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Jet calibration, cross section measurements and New Physics searches with the ATLAS experiment



- Thèses, Stages, Formation et Enseignement - Propositions de thèses antérieures - Propositions de thèses 2016 -
Date de mise en ligne : Monday 2 November 2015

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Equipe thématique «Masses et Interactions Fondamentales»; expérience: ATLAS

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Title : Jet calibration, cross section measurements and New Physics searches with the ATLAS experiment

The Large Hadron Collider (LHC) at CERN (Geneva) is currently taking data at a center of mass energy of 13 TeV, the largest energy ever achieved in laboratory up to now. This data-taking period will last until 2018, covering the first two years of this PhD proposal.

The ATLAS experiment, installed at the LHC, has been designed to explore, due to the very large amount of data provided by the LHC, phenomena taking place at these very high energies. In particular, ATLAS, together with the other mainstream experiment at the LHC, CMS, were able to discover in 2012 the Higgs boson, responsible for dynamically generating a mass for elementary particles in Standard Model.

The ATLAS LPNHE team has expertise on the jet reconstruction and calibration, as well as on electrons and photons. In particular the group has been involved in the Run I data analyses, like the discovery of the Higgs boson, precision measurements with jets in the final state, or precision measurements of Standard Model parameters. The group is also involved in the first Run II analyses, exploiting the luminosity that became available up to now.

Due to their similar experimental signatures, New Physics searches require an excellent understanding of Standard Model processes. Being able to measure as precisely as possible the energy of the objects reconstructed in the detector is of outmost importance for making precision measurements, as well as for enhancing the sensitivity of physics analyses to signals beyond the Standard Model.

The proposed PhD subject deals with these points by studying events with one or several jets in the final state, recorded using the ATLAS detector. On one side these events are used to improve the jet energy calibration, extremely important for analyses using jet counting or veto. Indeed, the new data-taking conditions at Run II require redefining the jet calibration strategy. Several improvements are possible, with a direct impact on numerous ATLAS physics results. On the other side, the differential cross section of multijet events is measured as a function of numerous observables and compared with various theoretical predictions. These measurements will be used to test QCD predictions, while also being sensitive to signals beyond the Standard Model like SUSY particles potentially explaining dark matter, or yet to new types of interactions.

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Discussions with experts on the phenomenological aspects of this project, like Matteo Cacciari of LPTHE, will be organized.

An internship with the supervising team will allow the student to get familiarized to the topics covered by the project, as well as to the tools necessary for its implementation.

Lieu de travail : LPNHE - Paris

Déplacements éventuels: missions régulières au CERN à Genève

Documentation:

- <http://lpnhe.in2p3.fr/>
- <http://lpnhe-atlas.in2p3.fr/Atlas/index.html>
- <http://atlas.web.cern.ch/Atlas/Collaboration/>

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References:

- « Jet energy measurement and its systematic uncertainty in proton-proton collisions at $\sqrt{s}=7\text{TeV}$ with the ATLAS detector », the ATLAS collaboration, Eur. Phys. J. C (2015) 75:17, [arXiv:1406.0076](https://arxiv.org/abs/1406.0076)
- « Measurement of dijet cross sections in pp collisions at 7 TeV centre-of-mass energy using the ATLAS detector », the ATLAS collaboration, JHEP 1405 (2014) 059, [arXiv:1312.3524](https://arxiv.org/abs/1312.3524)
- « Evaluation of the Strong Coupling Constant α_s Using the ATLAS Inclusive Jet Cross-Section Data », B. Malaescu and P. Starovoitov, Eur.Phys.J. C72 (2012) 2041, [arXiv:1203.5416](https://arxiv.org/abs/1203.5416)

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