

Uncovering the kinematical algebra behind colour-kinematic duality

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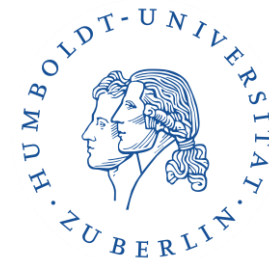
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SAGEX

Scattering Amplitudes:
from Geometry to Experiment



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Background

- ◀ 2012-2016 Bachelor, Physics University of Sci. and Tech. of China (Hefei, CN)
 - ◀ 2016-2017 Master, Physics Ecole Polytechnique (Palaiseau, FR)
 - ◀ 2017-2018 Master, Physics ETH Zürich (CH)
 - ◀ 06.2019 Ph.D., SAGEX ESR Humboldt-Universität zu Berlin (DE)
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- ◀ 03.2018-10.2018 Master's thesis with A. Ochirov and A. Lazopoulos at ETH Zürich
“QCD amplitudes with massive quarks in spinor-helicity formalism”

Training

- ◀ Amplitude 2019 at Trinity College, Dublin (07.2019)
- ◀ 1st SAGEX workshop and training school at DESY, Hamburg (07.2019)
- ◀ German language lecture at HU, Berlin (Since 11.2019)

Secondment

- ◀ 03.08.2020 - 24.10.2020 at RISC, Hagenberg im Mühlkreis, Austria.
- ◀ Project: Using labeled 3D medical image to generate new labeled data for the training phase of machine learning.

Project

◀ Description:

- ◀ Colour-kinematics duality (CKD) relates scattering amplitudes in gauge theories to dual gravitational theories.
- ◀ CKD implies the existence of hidden symmetries (kinematical algebra) within the perturbative expansion of gravitational theories.
- ◀ The kinematical algebra is at present understood only for the self-dual sector of Yang-Mills theory.

◀ What is done so far:

- ◀ CKD works for scattering amplitudes, we were interested in seeing if it can be extended to classical theories.
- ◀ We examined the classical double copy of matter coupled to Yang-Mills theory to dilaton-gravity at next-to-next-to-leading order (NNLO) in Post-Newtonian expansion.
- ◀ Our NNLO double-copied Lagrangian did not match that of classical dilaton-gravity.

◀ Publication: J. Plefka, C. Shi, et al., arXiv:1906.05875, SAGEX-19-11-E

Project

◀ Ongoing:

- ◀ To find the source of the mismatch, we investigated the double copy at the amplitude level.
- ◀ We considered massive scalar fields coupled to Yang-Mills theory (scalar QCD) and have established the gravitational Lagrangian from double copy up to 6th order in scalar self-interaction.
- ◀ We found the interaction terms of massive scalars and dilaton, as well as the self-interaction of the scalars in arbitrary dimension (Upcoming publication).

◀ What to do:

- ◀ From the established Lagrangian of amplitude double copy, we want to see if it contains the source of the mismatch of effective Lagrangian of classical double copy.
- ◀ To see how the interaction terms of the massive scalars affect the kinematic algebra.

Within the network

- ◀ SAGEX provides many chances for me to communicate intensively with the other ESRs, supervisors and mentors. I regularly have scientific discussion with my supervisor. I plan to pay a one-month visit to my mentor at TCD in 2020.
- ◀ We will continue working on organising the exhibition. 5 different topics are considered and each of us will join the specific topics that he or she is interested in.
- ◀ I will present an academic talk at HU group seminar in this semester (Dec. 18).