



SAGEX
Scattering Amplitudes:
from Geometry to Experiment



Durham
University



Perturbative Simplicity in lower dimensions

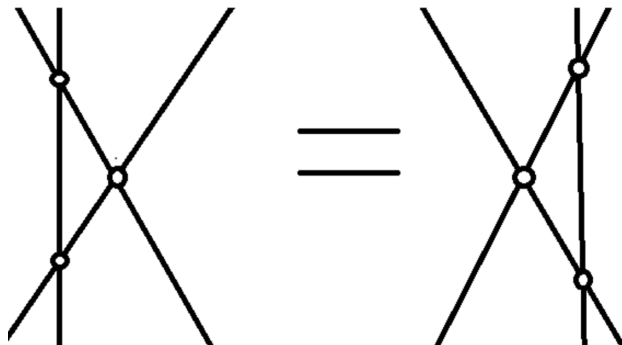
Queen Mary University of London , 8/11/2019

ESR: Davide Polvara
Supervisor: Patrick Dorey
Institute: Durham University

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Background and Projects

- I did my masters in the University of Milano Bicocca.
- Theoretical Physics background: QFT, general relativity and string theory.
- Topics of interest: Integrability in QFT, Toda theories, defects, bootstrap and the Lagrangian approach to computing S-matrix elements.



Achieved results

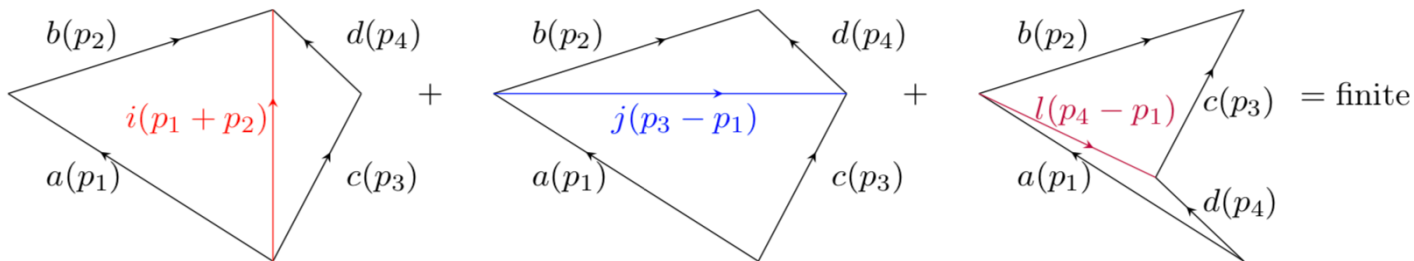
- Publication in JHEP (1902.10690) in collaboration with S. Penati, *“Quantum anomalies in $A_r^{(1)}$ Toda theories with defects”*.
- Based on the paper, I wrote an outreach article on the SAGEX blog, *“Particles-defects interactions: do special walls in scattering theory survive the quantisation?”*

Future projects and outgoing publications

Axiomatic approach

Exact S-matrices for integrable quantum field theories in 2d can be found using the bootstrap.

Many results obtained in the past 30 years.



Perturbation theory

Integrability manifests itself in a surprising cancellation of Feynman diagrams contributing to non-allowed processes.



We proved this phenomenon at tree-level for simply laced Toda models connecting on-shell singular diagrams to planar projections of higher-dimensional roots.



Future expected results: extending the argument to loop level.

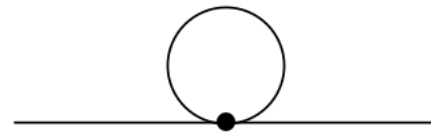
The secondment at Maple (23/09/2019- 20/12/2019)

Goals and perspectives:

- Based on a pre-existing C-algorithm for Feynman diagrams generation (1209.0949) we expect to write a similar one in Maple language.
- Finding bugs and implementing the Maple package Physics:-FeynmanDiagrams.
- Searching for a way to obtain Feynman diagrams from a non-graphical input.



P1-->H1 (I1.leg[1])
P2-->H1 (I1.leg[1])
H1-->H1 (I1.leg[1]-->I1.leg[1])
symmetryFactor = 12 *(1/4!) = 1/2
fermionSign=1



Training

Lectures attended in Durham University: supersymmetry, non-perturbative physics, conformal field theories, scattering amplitudes.

Schools, workshop and conferences attended :

- SAGEX meeting on outreach activities (Humboldt University Berlin, 7-8 February 2019)
- Young Researchers Integrability School and Workshop (Vienna, 10-16 February 2019)
- SAGEX welcome meeting and first soft skills training sessions (Durham University, 1-2 April 2019).
- Amplitudes (Trinity College Dublin, July 2019)
- DESY Summer School in Gauge and String Theory (22-26 July 2019)
- SAGEX workshop on soft-skills and outreach training (29 July- 2 August 2019)

Outreach and connections

- I am helping to organize the outreach exhibition that will be presented at the end of the project.
- In collaboration with Patrick Dorey and Herbert Gangl I am preparing an outreach game. The purpose of the game is to connect divergences of Feynman diagrams in Toda models with polygon tilings creating a “puzzle” for the public.
- I have had discussions with my mentor Tristan McLoughlin regarding the research developed until now.
- During the school and the other SAGEX events there has been the possibility to speak with the other ESRs about the respective projects.
- At the moment I see my future in academia. I am hoping to find a postdoc position.

Thank you



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