

Andrea Ghira

Second Year PhD Report

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Research Activity (under supervision of S.Marzani and G.Ridolfi)

My research activity is focused on high energy physics and LHC phenomenology. In particular, my main interest is directed to a better comprehension of the role that masses of the quarks play in the context of the Standard Model.

During the month of November I started a new project in collaboration with my supervisors regarding mass effects in soft gluon resummation. Starting from our previous work we developed a new formalism which allows to bridge in a consistent way two different calculation frameworks. On one hand the mass of the quark m is assumed to be zero since it is much smaller than the hard scale of the process q , therefore all the power corrections $\frac{m^2}{q^2}$ are systematically neglected: this means that the kinematics is treated correctly only when the gluon is emitted off the quark at very small angles. On the other hand the mass dependence is fully retained, making the calculation more and more cumbersome at higher perturbative orders.

Besides this project, I started two other works whose focus is to study how the masses of the quarks affect hadronic jet substructures. Our purpose is to implement the studies present in literature adding the contribution of the masses and analyzing the relevant differences.

Courses and Exams

I attended the following courses:

- Theoretical Physics (G. Ridolfi, 3CFU)

I passed the following exams:

- Non abelian Gauge Theory (N. Maggiore, 3CFU),
- Exam related to PhD school (3CFU).

Schools and Conferences

I attended the following PhD schools and conferences:

- Speaker at the conference QCD@LHC
IJCLab, Orsay, 22/11/2022-02/12/2022
- Speaker at the conference Milan Christmas Meeting,
Università degli Studi di Milano, Milan, 21/12/2022-23/12/2022,
- Chalk Talk at University of Oxford and Scientific visit at University of Cambridge
Oxford and Cambridge 29/01/2023-04/02/2023
- Chalk Talk at Fermilab and Speaker at DIS2023,
Batavia, Illinois and East Lansing, Michigan State 20/03/2023-02/04/2023,
- Scientific Visit at University of Cambridge
Cambridge, 09/07/2023-12/07/2023
- Conference Quantum Field Theory at the Frontiers of the Strong Interaction
ESI, Vienna, 30/07/2023-03/07/2023.

Publications

- *Non commutativity between massless and soft limit in processes with heavy quarks*, conference proceeding for LFC 2022, Trento, Author A. Ghira
- *Soft resummation in processes with heavy quark: bridging the gap from 4-flavor to 5-flavor scheme*, conference proceeding for DIS2023, East Lansing, Author A. Ghira
- *A consistent resummation of mass and soft logarithms in processes with heavy flavours*, preprint, arXiv:2309.06139, Authors: A. Ghira, S. Marzani, G. Ridolfi
- *Heavy-flavour-jet substructure*, in preparation, Authors: Prasanna Dhani, Oleh Fedkevych, Andrea Ghira, Simone Marzani, Gregory Soyez