

Dark soliton in a disorder potential

Małgorzata Mochol¹, Marcin Płodzień¹, Krzysztof Sacha¹

¹ *Instytut Fizyki imienia Mariana Smoluchowskiego, Uniwersytet Jagielloński w Krakowie, Poland*

Abstract

We consider a dark soliton in a Bose-Einstein condensate in the presence of a weak disorder potential. Deformation of the soliton shape is analyzed within the Bogoliubov approach and by employing an expansion in eigenstates of the Pöschl-Teller Hamiltonian. Comparison of the results with the numerical simulations indicates that the linear response analysis reveals a good agreement even if the strength of disorder is of the order of the chemical potential of the system. In the second part of the paper we concentrate on the quantum nature of the dark soliton and demonstrate that the soliton may reveal Anderson localization in the presence of disorder. The Anderson localized soliton may decay due to quasi-particle excitations induced by the disorder. However, we show that the corresponding lifetime is much longer than the condensate lifetime in a typical experiment.

References

- [1] M. Mochol, M. Płodzień, K. Sacha, *Phys. Rev. A* **85**, 023627 (2012).
- [2] J. Dziarmaga, *Phys. Rev. A* **70**, 063616 (2004).
- [3] C. Müller, *Appl. Phys. B* **102**, 459 (2011).