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Stabilizing Solitonic Dynamics of Ultracold Gases in the BCS-BEC crossover

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We develop a time dependent effective theory based on the PLDA theory [1] for the ground state behaviour of the order parameter of fermions in the BCS-BEC crossover. Our approach is computationally efficient and paves the way to compare with elaborated experimental implementations. With our time dependent theory we study the stability of dark soliton [2,3] solutions at T=0 across the BCS-BEC crossover. We discuss how one can stabilize density fluctuations arising due to non-linear mismatch while seeding the soliton and extend the lifetime of the soliton profile. We analyze possible escenarios relevant for the implementation with ultracold fermions using Spatial Light Modulators (SLM) and Digital Micromirror Devices (DMD). Our dynamical treatment can be extended to include additional corrections as with mPLDA theory[4,5] and finite temperature. This work is partially supported by the grant UNAM-DGAPA-PAPIIT:IN118823, as well as by grants from NVIDIA and utilized NVIDIA RTX 6000 Ada.

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