

# Mobile impurities in one-dimensional cold gases: subdiffusive, diffusive and ballistic regimes.

**Dr. Adrian Kantian**  
(Universität Genf)

## Abstract:

Advances in cold gases physics are beginning to enable experiments involving the direct manipulation and observation of single- or few-atom mobile impurities [1] within a many-body quantum system, a topic of longstanding interest for condensed matter theory, where it is related to studies of e.g. conductivity and the X-ray edge problem. Further progress in this direction is expected from the latest generation of experiments offering single-site addressability in optical lattices [2,3].

In light of these developments we study the dynamics of mobile impurities in 1D quantum liquids using a DMRG technique. We address the recently proposed subdiffusive regime of impurity motion [4], a class of excitations beyond those described by the standard Tomonaga-Luttinger theory. We study the conditions for observing this regime and its crossover to the ballistic regime. We furthermore examine the possibilities to observe the intermediate diffusive motion of impurities in these systems.

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[3] J. F. Sherson, C. Weitenberg, M. Endres et. al., Nature, 467, 7311 (2010)

[4] M. B. Zvonarev, V. V. Cheianov, T. Giamarchi, PRL 99, 240404 (2007); PRL 103, 110401 (2009)