凝縮系物理学ゼミナール
Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学 5 号館 413 号室)
Time and date: 13:30 – 15:00, Wednesday, 16 July 2014

Quantum drag in 1D cold atom systems

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Abstract:
Recently non-equilibrium dynamics of cold atom systems has been enthusiastically targeted, because cold atom systems are ideal as isolated quantum systems configured in laboratory, whose parameters can be modified dynamically [1]. While the dynamics of quantum quench has been explored by suddenly changing the trap potential and the interaction, dynamics induced by a gradual change of parameters in real time has a lot more to be investigated.

We study typical drag dynamics of several fermions in a fermion cloud in one-dimensional continuous systems, with particular emphasis on the non-trivial quantum many-body effects in systems whose parameters change gradually in real time. We adopt the Fermi-Hubbard model and the time-dependent density matrix renormalization group method [2] to calculate the drag force on a trapped fermion cluster in a cloud of another fermions species with contact interaction. A non-trivial peak in the resistance force is observed in the large cloud density region, and it is suggested that some momentum redistribution processes have a crucial role in the excitation process. We propose a simplified model which explains the detail of the excitation process and also the origin of the resistance peak. This model emphasizes the difference between the full-quantum calculation and the semiclassical calculation, which is the quantum effects, in slow dynamics of many-body systems bound in a fermion cloud.

References:
[1] A. Sommer, M. Ku, G. Roati and M.W. Zwierlein, Nature 472, 201 (2011).
[2] S. R. White and A. E. Feiguin, Phys. Rev. Lett. 93, 076401 (2004).