

Universal few-body correlations in a Bose polaron

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We study physical properties of an impurity embedded in and strongly interacting with a quantum medium. In particular, we consider a cold atom embedded in a Bose-Einstein condensate of bosonic atoms. This system has recently been realized in cold atom experiments and is referred to as the “Bose polaron” [1, 2]. In contrast to Fermi polaron systems [3, 4], the Bose system can show Efimov physics [5, 6, 7], so that 3-body and associated few-body clusters can appear. We investigate how these Efimov physics can affect quantum many-body behavior in the Bose polaron system. In particular, with a recently developed variational wave function [8], we theoretically study how the Efimov states and their associated length scale can characterize the Bose polaron, and unveil the crucial role of few-body correlations in the Bose polaron.

- [1] M. G. Hu, *et al.* Phys. Rev. Lett. 117, 055301 (2016).
- [2] N. Jorgensen, *et al.* Phys. Rev. Lett. 117, 055302 (2016).
- [3] A. Schirotzek, *et al.* Phys. Rev. Lett. 102, 230402 (2009).
- [4] M. Cetina, M. Jag, R.S. Lous, I. Fritsche, J.T. M. Walraven, R. Grimm, J. Levinsen, M.M. Parish, R. Schmidt, M. Knap, E. Demler, Science 354, 96 (2016).
- [5] V. Efimov, Phys. Lett. B, 33, 563 (1970).
- [6] P. Naidon, S. Endo, Rep. Prog. Phys. 80, 056001 (2017).
- [7] C. H. Greene, P. Giannakeas, J. Perez-Rios, Rev. Mod. Phys. 89, 035006 (2017).
- [8] J. Levinsen, M.M. Parish, G. M. Bruun, Phys. Rev. Lett. 115, 125302 (2015).