Third Year Report

Alberto Rescia

Supervisors: Federico Sforza (Genova), Ludovica Aperio Bella (DESY)

Status of Doctoral Project

My doctoral project is a collaboration between DESY and the University of Genova. I am a member of the ATLAS collaboration, and over the past year my main focus has been my analysis focusing on jet substructure observables measured on heavy-flavour jets in $Z + b\bar{b}$ events. This is a full Run 2 analysis which is being carried out in Release 21.

Together with the analysis team, I have made rapid progress. We have a functioning analysis code written in the CxAOD Framework, have finalised studies needed for unfolding, have completed technical closure tests for the unfolding framework, and are working on resolving the final bugs, on the background estimation, and soon will begin writing the internal note and request to begin the internal approval process.

One key aspect of the analysis is the observation of the dead cone effect, a fundamental prediction of QCD which was observed for the first time in 2022 by the ALICE experiment, which our final state should be sensitive to. I have worked on numerous studies over the past year aimed at understanding how to go about observing this effect, with good preliminary results. I have also started working with another group at University College London who are interested in observing this effect in $t\bar{t}$ events on how best to go about the observation.

Lastly, I have continued the work started at the Les Houches Workshop I attended in 2023. This work aims to compare the performance of new flavour-inclusive jet clustering algorithms and apply them experimentally. I have focused on more experimental aspects of the studies, specifically comparing the various algorithms and understanding how they could be implemented in LHC experiments. The report of the studies carried out at Les Houches has been published, and the continuation is likely to turn out in a paper which will be out in 2025. My work specifically has already been presented at a workshop in Durham and will also be presented at the ATLAS-CMS Flavour Tagging Workshop.

Courses & Schools Attended

All coursework required by the PhD has been completed in previous years.

- **Terascale Monte Carlo School 2024**

  19-23 February 2024, Hamburg

- **2024 CTEQ Summer School on QCD and Electroweak Phenomenology**

  21-31 August 2024, Bramsche

Conferences and Workshops

- **Flavoured Jets at the LHC**

  11-12 June 2024, Durham

  At this workshop, I gave a talk titled *"Jet substructure studies at the ATLAS experiment"*

- **27th High Energy Physics Conference in Quantum Chromodynamics**

  8-12 September 2024, Montpellier

  At this conference, I gave a talk titled *"QCD aspects in W and Z production in ATLAS"* on behalf of the ATLAS collaboration

- **2024 ATLAS-CMS Flavour Tagging Workshop**

  9-13 September 2024, Genova

  I will give a talk titled *"A comparative study of jet flavour labelling on $Z + b\bar{b}$ events"*

Publications

- Andersen, J., et al. "Les Houches 2023: Physics at TeV Colliders: Standard Model Working Group Report." arXiv preprint arXiv:2406.00708 (2024)