Form factors and Higgs amplitudes from $\mathcal{N} = 4$ super Yang-Mills to QCD

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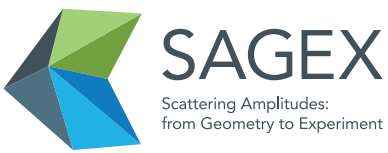

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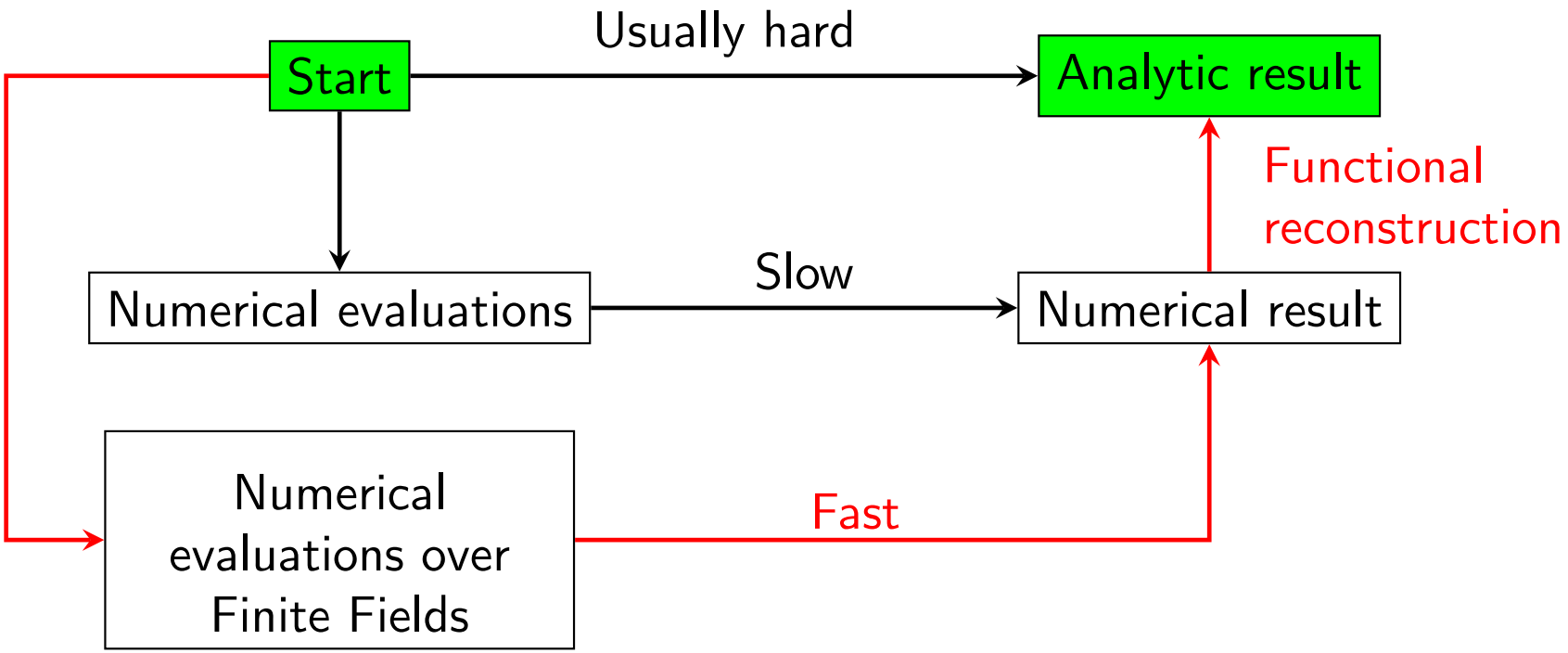
Before SAGEX

Bachelor and Master degree in Physics at Padova University (IT).
Main focus during the master thesis, under supervision of P.Mastrolia and T. Peraro:



N.B. True for rational functions.

Current research

What? Form Factors

$$\int d^4x e^{-iq\cdot x}\langle 1\dots n|\mathcal{O}(x)|0\rangle \equiv (2\pi)^4\delta^{(4)}\left(q-\sum p_i\right)\boxed{\mathcal{F}_{\mathcal{O}}(\{n\};q)}$$

Can be computed through a perturbative expansion:

$$\mathcal{F}_{\mathcal{O}}(\{n\};q)=\mathcal{F}^{(0)}_{\mathcal{O}}(\{n\};q)+\alpha\mathcal{F}^{(1)}_{\mathcal{O}}(\{n\};q)+\alpha^2\mathcal{F}^{(2)}_{\mathcal{O}}(\{n\};q)+\dots$$

We are interested in $\mathcal{O}_N=\mathrm{Tr}\,F^n=\mathrm{Tr}\,F^{\mu_1}{}_{\mu_2}F^{\mu_2}{}_{\mu_3}\cdots F^{\mu_n}{}_{\mu_1}$

Why?

Relevant for Higgs production in Effective Field Theory approach as well as experimental measures of possible Beyond Standard Model physics.

How?

- (Generalised) Unitarity methods
- Dimensional Reconstruction
- Six-dimensional spinor-helicity formalism

Goals of the project vs current status

$\mathcal{O}$	number of legs	number of loops
$\mathrm{Tr}\, F^2$	4 vs 3	2 vs 1
$\mathrm{Tr}\, F^3$	3 vs 4	2 vs 1
$\mathrm{Tr}\, F^n$	n	1

Results

- A paper including the above mentioned results [1910.04772]
- A `Mathematica` package including most of the tools needed for six-dimensional calculations.

Training and interactions

Schools and meetings:

- First outreach task-group meeting in Berlin
- ESR introductory meeting in Durham
- First SAGEX school and Workshop at DESY
- "School of analytic computing in high-energy theoretical physics"

Other training:

- Local seminars and London Triangle and Polygon seminars
- Graduate courses at Queen Mary

Interactions

Thanks to the above mentioned SAGEX events I am confident in interacting with the other ESRs, I think a good connection has been established. Particularly stimulating working with Stefano.

Secondments and outreach

Secondments

- Wolfram Research, from 16/03 to 16/06. Topic: integration and special functions.
- ETH Zurich, to be planned
- University of Copenhagen, to be planned

Outreach

- SAGEX exhibition planning
- SAGEX oureach videos
- "Hands on engagement" Queen Mary outreach training
- Plan a SAGEX exhibit at the festival of communities in May 2021

Future plans

Apply for a postdoctoral position

Thanks to the SAGEX curriculum

- I am acquiring knowledge in many different aspects of the Amplitudes field
- I am building a network of possible future collaborators as well as improving my team work

but also

- I am honing a wide range of different skills (presentation, writing, organisation...) which will hopefully allow me to easily access a job in industry if the academic route should fail.