Abstract Submitted
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Bound-state spectrum of an impurity in a quantum vortex[1] JOÃO E. H. BRAZ, CeFEMA, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal, HUGO TERÇAS, IPFN, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal — The study of quantum many-body systems has unveiled remarkable new physics upon the inclusion of impurities, with the polaron - a hybridization between an electron and a lattice phonon - a paradigmatic example. Though firmly rooted in the phenomenology of solid-state physics, interest in analogue models of polaron physics by immersion of impurities in Bose-Einstein condensates (BECs) has grown recently [J. Tempere et al., Phys. Rev. B 80 (2009)]. In turn, vortices in BECs have been shown to be producible in a controlled manner [J. R. Abo-Shaeer et al., Science 292, 5516 (2001)], whose stability is founded on a topological invariant quantizing the angular momentum of the BEC. In this work, we investigate the problem of an impurity bounded to a single vortex in a quasi two-dimensional (2D) BEC in the mean-field regime, obtaining approximate analytical solutions for the bound-state spectrum; in particular, we show that there is a tunable, finite number of bound states [JEHB, H. Terças, arXiv:1910.08434 (accepted in Phys. Rev. A)]. Such a vortex-impurity system provides a potentially new paradigm for polaron physics in quasi-2D BECs, as well as a promising scheme for the realization of qubits due to the topological stability of the vortex [JEHB, H. Terças, (in preparation)].

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