MP 17: Entropy in Quantum Field Theory

Time: Thursday 16:30–18:10 Location: H6

MP 17.1 Thu 16:30 H6

Relative entropy of coherent states on general CCR algebras — Henning Bostelmann[1], •Daniela Cadamuro[2], and Simone Del Vecchio[2] — [1]University of York, Department of Mathematics, York YO10 5DD, United Kingdom — [2]Institut für Theoretische Physik, Universität Leipzig, Brüderstraße 16, 04103 Leipzig

The study of relative entropy between states in quantum field theory has recently attracted much attention in connection with the quantum null energy condition; usually one considers the vacuum and a coherent excitation, and the relative entropy with respect to a wedge algebra. In generalization of this, we study the relative entropy for a subalgebra of a generic CCR algebra between a general (possibly mixed) quasifree state and a coherent excitation of it. We give a formula for this entropy in terms of single-particle modular data. We also investigate changes of the relative entropy along subalgebras arising from an increasing family of symplectic subspaces, and study lower estimates for the second derivative of the relative entropy along this family, which replace the usual notion of convexity of the entropy. Our main input is a regularity condition for the family of subspaces (differential modular position) which generalizes the notion of half-sided modular inclusions. Examples include thermal states for the conformal U(1)-current.

MP 17.2 Thu 16:55 H6

Relative entropic uncertainty relation for scalar quantum fields — Stefan Flörchinger, •Tobi Haas, and Markus Schröfl — Institut für Theoretische Physik, Universität Heidelberg

Entropic uncertainty is a well-known concept to formulate uncertainty relations for continuous variable quantum systems with finitely many degrees of freedom. Typically, the bounds of such relations scale with the number of oscillator modes, preventing a straight-forward generalization to quantum field theories.

In this talk, I will present a way of overcoming this difficulty by introducing the notion of a functional relative entropy, which has a meaningful field theory limit. I will present the first entropic uncertainty relation for a scalar quantum field theory and illustrate that its bound remains finite also for an infinite number of oscillator modes.

MP 17.3 Thu 17:20 H6

Entanglement entropy between spatial regions of an interacting condensate — •Natalia Sánchez-Kuntz and Stefan Flörchinger — ITP, Heidelberg University, Philosophenweg 16, D-69120 Heidelberg, Germany

We treat a nonrelativistic limit of QFT in which the entanglement entropy is finite in the UV. Furthermore we show that a scaling of the entanglement entropy with the system size for relativistic phonons is recovered. We discuss the emergence of an IR divergence, and its relation to zero modes. We compare this with other theories with similar behaviour.

We show the results related to a Bose-Einstein condensate in 1+1 dimensions and comment on further questions we are exploring at the moment, along with some challenges that come our way.

MP 17.4 Thu 17:45 H6

Inverted c-functions in thermal states — •Matthias Kaminski and Casey Cartwright — Department of Physics and Astronomy, University of Alabama,514 University Boulevard, Tuscaloosa, AL 35487, USA

We first compute the effect of a chiral anomaly, charge, and a magnetic field on the entanglement entropy in N=4 Super-Yang-Mills theory at strong coupling via holography. Depending on the width of the entanglement strip the entanglement entropy probes energy scales from the ultraviolet to the infrared energy regime of this quantum field theory prepared in a given state. From the entanglement entropy, we then compute holographic c-functions and demonstrate an inverted c-theorem for them. That is, these c-functions in generic thermal states monotonically increase towards the infrared energy regime in contrast to the c-functions in vacuum states which decrease along the renormalization group flow from the ultraviolet to the infrared regime. In these thermal states, the c-functions in the infrared limit are proportional to the value of the thermal entropy.