MP 9: Quantenfeldtheorie II

Zeit: Donnerstag 13:45–15:15 Raum: VMP6 HS B

MP 9.1 Do 13:45 VMP6 HS B

The two-loop sunrise integral and elliptic polylogarithms — •Luise Adams[1], Christian Bogner[2], and Stefan Weinzierl[1] — [1]Institut für Physik, Johannes Gutenberg - Universität Mainz — [2]Institut für Physik, Humboldt-Universität zu Berlin

In this talk, we present a solution for the two-loop sunrise integral with arbitrary masses around two and four space-time dimensions in terms of a generalised elliptic version of the multiple polylogarithms. Furthermore we investigate the elliptic polylogarithms appearing in higher orders in the dimensional regularisation ϵ of the two-dimensional equal mass solution .

Around two space-time dimensions the solution consists of a sum of three elliptic dilogarithms where the arguments have a nice geometric interpretation as intersection points of the integration region and an elliptic curve associated to the sunrise integral.

Around four space-time dimensions the sunrise integral can be expressed with the ϵ^0- and ϵ^1-solution around two dimensions, mass derivatives thereof and simpler terms.

Considering higher orders of the two-dimensional equal mass solution we find certain generalisations of the elliptic polylogarithms appearing in the ϵ^0- and ϵ^1-solutions around two and four space-time dimensions. We show that these higher order-solutions can be found by iterative integration within this class of functions.

MP 9.2 Do 14:05 VMP6 HS B

The Potential in General Linear Electrodynamics: Causal Structure, Propagators and Quantization — •Daniel Siemssen[1] and Christian Pfeifer[2,3] — [1]Department of Mathematical Methods in Physics, Faculty of Physics, University of Warsaw — [2]Institute for Theoretical Physics, Leibniz Universität Hannover — [3]Center of Applied Space Technology and Microgravity (ZARM), Universität Bremen

From an axiomatic point of view, the fundamental input for a theory of electrodynamics are Maxwell's equations $\mathrm{d}F = 0$ (or $F = \mathrm{d}A$) and $\mathrm{d}H = J$, and a constitutive law $H = \#F$, which relates the field strength 2-form F and the excitation 2-form H. In this talk we consider general linear electrodynamics, the theory of electrodynamics defined by a linear constitutive law. The best known application of this theory is the effective description of electrodynamics inside (linear) media (e.g. birefringence). We will analyze the classical theory of the electromagnetic potential A before we use methods familiar from mathematical quantum field theory in curved spacetimes to quantize it. Our analysis of the classical theory contains the derivation of retarded and advanced propagators, the analysis of the causal structure on the basis of the constitutive law (instead of a metric) and a discussion of the classical phase space. This classical analysis sets the stage for the construction of the quantum field algebra and quantum states, including a (generalized) microlocal spectrum condition.

10 Minuten Pause

MP 9.3 Do 14:35 VMP6 HS B

Lösbare Algebren und masselose Fermionen — Rein Saar[1] und •Stefan Groote[1,2] — [1]Füüsika Instituut, Tartu Ülikool, Ravila 14C, 50411 Tartu, Estonia — [2]PRISMA Cluster of Excellence, Institut für Physik, Johannes-Gutenberg-Universität, Staudinger Weg 7, 55099 Mainz, Germany

Das Standardmodell der Elementarteilchenphysik basiert auf Eichtheorien, welche die Fermionen über halbeinfache Gruppen wie $SU(2)$ und $SU(3)$ an Vektorbosonen koppeln. Dies ist ein erfolgreicher Zugang für massive Fermionen. Masselose Fermionen besitzen aber, wie wir in diesem Beitrag zeigen werden, eine andere Symmetrie und führen nicht auf halbeinfache, sondern auf lösbare Gruppen. Auch wenn nach neuesten Erkenntnissen selbst die Neutrinos Masse besitzen, ist das Konzept masseloser Fermionen insoweit auch heute noch relevant, als dass viele Rechnungen durch die Annahme masseloser Fermionen vereinfacht und damit erst durchführbar gemacht werden. In diesem Beitrag befassen wir uns mit der Lorentzstruktur der sogenannten erweiterten kleinen Gruppe, zerlegen diese in eine Kroneckersumme und decken Zusammenhänge zur Händigkeit des Teilchens auf. Verschiedene Darstellungen der erweiterten kleinen Gruppe werden zur Spache kommen.

MP 9.4 Do 14:55 VMP6 HS B

The unknown sister of Noether's theorem — •Walter Smilga — Isardamm 135d, Geretsried, Germany

Noether's theorem has gained outstanding importance in theoretical particle physics, because it leads to strong conservation laws, such as the conservation of momentum and of angular momentum. Closely related to this theorem is another law that has an opposite effect: it requires the exchange of momentum between two particles that are described by an irreducible two-particle representation of the Poincaré group. Exchange of momentum determines an interaction. On closer inspection, this interaction is uniquely identified as the electromagnetic interaction. This finding sheds new light on the phenomenon of particle interaction in general and, in particular, on the perturbation algorithm of quantum electrodynamics.

Reference: iopscience.iop.org/1742-6596/597/1/012069