Expanding the Physics reach of the ATLAS detector with Fast Machine-Learning

Second Cycle Integrated Project in Physics Engineering

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MEFT Boosting the Future

TÉCNICO UNIVERSIDADE DE LISBOA

LIP

ATLAS EXPERIMENT

MEFT Workshop
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Introduction

Study rare SM processes

Measure properties of the Higgs boson

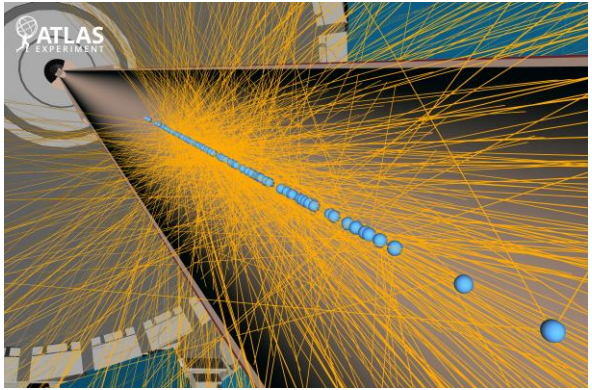
Search for new physics signatures

Probe new phase-space regions

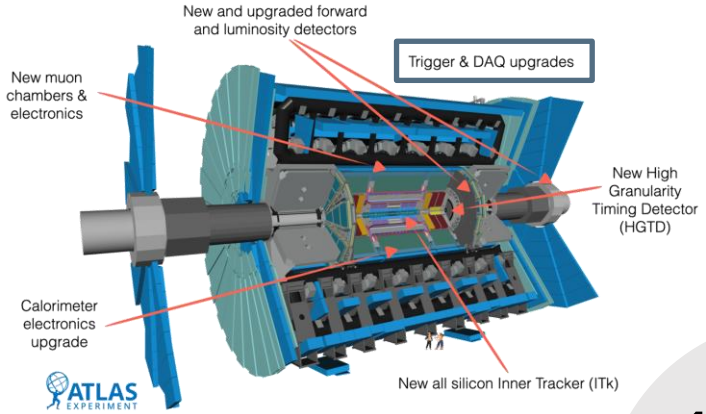
High-Luminosity LHC (HL-LHC)

Significant **increase** in instantaneous **luminosity,** with up to **200 inelastic proton-proton collisions** per beam crossing

→ ATLAS detector will go through an upgrade in preparation for the **high pile-up environment**



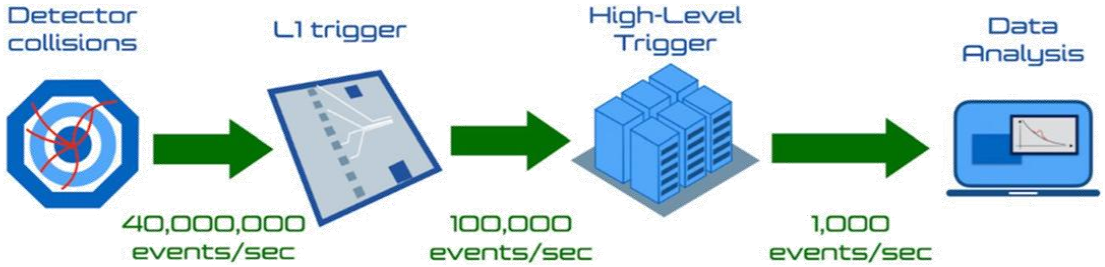
Source: ATLAS Public Event Displays from Upgrade Physics Simulated Data

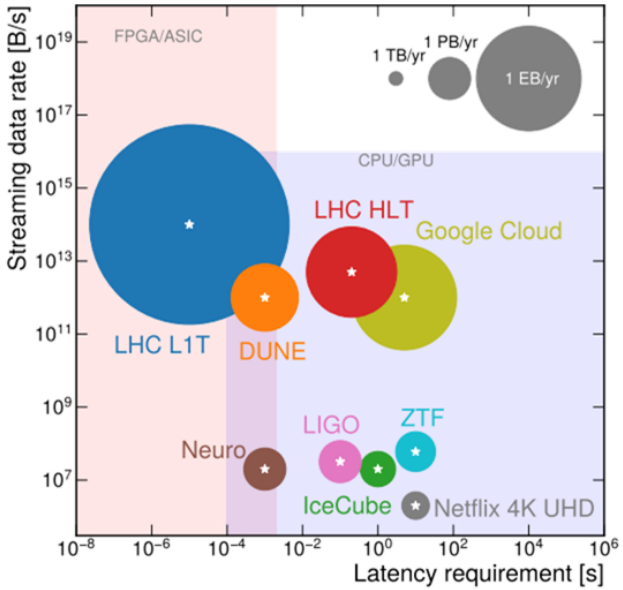


Source: ATL-UPGRADE-PUB-2025-001

ATLAS Trigger and Data Acquisition (TDAQ) System

Trigger System: online analysis for event selection





Increased latency at hardware trigger
→ implement more **complex background rejection** algorithms

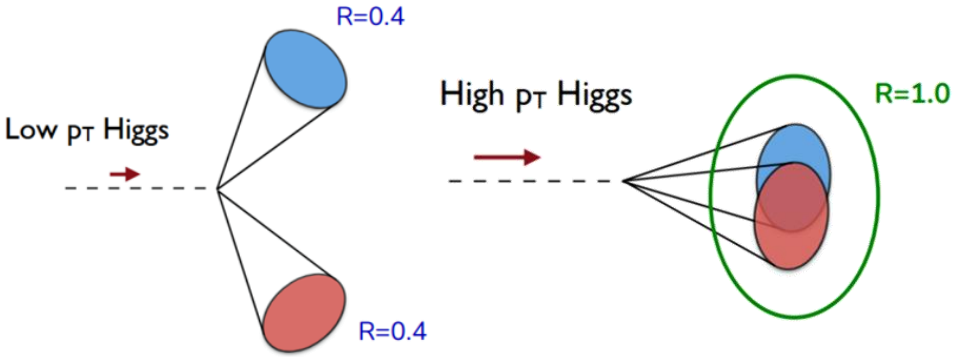
Test signal selection models in high pile-up samples

Compare the di-higgs signal efficiency with event shape and particle level variables

Future Work

For the second part of the project, we will focus on MC ATLAS simulation samples of **processes representative of the expected conditions** at the HL-LHC and of the **object reconstruction algorithms at the hardware trigger**

→ Focus on **large-radius jets**



Adapt jet reconstruction algorithm for R=1.0

So far, the performance studies have only used R=0.4

Develop an "anti-QCD tagger"

A **model agnostic strategy** to increase the trigger sensitivity to jets with any signs of new physics