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Séminaire de Physique Nucléaire Théorique

Can one sum up all Feynman diagrams for the unitary Fermi gas ?

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The unitary Fermi gas is a textbook model of strongly correlated fermions that accurately describes ultracold-atom experiments and is also relevant to neutron matter [1]. I will present our long-term project on reliable and accurate computation of equilibrium properties of the unitary Fermi gas by systematic summation of Feynman diagrams.

Thanks to a diagrammatic Monte Carlo algorithm, we accurately sample all skeleton diagrams (built on dressed single-particle and pair propagators) up to order ~ 9. The diagrammatic series is divergent and there is no small parameter so that a resummation method is needed. Previously we used Abelian resummation methods, which are applicable under the assumption that the diagrammatic series has a non-zero radius of convergence ; this led to good agreement with experimental data for the equation of state [2] and Tan's contact [3]. In our more recent work [4], we compute analytically the large-order asymptotics of the diagrammatic series, and find that even though the radius of convergence is actually zero, the series is resummable by a generalised conformal-Borel transformation. Our new data for the equation of state and the contact are consistent with the old ones, but the resummation procedure is now mathematically justified and the error bars are significantly smaller. I will also discuss the computational complexity of diagrammatic Monte Carlo algorithms [5], including the new algorithm of [6]. 1] G. C. Strinati, P. Pieri, G. Roepke, P. Schuck, and M. Urban, Physics Reports 1, 738 (2018)

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[3] K. Van Houcke, F. Werner, E. Kozik, N. Prokof'ev, B. Svistunov, arXiv :1303.6245

[4] R. Rossi, T. Ohgoe, K. Van Houcke, F. Werner, arXiv :1802.07717

[5] R. Rossi, N. Prokof'ev, B. Svistunov, K. Van Houcke, F. Werner, EPL 118, 10004 (2017)

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