T 22: Quantenfeldtheorie

Convenor: Stephan Stieberger

Zeit: Mittwoch 16:45–19:00 Raum: VG 3.101

T 22.1 Mi 16:45 VG 3.101

The three-loop form factor in $\mathcal{N} = 4$ super Yang-Mills theory — Thomas Gehrmann[1], Johannes Henn[2], and •Tobias Huber[3] — [1]Universität Zürich, Schweiz — [2]IAS Princeton, USA — [3]Universität Siegen, Deutschland

We present the calculation of the Sudakov form factor in $\mathcal{N} = 4$ super Yang-Mills theory to the three-loop order. At leading colour, the latter is expressed in terms of planar and non-planar loop integrals. We show that it is possible to choose a representation in which each loop integral has uniform transcendentality in the Riemann ζ-function. We comment on the expected exponentiation of the infrared divergences and the values of the three-loop cusp and collinear anomalous dimensions in dimensional regularisation. We also compare the form factor in $\mathcal{N} = 4$ super Yang-Mills to the leading transcendentality pieces of the quark and gluon form factor in QCD. Finally, we investigate the ultraviolet properties of the form factor in $D > 4$ dimensions.

T 22.2 Mi 17:00 VG 3.101

Color guided amplitudes — •Johannes Brödel[1] and Lance J. Dixon[2] — [1]Stanford Institute for Theoretical Physics and Department of Physics, Stanford University, Stanford, CA 94305, USA — [2]SLAC National Accelerator Laboratory, Stanford University, Stanford, CA 94309, USA

Amplitudes in gauge thoeries obtain contributions from color and kinematics. While these two parts of the amplitude seem to exhibit different symmetry structures, it turns out that they can be reorganized in a way to behave equally, which leads to the so-called color-kinematic dual representations of amplitudes. Astonishingly, the existence of those representations allows squaring to related gravitational theories right away. Contrary to the Kawaii-Levellen-Tye relations, which have been used to relate gauge theories and gravity previously, this method is applicable not only to tree amplitudes but also at loop level.

In this talk, the basic technique will be introduced followed by a discussion of the existence of color-kinematic dual representations for amplitudes derived from gauge theory actions which are deformed by higher-operator insertions. In addition, it will be commented on the implications for deformed gravitational theories.

T 22.3 Mi 17:15 VG 3.101

New relations for scattering amplitudes in Yang-Mills theory at loop level — •Reinke Sven Isermann and Rutger Boels — Universität Hamburg

The calculation of scattering amplitudes is important for the analysis of scattering processes at particle colliders as well as for our understanding of perturbation theory.

In this talk I will present a series of new relations for scattering amplitudes in quite general gauge theories at loop level.

The existence of these relations can be understood from the analysis of certain large momentum shifts of tree amplitudes and loop level integrands. As an example, a concrete relation for the integrand at one-loop will be discussed.

T 22.4 Mi 17:30 VG 3.101

Conformal Field Theory with background H-flux and T-duality — Ralph Blumenhagen[1], •Andreas Deser[1], Dieter Lüst[1,2], Erik Plauschinn[3], and Felix Rennecke[1] — [1]Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München — [2]Arnold Sommerfeld Center for Theoretical Physics, LMU, Theresienstr. 37, 80333 München — [3]Institute for Theoretical Physics and Spinoza Institute, Utrecht University, 3508 TD Utrecht

We consider closed bosonic string theory with flat background and constant H-flux. Up to linear order in the flux, this is a solution to the string equations of motion and we are able to define a world-sheet conformal field theory framework to compute scattering amplitudes. In the easiest cases of n-point tachyon amplitudes, we use the properties of the Rogers dilogarithm function to speculate about the nature of the product of functions on spacetimes T-dual to the original configuration.

T 22.5 Mi 17:45 VG 3.101

On stability and transport of cold holographic matter — •Shu Lin[1], Johanna Erdmenger[1], Jonathan Shock[1], Steffen Müller[1], Andy O'Bannon[2], and Martin Ammon[3] — [1]Max-Planck-Institut für Physik, Munich, Germany — [2]University of Cambridge, Cambridge, UK — [3]University of California, Los Angeles, USA

In the framework of gauge/gravity duality, we have studied the stability of N=4 supersymmetric Yang-Mills theory with N=2 hypermultiplet at zero temperature and finite density. The system is analogous to the ground state of large N_c QCD at finite baryon density. While experience from large N_c suggests the formation of chiral density wave, our systematic study of the meson spectrum shows no sign of instability. Furthermore, we find a peculiar diffusion mode in the dispersion, which exists at zero temperature.

