Contribution ID: **11** Type: **Contributed talk**

Odd-frequency superfluidity from a particle-number-conserving perspective

Wednesday 4 September 2024 15:20 (20 minutes)

We investigate odd-in-time—or *odd-frequency*—pairing of fermions in equilibrium systems within the particle-number-conserving framework of Penrose, Onsager and Yang, where superfluid order is defined by macroscopic eigenvalues of reduced density matrices. We show that odd-frequency pair correlations are synonymous with even fermion-exchange symmetry in a time-dependent correlation function that generalises the two-body reduced density matrix [1]. Macroscopic even-under-fermion-exchange pairing is found to emerge from conventional Penrose-Onsager-Yang condensation in two-body or higher-order reduced density matrices through the symmetry-mixing properties of the Hamiltonian. We identify and characterise a *transformer* matrix responsible for producing macroscopic even fermion-exchange correlations that coexist with a conventional Cooper-pair condensate, while a *generator* matrix is shown to be responsible for creating macroscopic even fermion-exchange correlations from hidden orders such as a multi-particle condensate. The transformer scenario is illustrated using the spin-imbalanced Fermi superfluid as an example. The generator scenario is demonstrated by the composite-boson condensate arising for itinerant electrons coupled to magnetic excitations. Structural analysis of the transformer and generator matrices is shown to provide general conditions for odd-frequency pairing order to arise in a given system.

References

[1] Thompson, K., U. Zülicke, M. Governale, and J. Brand. "Odd-Frequency Superfluidity from a Particle-Number-Conserving Perspective."arXiv, March 10, 2024. https://doi.org/10.48550/arXiv.2403.06325.

Short bio (50 words) or link to website

Professor Brand completed obtained his PhD from the University of Heidelberg. After a postdoctoral research fellowship at the University of Washington and the Max Planck Institute for the Physics of Complex Systems he joined Massey University in 2006.

Relevant publications (optional)

Thompson, K., U. Zülicke, M. Governale, and J. Brand. "Odd-Frequency Superfluidity from a Particle-Number-Conserving Perspective."arXiv, March 10, 2024. https://doi.org/10.48550/arXiv.2403.06325.
Reynolds, L. A., E. Schwartz, U. Ebling, M. Weyland, J. Brand, and M. F. Andersen. "Direct Measurements of Collisional Dynamics in Cold Atom Triads."Physical Review Letters 124, no. 7 (February 18, 2020): 073401. https://doi.org/10.1103/PhysRevLett.124.073401.
Yang, Mingrui, Matija Čufar, Elke Pahl, and Joachim Brand. "Polaron-Depleton Transition in the Yrast Excitations of a One-Dimensional Bose Gas with a Mobile Impurity."Condensed Matter 7, no. 1 (January 26, 2022): 15. https://doi.org/10.3390/condmat7010015.

Career stage

Professor

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Track Classification: FINESS