MP 13: Tensor Networks II

Time: Wednesday 16:30–17:10 Location: H-HS I

MP 13.1 Wed 16:30 H-HS I

From spin chains to real-time thermal field theory using tensor networks — Mari Carmen Bañuls[1,2], Michał P. Heller[3,4], Karl Jansen[5], •Johannes Knaute[3,6], and Viktor Svensson[3,4] — [1]Max Planck Institute of Quantum Optics, 85748 Garching bei München, Germany — [2]Munich Center for Quantum Science and Technology (MCQST), 80799 München, Germany — [3]Max Planck Institute for Gravitational Physics (Albert Einstein Institute), 14476 Potsdam-Golm, Germany — [4]National Centre for Nuclear Research, 00-681 Warsaw, Poland — [5]NIC, DESY-Zeuthen, 15738 Zeuthen, Germany — [6]Department of Physics, Freie Universität Berlin, 14195 Berlin, Germany

One of the most interesting directions in theoretical high-energy physics is understanding dynamical properties of collective states of quantum field theories. The most elementary tool in this quest are retarded equilibrium correlators governing the linear response theory. In the present letter we examine tensor networks as a way of determining them in a fully ab initio way in a class of (1+1)-dimensional quantum field theories arising as infrared descriptions of quantum Ising chains. We show that, complemented with signal analysis using the Prony method, tensor network calculations for intermediate times provide a powerful way to explore the structure of singularities of the correlator in the complex frequency plane.

MP 13.2 Wed 16:50 H-HS I

Scale and Translation invariant Tensor Networks — •Sukhbinder Singh — Max-Planck Institute for Gravitational Physics (Albert Einstein Institute), Potsdam

Entanglement renormalization (ER) [1] is a lattice renormalization group (RG) transformation that is described by a tensor network. Substantial numerical evidence indicates that it is capable of *approximating* the expected RG fixed points, both in gapped and critical phases of 1D quantum lattice systems. ER also generates the multi-scale entanglement renormalization ansatz (MERA) [2] — an efficient tensor network representation, in particular, of 1D critical ground states, from which the underlying conformal field theory (CFT) data can be accurately estimated [3,4]. I will describe first steps towards formalizing the *exact* relationship between ER and RG fixed points (beyond numerical approximations). A generic ER transformation breaks the symmetries that emerge at RG fixed points. I will propose certain *polynomial tensor constraints* that characterize (a subset of) ER transformations with *translation-invariant* fixed points. I show that some solutions of these constraints correspond to 2d TQFTs, which describe RG fixed points in gapped phases. I discuss why there may also be solutions that correspond to 2d *rational* CFTs. An exact relationship between ER fixed points and 2d CFTs might provide a novel pathway to bootstrap 2d CFTs directly on the lattice and illuminate holographic properties of the MERA [5]. **References** 1. G. Vidal, PRL 99 (2007). 2. G. Vidal, PRL 101 (2008). 3. V. Giovannetti et al PRL. 101 (2008) 4. R. Pfeifer et al PRA(R) 79(4) (2009) 5. B. Swingle, PRD 86 (2012).