Research interests and scattering amplitudes

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SAGEX
Scattering Amplitudes:
from Geometry to Experiment

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Brief presentation

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- Batchelor degree in Physics at the University of Padova (Italy)
- Master degree in Physics at the University of Padova (with focus on particle physics) and master thesis developed in Göttingen (Germany) under the supervision of K.H.Rehren and P.Marchetti about "The infinite-spin representation of the Poincaré group"
- Phd in scattering amplitudes at Trinity College Dublin (Ireland) under the supervision of R. Britto

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YM asymptotic symmetries and coherent states

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Question 1

What does the late-time dynamics of YM theory tells us about the infrared properties of the theory?

Question 2

Can we modify the asymptotic states in such a way that the S-matrix of YM-like theories is infrared finite? And how can those asymptotic symmetries help us in this respect?

Question 3

What about QCD with massless quarks?

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Analytic structure of cut diagrams at two loops and beyond

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Question 1

What are the best variables that are suitable to find the most compact representation of cut diagrams at two loops and beyond?

Question 2

Feynman representation fails to be so "effective" at two loops, due to the presence of ISPs. Baikov's representation is suitable to find a general representation of cut diagrams at two loops, but it becomes cumbersome to calculate non-maximal cut diagrams and we may have to introduce additional propagators. What are the "minimal" variables that we need from the geometric point of view?

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Coaction principle at two loops and beyond

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Question 1

Which numbers can appear in Feynman integrals, and why? What is the organization principle and can we find a suitable "basis" of special functions to which every Feynman integral evaluate?

Question 2

There is a general coaction formula for Feynman integrals in fixed (even) dimensions, discovered by F. Brown, which involves motivic periods and de Rham periods. What is the analogue for dimensionally regulated integrals? At one loop, where the natural functions are polylogs, it was shown by C. Duhr, E.Gardi, S.Abreu and R.Britto that the image of the coaction map involves naturally (generalized) cut diagrams. What about two loops?

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Summary

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- Asymptotic symmetries in YM-like theories and relation to infrared physics
- Analytical structure of generalized cut diagrams at two loops (and beyond)
- Coaction principle for dimensionally regulated integrals at two loops (and beyond)