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)

Date: **13:30-15:00**, Wednesday, 19 September 2018

“Doublon dynamics in the Hubbard model”

Speaker:

Dr. Roman Rausch (Condensed Matter Theory Group)

Abstract:

This talk aims to provide a better understanding of the role and behaviour of "doublons" (repulsively bound holes or electrons) which govern the physics of the Hubbard model in many regimes. They are relevant for spectroscopies, thermalization behaviour of closed systems and can be prepared directly in ultracold lattices.

In the first part, the two-hole excitation spectra of the one-dimensional Hubbard model are studied for all fillings using the density-matrix renormalization group (DMRG) in combination with the Chebyshev polynomial expansion technique. Experimentally, this corresponds to Auger Electron Spectroscopy (AES). The spectra reveal what can be called "multiplon" physics, which means that the relevant final states are not only characterized by two holes (doublon), but also by three (triplon), four (quadruplon) and more; potentially forming stable compound objects or resonances. A comparison with the Bethe ansatz reveals the decay channels of the initial doublon excitation into spinons and holons in one dimension. Furthermore, one discovers that the doublon lifetime surprisingly becomes infinite at the Brillouin zone edge despite interactions. This can be traced back to the "hidden" charge-SU(2) symmetry of the Hubbard model.

In the second part, the fate of a local two-hole doublon excitation is studied in real-time. It shows a mixed ballistic-diffusive propagation through the lattice with a partial decay. The dynamics of this decay is discussed as a function of filling and interaction strength. The ambivalent role of singly occupied sites is key in understanding the time-dependent doublon physics: For high fillings, ground-state configurations with single occupancies are able to open up decay channels. For fillings close to half filling, however, their presence actually helps the doublon to propagate ballistically.