up producing states of controllable partial entanglement.

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<sup>2</sup>K. E. Strecker *et. al.*, Nature **417**,150 (2002).

<sup>3</sup>A. I. Streltsov *et. al.*, Phys. Rev. Lett. **106**, 240401 (2011).

<sup>4</sup>Strecker, *op. sit.*

<sup>5</sup>Streltsov, *op. sit.*

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