MP 10: Quantum Field Theory: gauge theories

Time: Wednesday 12:00–13:00 Location: H-HS VII

MP 10.1 Wed 12:00 H-HS VII

Perturbative construction of a string-localized Dirac field in a Hilbert space representation of QED — A program. — •Jens Mund[1], Karl-Henning Rehren[2], and Bert Schroer[3] — [1]Universidade Federal de Juiz de Fora, Brazil — [2]Georg-August Universität Göttingen, Deutschland — [3]CBPF, Rio de Janeiro, Brazil

The construction of charged sectors in QED has been a difficult task due to the infrared problems related to Gauss law, implying that the Dirac field cannot be point-like localized and that the electron is an infra-particle.

We propose a novel strategy for a straightforward perturbative construction of QED along the lines of Epstein and Glaser, which complies with these features, and also with positivity. Our interacting Dirac field is not point- but "string-localized", i.e., localized on half-rays extending to space-like infinity. The construction works in a framework which relates the free (Gupta-Bleuler) vector potential acting in a Krein space with its string-localized version acting in the physical subspace. As input for the interacting Dirac field we use the free string-localized "dressed Dirac field" $:exp(iq\phi)\psi:$, where q is the electron charge, and ϕ is the (known) field that implements the gauge transformation between the two potentials. The free dressed Dirac field already describes the electron as an infra-particle.

We hope that this model can be renormalized at all orders, such that the mentioned features hold (positivity, Gauss' law, infra-particle aspect). Restricting to the forward light cone and using light-like string directions, the infra-particle aspect might disappear.

MP 10.2 Wed 12:20 H-HS VII

Asymptotically safe QED — •Jobst Ziebell[1] and Holger Gies[2] — [1]TPI, FSU Jena, Germany — [2]TPI, FSU Jena, Germany

High-energy completeness of Quantum electrodynamics (QED) can be induced by an interacting ultraviolet fixed point of the renormalization flow. We provide evidence for the existence of such fixed points in the subspace spanned by the gauge coupling, the electron mass and the Pauli spin-field coupling. Renormalization group trajectories emanating from the fixed point correspond to asymptotically safe theories that are free from the Landau pole problem. We analyse the set of fixed points, their stability properties with respect to a systematic expansion scheme, and compute high-energy complete flows towards the long-range physics. We observe the existence of a physical trajectory that matches the measured physical parameters in the infrared.

MP 10.3 Wed 12:40 H-HS VII

Avoiding Anomalies — •Klaus Morawetz — Münster University of Applied Sciences, 48565 Steinfurt, Germany — International Institute of Physics - UFRN, Campus Universitário Lagoa nova, 59078-970 Natal, Brazil

The quantum anomaly can be written alternatively as conservation-breaking term or as non-gauge invariant current. This is exemplified on the anomalous term $\sim \vec{E}\vec{B}$ in the balance of the chiral density. This term is derived from the quantum kinetic equations for systems with SU(2) structure within a completely conserving approach. Therefore the origin of this term is not a unique signal of symmetry-breaking terms in the field-theoretical Lagrangian. By reinterpreting the many-body averaging the connection to Pauli-Villars regularization is established which gives the anomalous term a new interpretation as arising from quantum fluctuations at short distances. A proper balance of these fluctuations by many-body effects on the same level avoids these anomalies. The origin of the $\sim \vec{E}\vec{B}$ is therefore proposed not due to anomalies but as a completely conventional quantum kinetic effect. [Eur. Phys. J. B 92 (2019) 176, Phys. Lett. A 383 (2019) 1362]