Theoretical Quantum Physics

Group Seminar

11:00 AM 29/07/2020

Online (Zoom)

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Abstract

For systems consisting of distinguishable particles, there exists an agreed upon notion of entanglement which is fundamentally based on the possibility of addressing individually each one of the constituent parties. Instead, the indistinguishability of identical particles hinders their individual addressability and has prompted diverse, sometimes discordant definitions of entanglement. In the present review, we provide a comparative analysis of the relevant existing approaches, which is based on the characterization of bipartite entanglement in terms of the behaviour of correlation functions. Such a point of view provides a fairly general setting where to discuss the presence of non-local effects; it is performed in the light of the following general consistency criteria: i) entanglement corresponds to non-local correlations and cannot be generated by local operations; ii) when, by “freezing” suitable degrees of freedom, identical particles can be effectively distinguished, their entanglement must reduce to the one that holds for distinguishable particles; iii) in absence of other quantum resources, only entanglement can outperform classical information protocols. These three requests provide a setting that allows to evaluate strengths and weaknesses of the existing approaches to indistinguishable particle entanglement and to contribute to the current understanding of such a crucial issue. Indeed, they can be classified into five different classes: four hinging on the notion of particle and one based on that of physical modes. We show that only the latter approach is consistent with all three criteria, each of the others indeed violating at least one of them.

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