复旦大学物理系 Colloquium

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Excitations, Spin-Charge Separation, and Quantum Phase Transition

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Abstract: Quasi-particles play important role in condensed matter physics and result in many emergent novel phenomena. In this talk, we discuss collective excitations in one-dimension as exemplified by antiferromagnetic Heisenberg model and δ-function interacting Fermi gas (Yang-Gaudin model). Using the thermodynamic Bethe ansatz (TBA) formalism, we analytically derive universal properties of the models with arbitrary interaction strength, and present a rigorous understanding of spin-charge separation, a unique feature predicted by the Tomonaga-Luttinger liquid (TLL) theory. Spinon, as an elementary spin excitation, is responsible for the TLL. We show that a dimensionless quantity, the Wilson ratio (RW), elegantly characterizes quantum liquid phase diagram. For the TLL phase, RW = 4Ks remains almost temperature independent, where Ks is the Luttinger parameter. WR can be used to identify quantum phase transitions for a wide variety of materials. Based on the exact low-lying excitation spectra, we further evaluate the spin and charge dynamical structure factors (DSFs). The peaks of the DSFs exhibit distinguishable propagating velocities of spin and charge as functions of interaction strength, which can be observed by Bragg spectroscopy with ultracold atoms.

林海青, 教授。1981年中国科学技术大学学士。1980年CUSPEA。1983年美国Iowa州立大学，理学硕士。1987年美国加州大学San Diego分校物理系，物理学博士。博士毕业后美国Brookhaven国家实验室副研究员（Research Associate），1987-1989;美国Los Alamos国家实验室副研究员（Research Associate），1989-1991;1991年10月-1995年7月美国University of Illinois at Urbana-Champaign物理系Research Assistant Professor。1995年8月至2012年9月香港中文大学物理系 副教授，教授 2009年8月至今，中国工程物理研究院、北京计算科学研究教授。2019年11月，当选为中国科学院院士。主要从事凝聚态物理和计算物理的研究。主要研究兴趣包括：关联系统，量子纠缠和量子相变，以及多体系统的数值方法。

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