MP 5: Scattering Amplitudes and Conformal Field Theory

Time: Tuesday 17:00–19:00 Location: ZEU/0250

MP 5.1 Tue 17:00 ZEU/0250

One–loop six–particle Feynman integral to higher orders in dimensional regulator — Johannes M. Henn, •Antonela Matijašić, and Julian Miczajka — Max-Planck-Institut für Physik, Werner-Heisenberg-Institut, 80805 München, Germany

The state–of–the–art in current two–loop QCD amplitude calculations is at five-particle scattering. In contrast, very little is known at present about two–loop six–particle scattering processes. Computing two–loop six–particle processes requires knowledge of the corresponding one–loop amplitudes to higher orders in the dimensional regulator. In this talk, I will show the analytic results for the one–loop hexagon integral to higher orders in dimensional regulator obtained via differential equations. I will discuss the function alphabet for general D–dimensional external states, function space up to weight two and one–fold integral representation up to weight four for all integrals in the integral basis. Finally, I will discuss the difference between the conventional dimensional regularization and the four–dimensional helicity scheme at the level of the master integrals. With this, the one–loop integral basis is ready for two–loop amplitude applications.

MP 5.2 Tue 17:20 ZEU/0250

new results from computing planar and non-planar three-loop integrals for Higgs plus jet process — •Jungwon Lim — Max Planck Institute for Physics, Munich, Germany

We present new results for Feynman integrals relevant to Higgs plus jet production at three loops, including first results for a non-planar class of integrals. The results are expressed in terms of generalized polylogarithms up to transcendental weight six. We also provide the full canonical differential equations, which allows us to make structural observations on the answer. In particular, find a counterexample to previously conjectured adjacency relations, for a planar integral of the tennis court type. Moreover, for a non-planar triple ladder diagram, we find two novel alphabet letters. This information may be useful for future bootstrap approaches.

MP 5.3 Tue 17:40 ZEU/0250

Gravitational Waves from Worldline Quantum Field Theory — •Gustav Mogull — Institut für Physik und IRIS Adlershof, Humboldt Universität zu Berlin, Zum Großen Windkanal 2, 12489 Berlin, Germany — Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Am Mühlenberg 1, 14476 Potsdam, Germany

Following the groundbreaking first detection by both LIGO observatories (Hanford/Livingston) of gravitational waves in 2015, a new era of gravitational wave astronomy has begun. The waves strong enough for us to detect on Earth are caused by the orbit, deceleration and eventual merger of pairs of extremely massive objects: primarily black holes, but also neutron stars. We aim to model these binary mergers mathematically, so that we may predict the gravitational waves emitted and thus learn about the black holes and neutron stars themselves - how they form, their internal composition - and Einstein's theory of gravity.

The Worldline Quantum Field Theory (WQFT) is a new formalism that we have developed, using tools and technologies from QFT to describe these gravitational merger events. The gravitational two-body problem is remarkably similar to our description of fundamental particles scattering in collider experiments such as CERN's Large Hadron Collider (LHC), and there is considerable overlap in our theoretical descriptions of these events. In this talk I will discuss the WQFT's fundamentals, its applications to gravitational wave physics and its supersymmetric extension to describe spinning black holes and neutron stars.

MP 5.4 Tue 18:00 ZEU/0250

Non-supersymmetric string backgrounds — •Ida Zadeh — Mainz Institute for Theoretical Physics, Mainz, Germany

New constructions of non-supersymmetric backgrounds arising from compactifications of superstring theories on Ricci-flat compact manifolds will be discussed. Such constructions give new insights on properties of theories of quantum gravity. I will discuss the problem within the framework of conformal field theories, namely the exact string worldsheet description. We will see how the conformal field theory formulation gives novel descriptions of the underlying semi-classical field theories and their associated moduli (parameter) spaces.

MP 5.5 Tue 18:20 ZEU/0250

Torus Conformal Blocks of 2D Conformal Field Theories — •Jakob Hollweck — Theoretisch-Physikalisches Institut, Jena, Germany

We compute higher point sl(2,R) conformal blocks on different topologies like the sphere and the torus. The usual methods, like the direct use of the Casimir equations, shadow operator representations, or successive use of the operator product expansion, quickly become complicated for higher point conformal blocks. The use of oscillator representations reproduces the known results and promises further insights, like the computation of (semi-classical) Virasoro conformal blocks, or conformal blocks in higher dimensions than two, which have recently spiked in interest.

MP 5.6 Tue 18:40 ZEU/0250

Quantum energy inequalities in integrable models with bound states and several particle species — •Jan Mandrysch[1], Daniela Cadamuro[1], and Henning Bostelmann[2] — [1]Institute for Theoretical Physics, Uni Leipzig — [2]Department of Mathematics, University of York, United Kingdom

In quantum theory negative energy densities appear and should be constrained in physically reasonable models. Otherwise, one expects instabilities and violations of the 2nd law of thermodynamics.

I present lower bounds of the time-smeared energy density, so-called quantum energy inequalities (QEI), in the class of integrable quantum field theory models. Our main results are a state-independent QEI for interactions which have a constant scattering function and a QEI at one-particle level for generic models including bound states and several particle species. Examples include the Bullough-Dodd, the Federbush, and the O(n)-nonlinear sigma model.