Effects beyond mean-field in bosonic quantum systems

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For long, we know that beyond-mean-field effects are essential when fermions form self-bound states as in nuclei or metallic clusters. More recently, an analogous yet somewhat different scenario was realized in experiments with dipolar or binary Bose gases: Self-bound quantum droplets may form out of a gaseous Bose-Einstein condensate stabilized by quantum fluctuations (see the Review by Böttcher et al. [1]). I will discuss the formation of vortices and persistent currents in such self-bound binary boson droplets [2] and comment on implications of these findings for toroidally confined dipolar [3] and binary bosonic [4,5] systems.

[1] *New states of matter with fine-tuned interactions: Quantum droplets and dipolar supersolids*, F. Böttcher *et al.*, Rep. Prog. Phys. **84**, 012403 (2020).

[2] *Persistent currents in toroidal dipolar supersolids*, M. Nilsson Tengstrand *et al.*, Phys. Rev. A **103**, 013313 (2021).

[3] *Rotating binary Bose-Einstein condensates and vortex clusters in quantum droplets*, M. Nilsson Tengstrand *et al.*, Phys. Rev. Lett. **123**, 160405 (2019).

[4] *Breathing mode in two-dimensional binary self-bound Bose-gas droplets*, P. Stürmer *et al.*, Physical Review A **103**, 053302 (2021).

[5] M. Nilsson Tengstrand and S.M. Reimann, *to be published*.