

**fct** Fundação  
para a Ciência  
e a Tecnologia



LABORATÓRIO DE INSTRUMENTAÇÃO  
E FÍSICA EXPERIMENTAL DE PARTÍCULAS  
*partículas e tecnologia*

**Universidade do Minho**  
Escola de Ciências

# Anomaly Detection techniques for the search of new signal at LHC with ATLAS experiment

Presented by: Annalisa Berti

Supervisors: Nuno Castro, Rute Pedro

17/10/24

Ref. UI/BD/154673/2023

# AD for the search for new physics

The Standard Model is great but it's not complete.

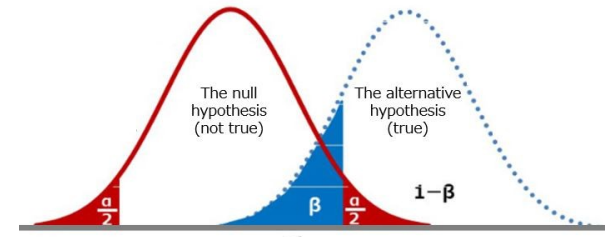
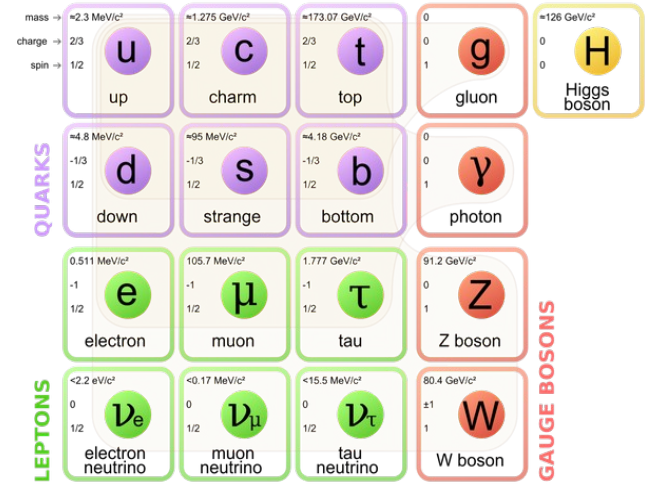
It cannot explain, for instance:

- The matter/antimatter asymmetry
- Neutrinos massiveness
- The hierarchy problem
- The existence of Dark Matter

No experimental evidence of **any** Beyond Standard Model theory

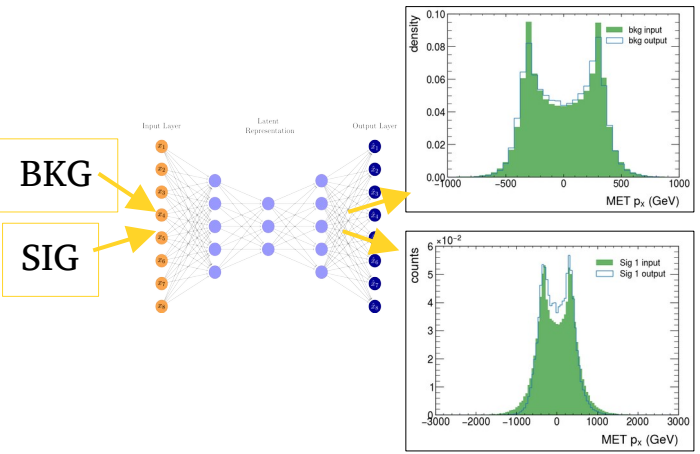
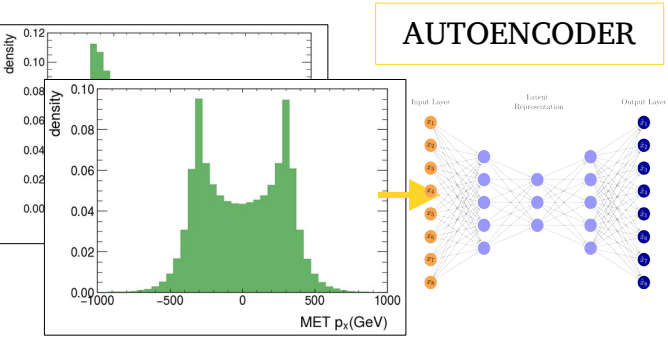
New approach with Anomaly Detection

Tool able to discriminate between background and NON-background events regardless of the specific signal model.



**Signature:** events with a large-R jet + missing energy

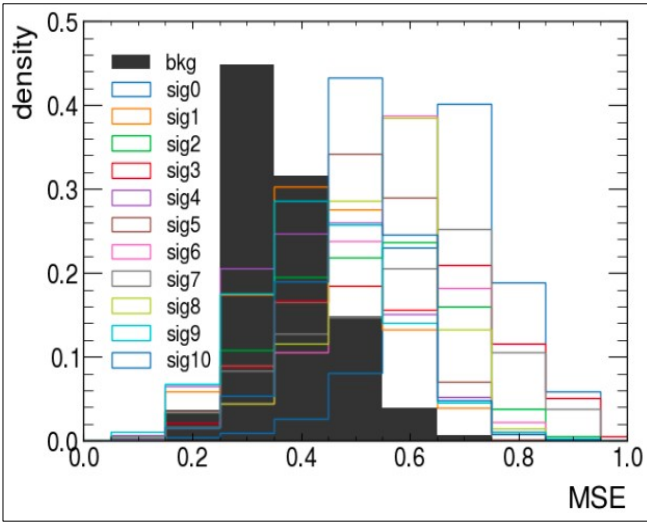
Different signal models are covered (SUSY, 2HDM, HVT,...)



