Exotic superfluids in multi-component homogeneous Bose-Einstein condensates

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Inhomogeneous atomic superfluids have been realized experimentally for almost three decades, allowing insight into both the fundamentals of quantum systems as well as promising applications in metrology, quantum information and the emergent field of atomtronics. Recent ground breaking experiments have now demonstrated box-trapped quantum gases [1, 2, 3] – giving a new tool to understand superfluidity in its natural uniform state analagouly to strongly correlated systems like the paradigmatic Helium liquids ^{4}He and ^{3}He [4].

Building on existing phenomenology [5] we explore the properties of uniform quasi-two-dimensional condensates with several interacting internal degrees of freedom, which we model in terms of a multi-component Gross-Pitaevskii equations in the rotating frame for a Bose-Einstein condensate in different experimentally realistic box geometries. The rich parameter space this system affords gives rise to novel superfluids whose vortex morphology and topology we quantity for the first time.

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