MP 2: Quantum Field Theory I

Time: Monday 16:30–18:00 Location: ZEU/0250

MP 2.1 Mon 16:30 ZEU/0250

String-localized quantum field theory: the reverse side of the BRST coin — •Karl-Henning Rehren[1], Jens Mund[2], and Bert Schroer[3] — [1]Universität Göttingen — [2]Universidade Federal de Juiz de Fora, Brazil — [3]Freie Universität Berlin

Gauge symmetry is most successful at predicting the structure of all interactions among particles in the Standard Model. Yet, it addresses exclusively non-observable entities (gauge potentials and Fermi fields). One may ask how "fundamental" such a principle can be.

Quantum gauge symmetry can only be formulated on state spaces with indefinite metric ("negative probabilities"). The BRST method allows to return to a Hilbert space. Charged interacting fields are not defined on this Hilbert space, because they are not BRST-invariant.

An alternative is presented with the same (and in one instance even superior) predictive power on the structure of interactions. It proceeds directly on the physical Hilbert space, and allows to construct interacting charged fields. They exhibit a weaker localization than usual, while observables coincide with those in the BRST setup.

arxiv:2209.06133v2

MP 2.2 Mon 17:00 ZEU/0250

On the mass dependence of the modular operator for a double cone — •Christoph Minz[1], Henning Bostelmann[2], and Daniela Cadamuro[1] — [1]Institut für Theoretische Physik, Universität Leipzig — [2]University of York, Department of Mathematics

We present a numerical approximation scheme for the Tomita-Takesaki modular operator of local subalgebras in linear quantum fields, where the modular data are determined at one-particle level using time-0 formulation in position space. The technique is tested against the known results for the local subspace of a right wedge in 2-dimensional Minkowski spacetime, where one component of the modular operator is known to be a mass-independent multiplication operator. Applying the same technique to the unknown case of a double cone in 2 (and 4) dimensions, we find that the same component of the modular operator depends on the mass (and angular momentum).

MP 2.3 Mon 17:20 ZEU/0250

Information theoretic properties of soft photon clouds — •Henning Bostelmann[1], Daniela Cadamuro[2], and Wojciech Dybalski[3] — [1]Department of Mathematics, University of York, UK — [2]Institute for Theoretical Physics, University of Leipzig, Germany — [3]Adam Mickiewicz University, Poznań, Poland

In quantum field theories with massless particles, states which describe clouds of soft photons in front of the vacuum are macroscopically different from the vacuum state: in mathematical terms, they lead to inequivalent representations of the quasilocal observable algebra, and a global "photon charge" labels these representations.

Here we investigate this macroscopic difference from an information-theoretic perspective. In a massless free theory, we compute the relative entropy between a coherent photon cloud state and the vacuum with respect to the forward lightcone algebra. It turns out that this entropy is infinite if, and only if, the "photon charge" of the cloud is zero.

MP 2.4 Mon 17:40 ZEU/0250

Quantum energy inequality in the Sine-Gordon model — •Markus B. Fröb and Daniela Cadamuro — Institut für Theoretische Physik, Universität Leipzig, Germany

We consider the massless Sine–Gordon model in the finite regime $\beta^2 < 4\pi$ of the theory. We prove convergence of the renormalised perturbative series for the interacting stress tensor defined using the Bogoliubov formula in an arbitrary Hadamard state, even for the case that the smearing is only along a one-dimensional time-like worldline and not in space-time. We then show that the interacting energy density, as seen by an observer following this worldline, satisfies an absolute lower bound, that is a bound independent of the quantum state. Our proof employs and generalises existing techniques developed for free theories by Flanagan, Fewster and Smith.