Computational Reproduction, Optimisation and Discussion of the ATLAS Experiment Analysis on the Production of ZZ in Proton-Proton Collisions at √s = 13 TeV Using Open Data

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ATLAS Collaboration Open data published a pp collision dataset to the public. The data has been collected by the ATLAS detector at the LHC at 13 TeV. This open proton-proton collision dataset is accompanied by a set of tools that provide simple and easy-to-use interactive interfaces for the analysis of particle physics data. In turn, a selection of events was implemented for the DiBoson analysis, as well as the creation and analysis of histograms. One of the most interactive open source tools for reproducing analysis is the Jupyter Notebook, also known as a computational notebook. As well as the handling of ROOT for data processing that allows saving them and any C ++ object, also having access to the data to extract them and providing a set of links to integrate perfectly with languages such as Python. Finally, the management of virtual machines, create them and work with them directly for data analysis. All these tools were helpful for the computational reproducibility of said analysis, as a consequence of this, an Optimization is proposed based on the results obtained.

1) Tools for Data Analysis

Data
√s = 13 TeV
L_{int} = 10 fb^{-1}
Data Samples~ 297 KB

Datasets

MC Simulations
MC Samples~ 19,9 GB

Event selection:

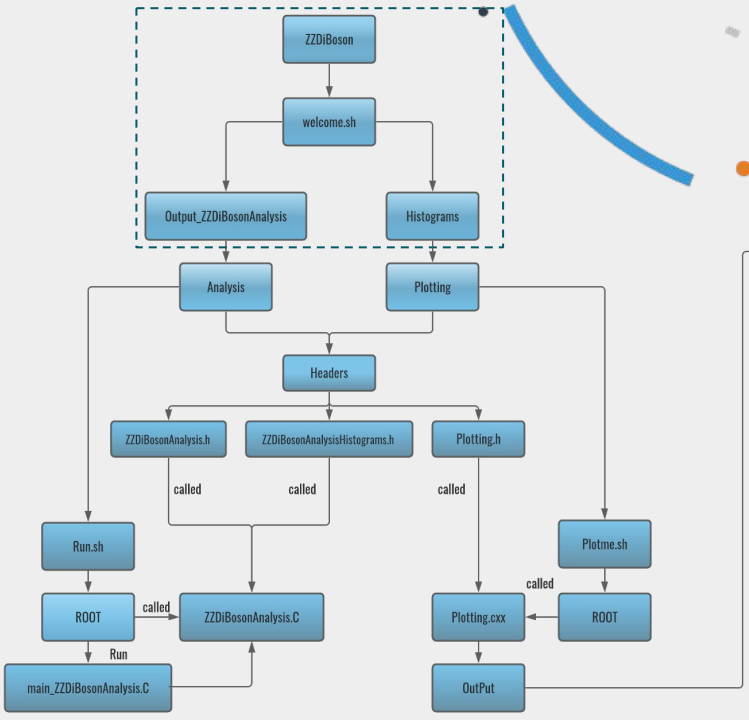
- Two pairs of leptons (μ+ μ- or e+e-) are formed, giving rise to three channels: 4e, 4μ and 2e2μ;
- Each lepton pair must have an invariant mass within a range of 66 < m“ < 116 GeV;
- p_T > 20 GeV, 4 leptons, opposite charge – same flavour pair.

2) Tools for Data Analysis

- Virtual Machine
- ROOT
- Jupyter Notebook
- GitHub
- Swan

13 Tev ATLAS Open Data

3) Analysis framework for reproduction



The results obtained in jupyter notebook with ROOT C ++ kernel of the computational reproduction of the analysis are discussed in contrast to the analysis of the ATLAS experiment on the production of ZZ in proton-proton collisions at √s = 13 TeV using open data.

4) Histogram

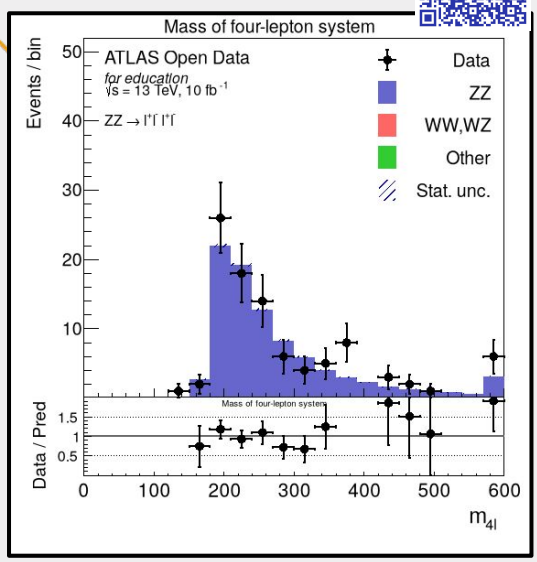


Figura 1: Comparison between data and MC prediction for the distribution in the ZZ →l⁺l⁻ l'⁺ l'⁻ selection. Distributions of the invariant masses.

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References

[1] CERN. “Review of the 13 TeV ATLAS Open Data release”. Adelaide, Australia, 4 - 8 Nov 2019. Website: https://cds.cern.ch/record/2707171. [Accessed 12 October 2020].

[2] ATLAS .“ZZ4l”. Website: https://github.com/mildredarias/ZZ4l. [Accessed 01 January 2021].

PARTICIPATION IN THE WORKSHOP ON PHYSICS, SCIENCE AND THEIR BIG DATA
2016
2018
2019
PARTICIPATION INTERNATIONAL MASTERCLASSES HANDS ON PARTICLE PHYSICS
PARTICIPATION IN CEVALE2VE COURSE 2019 Course: Introduction to Particle Physics