

RESEARCH ACTIVITY

During the first year of my Ph.D., I focused my research on the small- x resummation. This technique is useful to enhance the precision of predictions in high energy physics. In fact, it is a way to handle with divergent terms in the perturbative expansion that allows making prediction on observables at collider physics.

I spent the first months deepen my knowledge on this subject, studying some of the foundational papers on this topic like [1], [2], [3] and [4]. Since we want to push forward the state of art of small- x resummation, it was important to master the basis of what have been done until now.

After this preliminar phase, we started to collaborate with Marco Bonvini e Federico Silvetti, from *Universtà la Sapienza* in Rome. We chose to address a specific process to better understand the role of k_t -factorization in small- x resummation. We decided to compute the small- x resummed cross section for a deep-inelastic-scattering-like process induced by an Higgs boson. To make the calculation as easy as possible, we considered the Higgs directly coupled with the gluon with an effective vertex. We computed and well-understood the tree-level case, and then we addressed the more challenging one-loop cross-section. We are now at the final stages of this calculation. What we expect, once we found the result, is to be able to answer some questions, like if and how the k_t -factorization depends on the gauge choice and how this dependence conditions the resummation. Some hints of how these questions can already be deducted by our preliminary results, however, we have to wait for the final result in order to make precise statements.

Once having answered these questions and fully understood the properties of k_t -factorization, we planned to use it to find a method to improve small- x resummation. Doing this, we will be able to push forward the precision of perturbative calculation at collider physics.

ATTENDED COURSES

I attended the following courses

- **Teorie di gauge non abeliane (Non-abelian gauge theories)**

Nicola Maggiore, Simone Marzani

Passed exam: In order to pass this exam, I gave a presentation with the title: “*Banks-Zaks phase and QCD conformal window*”.

- **Fisica teorica (Theoretica physics)**

Giovanni Ridolfi

- **Gravitational waves**

Gianluca Gemme, Andrea Chincarini and Fiodor Sorrentino

- **Classical and quantum phase transitions**

Nicodemo Magnoli

SCHOOLS AND CONFERENCES

I attended the following schools and conferences:

- **School:** *GGI Lectures on the Theory of Fundamental Interactions 2020*, Galileo Galilei Institute, Florence; from 7th to 24th January 2020; link to school's website: <https://www.ggi.infn.it/ggilectures/ggilectures2020/>
- **Conference:** *Cortona young 2020*, online conference; from 27th to 29th May 2020; link to conference's website: <https://www.ggi.infn.it/showevent.pl?id=377>
- **Conference:** *Boost 2020*, online conference; from 20th to 24th July 2020; link to conference's website: <https://indico.cern.ch/event/775951/overview>

COMMENTS

During last months the COVID-19 crisis has changed many aspects of our lives. It also affected our way of doing research, increasing the remote working and reducing the possibilities of travelling. This influenced the research activity especially because we saw our opportunities of networking and mutual exchanges drastically decreased. Many conferences or schools have been cancelled or organised online. As an example, in March I would have attended the PREFIT school in Hamburg (<https://indico.cern.ch/event/817757/>), but due to travel restriction I couldn't participate.

BIBLIORAPHY

- [1] G. Curci, W. Furmanski, and R. Petronzio, "Evolution of Parton Densities Beyond Leading Order: The Nonsinglet Case", *Nucl. Phys. B*, vol. 175, pp. 27–92, 1980.
- [2] S. Catani, M. Ciafaloni, and F. Hautmann, "High-energy factorization and small x heavy flavor production", *Nucl. Phys. B*, vol. 366, pp. 135–188, 1991.
- [3] S. Catani and F. Hautmann, "High-energy factorization and small x deep inelastic scattering beyond leading order", *Nucl. Phys. B*, vol. 427, pp. 475–524, 1994. arXiv: hep-ph/9405388.
- [4] J. R. Forshaw and D. Ross, *Quantum chromodynamics and the pomeron*. Cambridge University Press, Jan. 2011, vol. 9, ISBN: 978-0-511-89326-1, 978-0-521-56880-7.