MP 1: Quanten-Information I

Time: Monday 15:00–16:00 Location: SPA SR125

MP 1.1 Mon 15:00 SPA SR125

Emergence of coherence and the dynamics of quantum phase transitions — Simon Braun[1,2], •Mathis Friesdorf[3], Sean Hodgman[1,2], Michael Schreiber[1,2], Jens Philipp Ronzheimer[1,2], Arnau Riera[3,4], Marco del Rey[5], Immanuel Bloch[1,2], Jens Eisert[3], and Ulrich Schneider[1,2] — [1]Max-Planck-Institut für Quantenoptik, Garching, Germany — [2]Ludwig-Maximilians-Universität München, Munich, Germany — [3]Freie Universität Berlin, Berlin, Germany — [4]Max Planck Institute for Gravitational Physics, Potsdam-Golm, Germany — [5]Instituto de Fisica Fundamental, CSIC, Madrid, Spain

We investigate the dynamical emergence of coherence when crossing the Mott to superfluid quantum phase transition in the precisely controllable setup of ultracold atoms, experimentally addressing long-standing questions on the dynamics of quantum phase transitions. For one-dimensional systems, we find perfect agreement between experimental observations and numerical simulations of homogeneous systems, thus performing a certified quantum simulation. For intermediate quench velocities, we observe a power-law behaviour of the coherence length, reminiscent of the Kibble-Zurek mechanism. Contrary to what the latter suggests, we find a complex behaviour, yielding exponents that strongly depend on the final interaction strength in the superfluid. By using the full power of the quantum simulation, we also explore the emergence of coherence in higher dimensions as well as for negative temperatures. We connect our findings with insights into the propagation of quasiparticles and close-to-adiabatic quantum evolutions.

MP 1.2 Mon 15:20 SPA SR125

Optimality of entropic uncertainty relations — •Kais Abdelkhalek[1], Jörg Duhme[1], Berthold-Georg Englert[2], Fabian Furrer[3], Hans Maassen[4], Philippe Raynal[2], René Schwonnek[1], and Reinhard F. Werner[1] — [1]Institut für Theoretische Physik, Leibniz Universität Hannover, Hannover, Germany — [2]Centre for Quantum Technologies and Department of Physics, National University of Singapore, Singapore — [3]Department of Physics, Graduate School of Science, University of Tokyo, Tokyo, Japan — [4]Department of Mathematics, Radboud University, Nijmegen, The Netherlands

We investigate the optimality of the entropic uncertainty relation proven by Maassen and Uffink and its generalisation to side information from Berta *et al* for observables, for which the lower bound attains its maximal value. Here, we call an uncertainty relation optimal if the lower bound can be attained for any value of either of the corresponding uncertainties. We show that the uncertainty relation with side information cannot be optimised. In the case of the Maassen-Uffink uncertainty relation, we disprove a conjecture by Englert *et al* and provide a characterisation of those states that parametrise the optimal lower bound. This leads to a new conjecture.

MP 1.3 Mon 15:40 SPA SR125

A Monte Carlo Time-Dependent Variational Principle — •Fabian W. G. Transchel, Ashley Milsted, and Tobias J. Osborne — Institut für Theoretische Physik, Appelstr. 2, Hannover, D-30167, Germany

We generalize the Time-Dependent Variational Principle (TDVP) to dissipative systems using Monte Carlo methods, allowing the application of existing variational classes for pure states, such as Matrix Product States (MPS), to the simulation of Lindblad master equation dynamics. The key step is to use sampling to approximately solve the Fokker-Planck equation derived from the Lindblad generators. An important computational advantage of this method, compared to other variational approaches to mixed state dynamics, is that it is *embarrassingly parallel*.