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Exact Results of Fermi Polarons with Ultracold Atoms

Wednesday 4 September 2024 09:40 (40 minutes)

The behaviour of an impurity immersed in a many-body Fermi sea –the so-called Fermi polaron problem –is a long-standing challenge in condensed matter physics and many-body physics. Over the last two decades, there are numerous efforts from ultracold atom community to quantitatively understand the Fermi polaron physics. To date, the ground state of the attractive Fermi polaron has been theoretically predicted and experimentally measured to a great accuracy. However, describing the excited states of Fermi polarons proves to be notably difficult and current theoretical works fail to explain the latest spectral measurement at finite temperature.

In this talk, we present two exact results for the finite-temperature spectral function of Fermi polarons. On the one hand, we propose an exactly solvable model in the immobile heavy polaron limit, which exactly establishes various salient quasiparticle features in the spectral function. On the other hand, we derive an exact set of equations of the spectral function for mobile Fermi polarons, by using the diagrammatic theory and by including particle-hole excitations of the Fermi sea shake-up to arbitrarily high orders. This provides a very rare case that a quantum many-body system can be exactly solved by working out the complete Feynman diagrams. Our exact results of Fermi polarons might be used to better understand the intriguing polaron dynamical responses in two or three dimensions, whether in free space or within lattices.

References

Short bio (50 words) or link to website

https://www.swinburne.edu.au/research/our-research/access-our-research/find-a-researcher-or-supervisor/researcher-profile/?id=hhu

Relevant publications (optional)

Career stage

Professor

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Track Classification: FINESS