复旦大学物理系 Colloquium

Time: 14:00, Monday, 2024.12.02

Location: C108, Jiangwan Physics Building

Heat propagation in liquid ^{3}He and in metallic Fermi liquids

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Abstract: The normal liquid 3He conforms to Landau's Fermi liquid picture, but only at very low temperature. We will show that to explain its thermal conductivity [1] in the whole temperature range, one needs to assume that it is the sum of two contributions: one by quasi-particles (varying as the inverse of temperature) and another by a hydrodynamic sound mode (following the square root of temperature) [2]. The first component has been known for decades. The second is a collective [sound] mode [3] with a ~2k_F wave-vector in the hydrodynamic limit. Our expression for it, derived from Landauer's formula, is a quantum version of the Bridgman equation for thermal conductivity of classical liquids [4]. This collective mode may be relevant to transport in strongly correlated Fermi liquids whose resistivity deviates from a quadratic behavior well below the Fermi temperature.

[1] D. S. Greywall, Phys. Rev. B **29**, 4933 (1984).
[2] K. Behnia & K. Trachenko, Nature Commun. **15**, 1771 (2024).
[3] F. Albergamo et al., Phys. Rev. Lett. **99**, 205301 (2007).
[4] P. W. Bridgman, P. W. Proc. Am. Acad. Arts Sci. **59**, 141–169 (1923).

Biography: Kamran Behnia obtained his Ph.D. in 1990 in Grenoble. After two years of postdoctoral fellowship at University of Geneva, he was employed by Centre National de la Recherche Scientifique (CNRS) and spent seven years working on organic and cuprate superconductors at Paris-Sud (now Paris-Saclay) University. Since 2000, he has been based at Ecole Supérieure de Physique et de Chimie Industrielles (ESPCI) in Paris exploring collective quantum phenomena in a variety of solids ranging from semimetals to superconductors. His monograph Fundamentals of Thermoelectricity was published by Oxford University Press in 2015.