Mixture of unequally charged superfluids in a synthetic magnetic field

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We present the effects of a light induced synthetic magnetic field on a mixture of two unequally charged interacting trapped bosonic ultracold atomic superfluids. The details of angular momentum transfer between the two superfluids, the possibility of vortex induction and instabilities of the system are the main focus of our investigation.

A charged Bose gas subject to a magnetic field can transport the effect of Lorentz force to an uncharged Bose gas in the mixture via the interaction between particles. In this case, the gas not coupled to the magnetic field would be accelerated by the other gas. Therefore, there happens a non-dissipative drag of the superfluids as a result of the momentum transport between two systems. The new capabilities presented by the light induced synthetic magnetic field now allows us to investigate more exotic problems such as non-dissipative drag between two unequally charged superfluids in the same space. Accordingly, in this study we investigate the non-dissipative drag between two unequally charged superfluids.

First, we calculate the amount of the angular momentum transferred between two unequally charged superfluids when they are subject to a common magnetic field. We investigate the possibility of vortex induction as a result of angular momentum transfer. We analyze instabilities leading to collapse or phase separation of the system. Accordingly, a phase diagram showing different phases of the system are presented.