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Pfaffian, Onishi formula and Wick's theorem

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Since the pioneering work of Robledo [1], the Pfaffian has been extensively studied in nuclear physics. With the use of the Grassmann integrals, his work gives an excellent answer to the sign-problem in the overlap between HFB wave functions (Onishi formula [2] proposed in half a century ago). After Robledo's work, I have also studied some extensions [3] and applications. Here I will talk about the following topics :

1. Basics of Pfaffian and matrix elements of quantum many-body system
2. Pfaffian and sign-problem of Onishi formula
   – Pfaffian formula for overlap of HFB wave functions
   – Origin of the sign-problem and liked cluster theorem
3. Pfaffian and Wick's theorem

I will show some examples of Pfaffian in other fields of quantum many-body physics.

[1] L.M. Robledo, Phys. Rev. C 79 (2009), 021302(R).
[2] N. Onishi, S. Yoshida, Nucl. Phys. 80 (1966) 367.
[3] M. Oi, T. Mizusaki, Phys. Lett. B 707 (2012) 305, T. Mizusaki, M. Oi, Phys. Lett. B 715 (2012) 219,T. Mizusaki, M. Oi, F. Chen, Y. Sun, Phys. Lett. B 725 (2013) 175, T.Mizusaki, M.Oi, N.Shimizu, Phys. Lett. B779 (2018) 237.

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