

Career Development Plan - Year 1

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Name of Supervisor: Konstantinos Papadopoulos

Date: 24/10/2014

BRIEF OVERVIEW OF RESEARCH PROJECT AND MAJOR ACCOMPLISHMENTS EXPECTED (half page should be sufficient)

During the first year of my stay at Demokritos, I plan to finish two ongoing projects. One on the calculation of the hitherto unknown Feynman integrals needed for calculations of massless $2 \rightarrow 3$ scattering at two loops, and one on the calculation of the two-loop contributions to the cross sections for $H \rightarrow Z\gamma$ and $H \rightarrow ggg$ with the full top-mass dependence, and perhaps also $H \rightarrow gg$ at three loops. In addition to this I plan to continue my investigations into integrand reduction, initially in the context of $q\bar{q} \rightarrow \gamma^*\gamma^*$ at two loops.

These projects all fit under my project-description which is to perform and automate calculations of scattering amplitudes beyond one loop. This is needed in the context of the LHC, but is also of theoretical interest in its own right. Much progress has been made in this direction over the last decade, and many techniques have been invented and improved. To keep up with the plentitude of new results, I will need to familiarize myself with these techniques and use them in my own work, the projects mentioned above all being examples of this.

LONG –TERM CAREER OBJECTIVES (over 5 years):

1. *Goals:*

The over-all goal of my research is to contribute to the on-going automating of calculations of scattering amplitudes at higher loop orders. This includes both the integrand reduction, which can be performed using generalized unitarity cuts or otherwise, and the calculation of master integrals.

2. *What further research activity or other training is needed to attain these goals?*

I need to familiarize myself further with the mathematical ideas behind the most recent developments in the field. This includes Algebraic geometry, Chen iterated integrals, co-products, and more. Additionally I would like to become more familiar with certain physical concepts such as momentum twistors and maximal cuts, and to be more proficient in the use of computer algebra tools such as Mathematica.

SHORT-TERM OBJECTIVES (1-2 years):

1. *Research results:*

- *Anticipated publications:*

- ✓ A publication on five-point massless Feynman Integrals
- ✓ A publication on $H \rightarrow Z\gamma$
- ✓ A publication on $H \rightarrow ggg$

- ✓ A publication on integrand reduction (perhaps exemplified by $q\bar{q} \rightarrow \gamma^* \gamma^*$)
- *Anticipated conference, workshop attendance, courses, and/or seminar presentations:*

All meetings in the HiggsTools network – i.e.

- ✓ the Young Researchers Meeting 17-20 February 2015,
- ✓ the Annual Meeting in Freiburg 15-17 April 2015,
- ✓ the Summer School in Torino 29 June to 3 July 2015, etc.

Additionally, probably

- ✓ LHC PhenoNet final meeting, 24-26 November 2014
- ✓ "Amplitudes" 2015
- ✓ "Loop and Legs" 2016

2. *Research Skills and techniques:*

- *Training in specific new areas, or technical expertise etc.:*
 - ✓ To learn the full theory behind momentum twistors.
 - ✓ To obtain fluency in the use of Mathematica.

3. *Research management:*

- *Fellowship or other funding applications planned (indicate name of award if known; include fellowships with entire funding periods, grants written/applied for/received, professional society presentation awards or travel awards, etc.)*
 - ✓ I hope to obtain a grant for a postdoc position by the end of my current position. Perhaps through the Humboldt foundation or the Danish FNU.

4. *Communication skills:*

- ✓ I hope to be able to write my first single-author paper, which will give me proficiency in the full writing procedure.
- ✓ I plan to make my PhD thesis, which was written with the hope of producing a document suitable as an introduction to the OPP method for generalized unitarity cuts, publicly available, after a number of changes.
- ✓ I plan to give a number of presentations/talks at conferences which will improve my presentation skills.

5. *Other professional training (course work, teaching activity)*

- ✓ -

6. *Anticipated networking opportunities*

- ✓ I look forward to meeting and collaborating with other researchers both from within and beyond the HiggsTools network.

7. *Other activities (community, etc.) with professional relevance:*

- ✓ I plan to learn the Greek language.

Date & Signature of ESR:

Hjalte Frellesvig - 24/20 2014

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