Input Features (11):  
**Missing Transverse Energy,**  
**large-R jet Energy and Momentum,**  
**small-R jet Energy and Momentum**

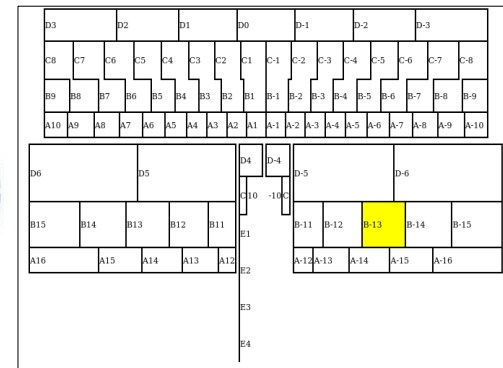
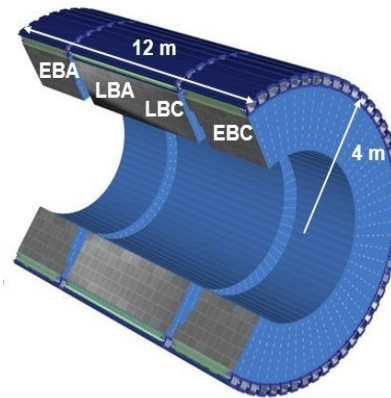
Train (fit) the model on background data

Use the model to reconstruct signal and background separately

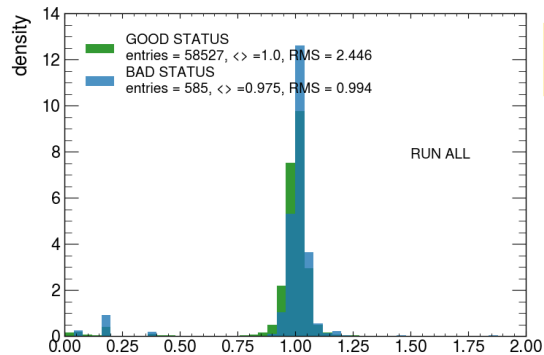
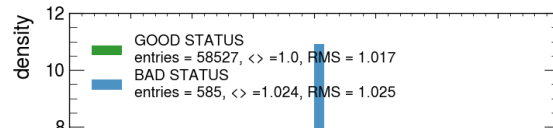
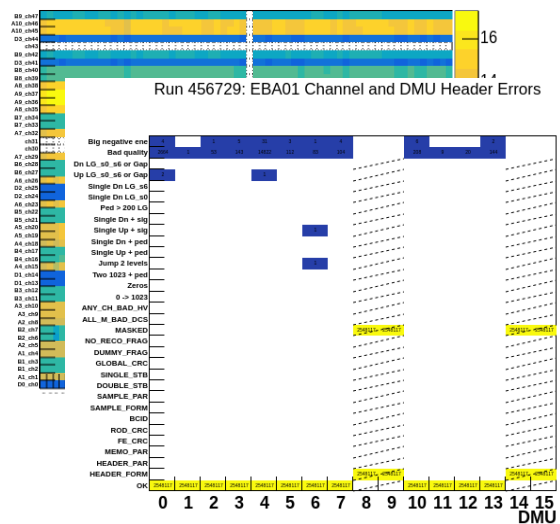


Use the mean squared reconstruction error (MSE) as discriminating variable

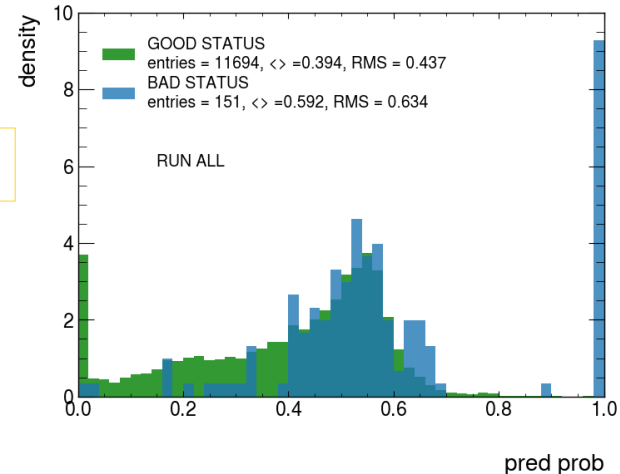
# AD for the data quality check at the Hadronic Tile Calorimeter



Run 456729 Trigger AnyPhysTrig Partition LBA HG: Occupancy Map [MeV]



NN



Channel energy HG norm. to cell mean

pred prob