

## Search for new physics signatures in the data collected by the ATLAS experiment using unsupervised machine learning methods

Our understanding of the infinitely small is based on the Standard Model of particle physics. Although remarkably successful over the last 50 years, this model is likely an approximation of a more complete theory that has yet to be identified. Since 2009, with the help of the exceptional data produced by the LHC (Large Hadron Collider), many alternative Beyond the Standard Model theories have been tested without, however, any experimental confirmation of their validity.

Since these new particles remain elusive it is therefore necessary to investigate other avenues, one of them being the search for anomalies. These generic searches track down, in collected data, any deviations from the predictions of the Standard Model. This approach does not rely on a particular new physics theory and therefore aims at exploring a very large parameter space. Indeed data could contains signatures of new particles that are not searched for because no theory predicted them.

The recent development of Machine Learning allows the implementation of algorithms that are particularly adapted to systematically search for these deviations which then appear as anomalies in the data. This internship proposes to use these tools, and more particularly the algorithms developed within the ATLAS team of the Laboratoire de Physique de Clermont [1], to search for anomalies in data collected by the ATLAS detector at the LHC [2].

The current algorithms, based essentially on artificial neural networks, have shown their performance on simulated data. The challenge now is to prove that they can be adapted to real data without introducing bias, and to identify and characterize potential anomalies that could be discovered.

For this internship good knowledge of experimental particle physics and modern Machine Learning techniques are required. The candidate should also have skills in computer science (Python language) and a strong interest for statistical data analysis.

[1] <https://atlas-clermont.web.cern.ch>

[2] <https://atlas.cern/>

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