Contribution ID: **30** Type: **Workshop 2025/2026**

Expanding the Physics Reach of the ATLAS Detector with Fast Machine-Learning

Wednesday 28 January 2026 11:30 (15 minutes)

The Standard Model of Particle Physics (SM) is a very successful and precise description of particle interactions, yet it leaves unexplained several observable phenomena, such as the matter-antimatter asymmetry or dark matter. Therefore, after the discovery of the Higgs boson by the ATLAS and CMS experiments at the Large Hadron Collider (LHC), searching for new physics beyond the SM (BSM) has been one of the main focus of the LHC experiments.

In its next stage, the High-Luminosity LHC (HL-LHC), to start running in 2030, will present new challenges in trigger and data acquisition, due to its much larger collisions rates. The ATLAS detector relies on real-time event filtering systems to process millions of proton-proton collision events and decide whether to discard or keep them for further processing. This decision is currently reached within a few microseconds by a hardware-based trigger. In order to cope with the higher collision rate expected at the HL-LHC, the ATLAS trigger system will be upgraded to allow for a first decision latency of up to 10 microseconds.

It is crucial that the trigger decision is as unbiased as possible, to avoid reducing or eliminating completely any sensitivity to potential (and even unexpected) BSM signals. Therefore, taking advantage of the increased hardware trigger latency, complex algorithms that rely on fast machine-learning can be used to reach the trigger decision. In this work, we will explore and develop dedicated ML algorithms that can perform fast background rejection in favor of a model-agnostic signal detection, e.g. via unsupervised learning. We will focus on signal selection based on large-radius jets, developing a strategy that is able to discriminate hadronic boosted objects, or other signs of new physics in hadronic final states, from the QCD background jets.

Field of Research/Work

Particles and Fields

Author: FERREIRA CARVALHO, Ana Rita (Instituto Superior Técnico)