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A. V. Tsytrinov[1] and A. A. Pankov[1,2,3]

FIRST RESULTS ON DETERMINATION OF Z-Z' MIXING BASED ON LHC COLLISION DATA AT 13 TEV AND PREDICTIONS FOR RUN II

[1] *Abdus Salam ICTP Affiliated Centre at Pavel Sukhoi Gomel State Technical University, Gomel, 246746, Belarus*
pankov@ictp.it, tsytrin@rambler.ru
[2]*Institute for Nuclear Problems, Belarusian State University, Minsk, 220030, Belarus*
[3]*Gelepov Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, Dubna, 141980, Russia*

The exploration of electroweak boson pair production $Z' \rightarrow W^+W^-$ provides a powerful test of the spontaneously broken gauge symmetry of the Standard Model (SM) and can be used to search for new phenomena beyond the SM [1]. Extra neutral gauge vector bosons Z' decaying to charged gauge vector boson pairs $Z' \rightarrow W^+W^-$ are predicted in many scenarios of new physics, including models with an extended gauge sector (E_6, LR, ALR, SSM). The diboson production allows to place stringent constraints on the Z-Z' mixing parameter ξ and Z' mass, $M_{Z'}$. We present the Z' exclusion region in the $\xi - M_{Z'}$ plane for the first time by using data comprised of pp collisions at $\sqrt{s}$=13 TeV and recorded by the ATLAS and CMS detectors at the CERN LHC, with integrated luminosities of 36.1 and 35.9 fb^{-1}, respectively. The exclusion region has been significantly extended compared to that obtained from the previous analysis performed with Tevatron data as well as with LHC data collected at 7 and 8 TeV. Also, we found that these constraints on the Z-Z' mixing factor are more severe than those derived from the global analysis of electroweak data indicated as EW in Fig.1. Further improvement on the constraining of this mixing can be achieved from the analysis of data to be collected at higher luminosity.

Here, we present an analysis of Z-Z' mixing in the process of W pair production. The analysis is based on preliminary pp collision data at a centre-of-mass energy $\sqrt{s}$=13 TeV, collected by the ATLAS and CMS experiments at the LHC. We analyze the popular Z'_{SSM} model and determine limits on its mass, $M_{Z'}$, as well as on the Z-Z' mixing angle. We present the Z' exclusion region in the $\xi - M_{Z'}$ plane for the first time by using these data. The exclusion limits represent a large improvement over previously published results obtained at the Tevatron, and also over precision electroweak data and results obtained from proton-proton collisions at $\sqrt{s}$=7 TeV and 8 TeV. These are the most stringent exclusion limits to date on the $\xi - M_{Z'}$ plane. Further improvement on the constraining of this mixing can be achieved from the analysis of data which will be collected at higher luminosity in the near future at Run II of the LHC.

In conclusion, if a new Z' boson exists in the mass range ~ 4 –5 TeV, its discovery is possible at the LHC in the Drell–Yan channel. Moreover, the detection of the $Z' \rightarrow W^+W^-$ mode is eminently possible and would give valuable information on the Z-Z' mixing.

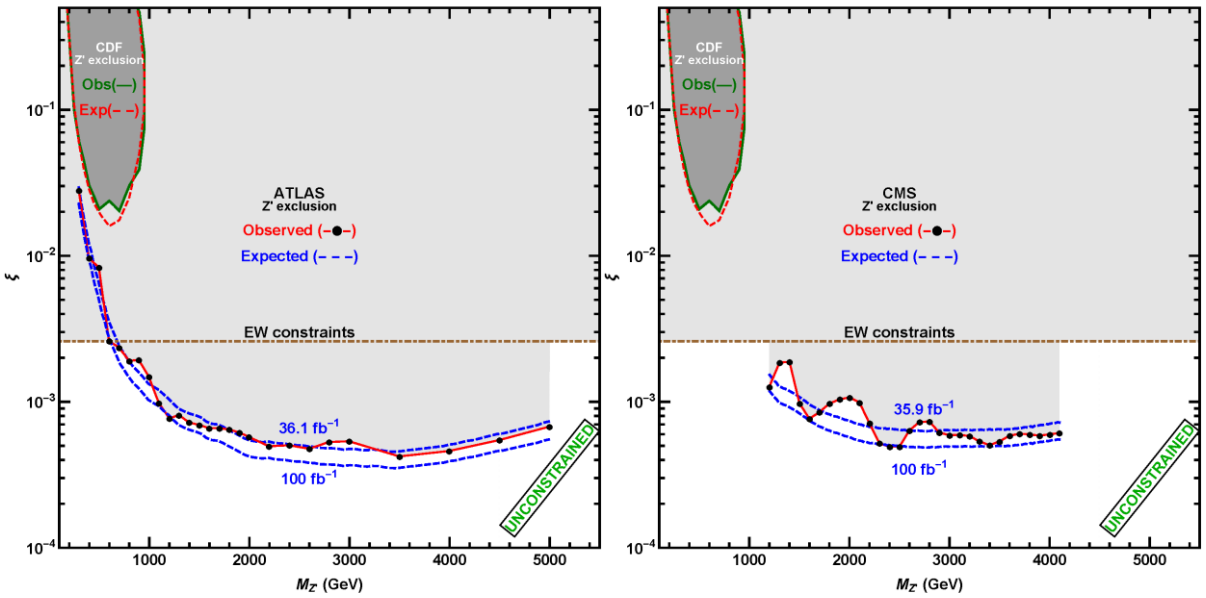

Figure 1. Z'_{SSM} exclusion regions (indicated in grey) in the two-dimensional plane of ($M_{Z'}$, ξ) obtained from W pair production at CDF (Tevatron), precision electroweak (EW) data and preliminary LHC diboson production data. Left panel: ATLAS data for 36.1 fb^{-1}, right panel: CMS data for 35.9 fb^{-1}. Exclusion plots with 100 fb^{-1} of data correspond to an extrapolation of the expected sensitivity that can be achieved from the analysis of data which will be collected at higher luminosity in the near future at Run II of the LHC (13 TeV).

Acknowledgments

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[1] For details of the analysis and original references, see

Osland P. Probing Z-Z' mixing with ATLAS and CMS resonant diboson production data at the LHC at √s=13 TeV. / P. Osland, A. A. Pankov and A. V. Tsytrinov // Phys. Rev. D. – 2017. – v. 96. – P. 055040.