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A general search for new phenomena with the ATLAS detector in pp collisions at $\sqrt{s} = 7\,\text{TeV}$

S. Amoroso(*)
Physikalishes Institut, Albert Ludwig Universität Freiburg - Freiburg, Germany

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Summary. — We present results of a Model-Independent General Search for new physics in proton-proton collisions at $\sqrt{s} = 7\,\text{TeV}$. Data collected by the ATLAS experiment in 2011, for a total integrated luminosity of $4.7\,\text{fb}^{-1}$ has been used. All event topologies involving isolated electrons, photons, muons, jets, b-jets and missing transverse momentum are subdivided according to their final states into exclusive classes. A search algorithm is then used to scan all classes for deviations from the Monte Carlo simulated background in the distribution of the scalar sum of transverse momenta. No excess over the Standard Model expectation is observed.

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1. – Introduction

The LHC data has been used to search for various signals of new physics and strong limits have been set on many models of Supersimmetry and other new phenomena. Although these searches cover a wide range of event topologies, they do not cover them all. Events caused by new interactions or new particles might still be hidden in LHC data. The approach described here addresses this issue with a model-independent strategy.

2. – Event classification

All final states containing an electron, a muon, or a jet are investigated in a single analysis. The physics objects considered are muons ($P_T > 20\,\text{GeV}$), electrons ($P_T > 20\,\text{GeV}$), photons ($P_T > 40\,\text{GeV}$), missing transverse energy ($E_T^{miss} > 130\,\text{GeV}$), jets and b-jets ($P_T > 50\,\text{GeV}$). A set of robust and well-understood identification criteria is used for reconstruction. All events are assigned to an exclusive class according to the number and type of particles identified. After classification, data is present in 655 event classes.

(*) E-mail: s.amoroso@physik.uni-freiburg.de

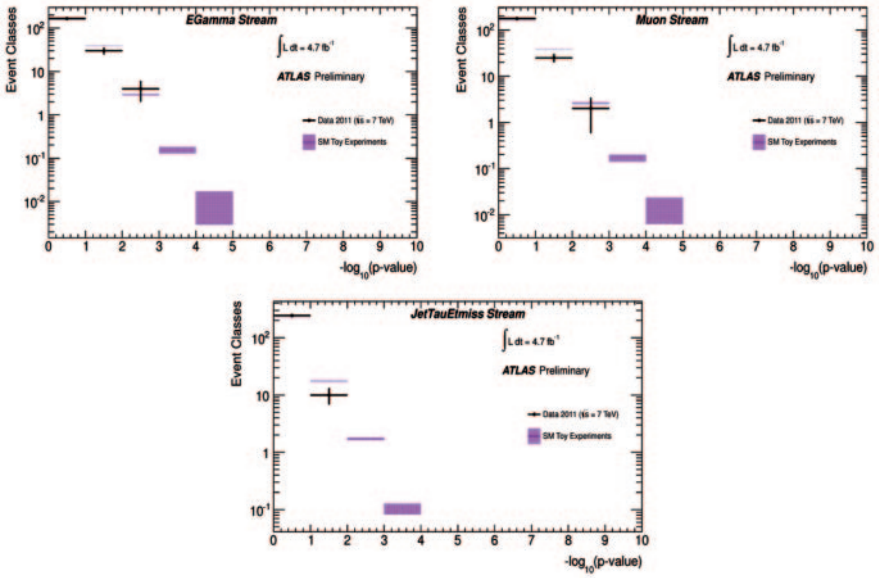

Fig. 1. – The observed and expected number of classes, for events triggered by an electron (top left) a muon (top right) or a jet (bottom).

3. – Search algorithm

In order to quantitatively determine the level of agreement between the data and the Standard Model (SM) expectation and to identify regions of possible deviations a search algorithm is applied to the scalar sum of transverse momenta of all reconstructed objects in the event, including the missing transverse energy. The algorithm locates the region of largest deviation in a distribution. The number of data events and the background expectation with its total systematic uncertainty is determined for each possible connected region of the histograms. A statistical estimator p is used to judge which region is of most interest. This estimator is derived from the convolution of a Poisson probability density function (pdf) to account for statistical fluctuations with a Gaussian pdf, to include the effect of non-negligible systematic uncertainties. The value of p gives an estimate of the probability that the SM expectation fluctuates upwards to the data in a given region. Such a method is able to find narrow resonances and single outstanding events as well as signals spread over large regions of phase space in distributions of any shape. The fact that a fluctuation can occur anywhere in a distribution and in any of the classes is modelled by toy experiments, where data is replaced by pseudo-data generated with the probability density of the Monte Carlo expectation.

4. – Results

The 2011 dataset recorded by ATLAS has been searched for deviations in 655 final states. The distributions of local p-values observed in data, compared to the expectation from SM toy experiment is shown in fig. 1 for classes triggered by an electron, a muon or a jet. No significant excess above the Monte Carlo prediction has been observed [1].

REFERENCES

[1] ATLAS Collaboration, *A general search for new phenomena with the ATLAS detector in pp collisions at* $\sqrt{s} = 7$ TeV, ATLAS-CONF-2012-107.