T 22.6 Mi 18:00 VG 3.101

Towards a Holographic Realization of Homes' Law — Martin Ammon[1], Johanna Erdmenger[2], •Steffen Müller[2], Andy O'Bannon[3], and Patrick Kerner[2] — [1]Department of Physics and Astronomy, UCLA, Los Angeles, CA 90095, United States — [2]Max-Planck-Institut für Physik, 80805 München — [3]DAMTP, University of Cambridge, Cambridge CB3 0WA, United Kingdom

In recent years there has been much experimental progress on novel types of strongly correlated quantum matter, but a theoretical framework to describe these interesting systems is still missing. The Gauge/Gravity Duality has proved to be a very successful tool for describing strongly coupled systems in particle physics. Thus, the application of the Gauge/Gravity Duality to conformal quantum matter is a promising candidate to explain questions concerning non-zero temperature dynamics and transport coefficients. In particular high T_c superconductors, as well as some conventional superconductors, exhibit an universal scaling relation called Homes' Law between the superfluid density at zero temperature and the product of the conductivity and temperature at the critical temperature. This universal behavior may be linked to the "Planckian dissipation" giving rise to a perfect fluid description of the "strange metal phase" with possible universal behavior, comparable to the viscosity of the quark-gluon plasma. In this work we describe progress in employing the models of holographic superconductors to realize Homes' Law and to find a universal relation governing strongly correlated quantum matter.

T 22.7 Mi 18:15 VG 3.101

Beyond the unitarity bound in AdS/CFT$_{\text{(A)dS}}$ — •Tomás Andrade[1] and Christoph Uhlemann[2] — [1]University of California, Santa Barbara — [2]Universität Würzburg

We study CFTs on dS and AdS spacetimes from a holographic perspective, in particular how the unitarity properties of the boundary theory are reflected in the bulk description. On geometries with an (A)dS conformal boundary we choose mass and boundary conditions for a Klein-Gordon field such that the corresponding CFT operator violates the unitarity bound. We analyze how the non-unitarity is reproduced in the bulk and discuss, for the case of an AdS boundary, prospects for multi-layered AdS/CFT-type dualities.

T 22.8 Mi 18:30 VG 3.101

Matching coefficients of thermal QCD — •Ioan Ghişoiu — Faculty of Physics, University of Bielefeld, D-33501 Bielefeld, Germany

I present an approach for calculating the matching coefficients of the electrostatic effective theory (EQCD) of thermal QCD at NNLO. The matching computation for the electric screening mass m_{E} and the effective gauge coupling g_{E} is performed in the background field gauge, reducing the computation to two-point vertex functions.

In addition, since EQCD by construction describes long distance phenomena, a low momentum expansion of the vertex functions is possible, and consequently only vacuum sum-integrals are generated. The $\approx 10^7$ vacuum sum-integrals are expressed in terms of $\lesssim 10$ non-trivial so called master sum-integrals using Integration-by-Parts relations. After a suitable basis transformation, the remaining master sum-integrals are computed using the technique implemented by Arnold and Zhai.

T 22.9 Mi 18:45 VG 3.101

Lorentz violation in the photon sector: parity-odd modified Maxwell theory — •Marco Schreck — Institut für Theoretische

Physik, Karlsruher Institut für Technologie (KIT), Karlsruhe

In light of the detection of superluminal muon neutrinos by the OPERA collaboration, Lorentz-violating quantum field theories have enjoyed a great revival. Besides the enthusiasm concerning Lorentz symmetry breaking in the neutrino sector, Lorentz violation in the photon sector also is of special interest. Modified Maxwell theory coupled to standard Dirac theory of spin-1/2 fermions is one of two possible Lorentz-violating deformations of quantum electrodynamics affecting photons.

In this talk the parity-odd nonbirefringent case of modified Maxwell theory will be considered. The theory mentioned is the only parity-odd renormalizable extension of the standard model that violates Lorentz invariance in the photon sector and is not tightly bounded by experiment. Hence, it is of certain importance and therefore will be discussed concerning its peculiarities — e.g. with regard to the modified photon polarization vectors. Recently obtained interesting results about its consistency will be presented.