Theoretical Quantum Physics

Group Seminar

11:00 AM
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Online (Zoom)

Fermionic Mode Entanglement: The Good, the Bad, and the Ugly.

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Abstract

In this talk, I will review the notion of mode entanglement in fermionic systems (based on [1] and references therein). For bosonic systems, there is nothing unusual about considering quantum states with no fixed particle content, and talking about entanglement and general quantum information processing tasks with such states is common practice. For fermions, the situation is somewhat more complicated since the Pauli principle and superselection rules for parity and particle number severely restrict both the theoretical and the practical options for exploiting fermionic mode entanglement (FME). The crucial questions that we want to examine here are: (1) How can we sensibly define and quantify FME? (2) What can we do with FME? In attempting to answer these questions, we will come across three observations (though not necessarily in that order): The Good: FME can be used for typical quantum information processing tasks such as teleportation or violation of Bell inequalities. The Bad: There is a lot of fine print on the above statement regarding what exactly is meant by teleportation and Bell inequality violation. And finally, the Ugly: Some of this fine print concerns the relation between the quantification of FME and the practical usefulness of a given state leading to so-called mixed maximally entangled states.

[1] Tiago Debarba, Fernando Iemini, Géza Giedke, and Nicolai Friis, *Teleporting quantum information encoded in fermionic modes*, Phys. Rev. A **101**, 052326 (2020), Preprint: arXiv:2002.08201 [quant-ph].

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