M2R training, year 2026-2027

Agnostic Search for New Physics with the ATLAS Experiment

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Scientific context

When an unstable particle is produced during a proton-proton collision at the LHC, it decays into lighter particles that can be detected, for instance, by the ATLAS experiment. The production of these unstable particles can be measured by observing a narrow Gaussian peak (“bump”) on the invariant mass distribution of its decay products. Looking for such bumps is one of the main strategies to identify new particles, having successfully being used to discover the W, Z and Higgs bosons.

Agnostic searches for new physics complement analyses that target specific theoretical models: they look for unexpected signatures in data without prioritizing a particular scenario. The **BumpNet** strategy is designed to automate the search for localized excesses in mass distributions using modern machine-learning methods. This approach could make it easier to explore a wide range of signatures and data regions. JHEP02 (2025) 122 (arXiv:2501.05603)

The internship will take place within the ATLAS team in Clermont-Ferrand, which contributes to the physics analyses conducted by the international ATLAS collaboration at the LHC.

Project and responsibilities

The intern will contribute to the ongoing ATLAS analysis using the BumpNet methodology to search for new physics in an agnostic way. They will also take part in preliminary studies for the next version of the analysis.

The work may include data analysis, the application and evaluation of machine-learning methods, and the interpretation of results. The intern will attend meetings with the international teams working on this topic and gain experience of how a large particle-physics collaboration operates.

What the internship offers

The internship will provide experience in particle-physics data analysis and modern machine-learning techniques, while contributing to a search for new physics within a major international collaboration. The team plans to open a PhD position on this topic next year.