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Exploring the dynamics of polar core vortices in homogeneous spin-1 Bose-Einstein condensates

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Atomic superfluids with internal spin degrees of freedom exhibit a rich phenomenology, which in turn heralds their utility in both fundamental research and applications with emerging quantum technologies such as metrology and atomtronics. Complementary to this, it is now feasible to make quantum gases in homogeneous potentials, allowing a stronger connection between existing theoretical methodology and state-of-the-art experiments [1].

In this work, we explore the topological nature of the superfluid vortices present in the ferromagnetic phase of spin-1 Bose-Einstein condensates [2, 3]. In particular we examine the static and dynamic properties of polar core vortices that exist in the so-called easy-plane phase of the spinor system. Comprehensive numerical simulations reveal the structure of the individual vortices, while the dynamics of pairs of these excitations are shown to depend strongly on their individual phase windings as well as the atomic interactions and confining geometry of the homogeneous system. Our findings provide both useful insight as well as being accessible to the current generation of experiments with spinor condensate systems [4].

References

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[4] Y. Xiao, M. O. Borgh, L. S. Weiss, A. A. Blinova, J. Rustekoski, and D. S. Hall, Commun. Phys. 4, 52 (2021).

Short bio (50 words) or link to website

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Relevant publications (optional)

Career stage

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