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"Low dimensional systems"
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organized by
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- **Monday, May 7, 2018**
  11:00 Gergeley Zarand (Budapest)
  Semi-semiclassical theory of one-dimensional non-equilibrium systems

  I intend to review some of the applications of our recently developed semi-semiclassical theory of non-equilibrium systems and quantum quenches. Our hybrid semiclassical method handles internal degrees of freedom completely quantum mechanically, and accounts efficiently for entanglement entropy generation by these. In non-equilibrium situations, we can follow the time evolution up to timescales at which local equilibration occurs. As an application, we investigate the quench dynamics and phase fluctuations of a pair of tunnel coupled one dimensional Bose condensates described by the sine-Gordon model, where we have also obtained a full analytical semiclassical description of phase correlations in the so-called universal limit.

  Using this semi-semiclassical approach, we also study inhomogeneous charge (spin) relaxation and the formation of non-equilibrium steady states in non-linear sigma models. Depending on the initial conditions - spin transport is found to be ballistic or diffusive. In the ballistic case we identify a "second front" that moves more slowly than the maximal quasiparticle velocity, spreads diffusively, and equilibrates locally.

  References:
  C.P Moca, M. Kormos, and G. Zaránd, Phys. Rev. Lett. 119, 100603 (2017)
  M. Kormos and G. Zaránd, Phys. Rev. E 93, 062101 (2016)
  M. Kormos, C.P Moca, and G. Zarnd, arXiv:1712.09466
  M. Werner et al, unpublished.

- **Tuesday, May 8, 2018**
  10:00 Marcos Rigol (Penn State)
  Emergent eigenstate solution to quantum dynamics far from equilibrium

  The quantum dynamics of interacting many-body systems has become a unique venue for the realization of novel states of matter. In this talk, we discuss how it can lead to the generation of time-evolving states that are eigenstates of emergent local Hamiltonians, not trivially related to the ones dictating the time evolution. We study geometric quenches in fermionic and bosonic systems in one-dimensional lattices, and provide examples of experimentally relevant time-evolving states [1,2] that are either ground states or highly excited eigenstates of emergent local Hamiltonians [3]. We also discuss the expansion of Mott insulating domains at finite temperature. Surprisingly, the melting of the Mott domain is accompanied by an effective cooling of the system [4]. We explain this phenomenon analytically using the equilibrium description provided by the emergent local Hamiltonian [4,5].

References: [1]L. Vidmar, J. P. Ronzheimer, M. Schreiber, S. Braun, S. S. Hodgman, S. Langer, F. Heidrich-Meisner, I. Bloch, and U. Schneider, Phys. Rev. Lett. 115, 175301 (2015).
[2]M. Rigol and A. Muramatsu, Phys. Rev. Lett. 93, 230404 (2004).
[3]L. Vidmar, D. Iyer, and M. Rigol, Phys. Rev. X 7, 021012 (2017).
[4]W. Xu and M. Rigol, Phys. Rev. A 95, 033617 (2017).
[5]L. Vidmar, W. Xu, and M. Rigol, Phys. Rev. A 96, 013608 (2017).

11:30 David Weiss (Penn State)
Dynamics of 1D gases, integrable and otherwise

My talk will consider two aspects of 1D Bose gases. First, I will describe experiments that observe dynamical fermionization in 1D Bose gases, by which the underlying conserved quantities in these very nearly integrable, quantum degenerate, many-body systems can be directly measured. Second, I will describe experiments with highly excited 1D gases, co-called quantum Newton's cradles. In the short run, these 1D collisional systems reach a steady state that is not thermal. Weakly non-integrable terms in the Hamiltonian can lead to the onset of thermalization due to diffractive 3-body collisions. We experimentally infer the presence of these diffractive 3-body collisions.

- **Wednesday, May 9, 2018**
  11:00 Alexei Tsvelik (Brookhaven National Laboratory)
  Fractionalized Fermi liquid in a Condo-Heisenberg model

  The Kondo-Heisenberg model is used as a controllable tool to demonstrate the existence of a peculiar metallic state with unbroken translational symmetry where the Fermi surface volume is not controlled by the total electron density. I use a non-perturbative approach where the strongest interactions are taken into account by means of exact solution, and corrections are controllable. In agreement with the general requirements formulated in (T. Senthil et.al. Phys. Rev. Lett. 90, 216403 (2003)), the resulting metallic state represents a fractionalized Fermi liquid where well defined quasiparticles coexist with gapped fractionalized collective excitations. The system undergoes a phase transition to an ordered phase (charge density wave or superconducting), at the transition temperature which is parametrically small in comparison to the quasiparticle Fermi energy.