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Ferrodark solitons in a spinor superfluid: exact solutions, novel speed limit and anomalous dynamics

Tuesday 3 September 2024 12:20 (20 minutes)

Exact propagating topological solitons are found in the easy-plane phase of ferromagnetic spin-1 Bose-Einstein condensates, manifesting themselves as kinks in the transverse magnetization. Propagation is only possible when the symmetry-breaking longitudinal magnetic field is applied. Such solitons have two types: a low energy branch with positive inertial mass and a higher energy branch with negative inertial mass. Both types become identical at the maximum speed, a new speed bound that is different from speed limits set by the elementary excitations. The physical mass, which accounts for the number density dip, is negative for both types. In a finite one-dimensional system subject to a linear potential, the soliton undergoes oscillations caused by transitions between the two types occurring at the maximum speed.

References

1) Xiaoquan Yu and P.B. Blakie, Dark soliton-like magnetic domain walls in a two-dimensional ferromagnetic superfluid, Phys. Rev. Research 3, 023043,(2021)

2) Xiaoquan Yu and P. B. Blakie, Propagating Ferrodark Solitons in a Superfluid: Exact Solutions and Anomalous Dynamics, Phys. Rev. Lett. 128, 125301,(2022)

3) Xiaoquan Yu and P. B. Blakie, Core structure of static ferrodark solitons in a spin-1 Bose-Einstein condensate, Phys. Rev. Research 4, 033056, (2022)

Short bio (50 words) or link to website

https://xiaoquanyu.github.io/resaerch-group-on-quantum-liquid/

Relevant publications (optional)

Career stage

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Track Classification: FINESS