Theoretical Quantum Physics

Group Seminar

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Quantifying the effect of fermionic interactions: a quantum correlations perspective

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Abstract

Free fermion systems enjoy a privileged place in physics. With their simple structure they can explain a variety of effects, ranging from insulating and metallic behaviours to superconductivity and the integer quantum Hall effect. Interactions, e.g. in the form of Coulomb repulsion, can dramatically alter this picture by giving rise to emerging physics that may not resemble free fermions. Examples of such phenomena include high-temperature superconductivity, fractional quantum Hall effect, Kondo effect and quantum spin liquids. The non-perturbative behaviour of such systems remains a major obstacle to their theoretical understanding that could unlock further technological applications.

In this talk I will present a pedagogical review of "interaction distance" [Nat. Commun. 8, 14926 (2017)] -- a systematic method that quantifies the effect interactions can have on the energy spectrum and on the quantum correlations of generic many-body systems. In particular, the interaction distance is a diagnostic tool that identifies the emergent physics of interacting systems. I will illustrate this method with various integrable and non-integrable models.

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