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Search for high-mass dimuon resonances using proton-proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

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A search for new resonant high-mass phenomena in dimuon final states is presented. The analysis uses proton–proton collision data collected by the ATLAS detector at the LHC at an unprecedented centre-of-mass energy of 13 TeV. No significant deviations from the Standard Model expectation are observed. Lower limits are set on the signal parameters of interest at 95% confidence level.

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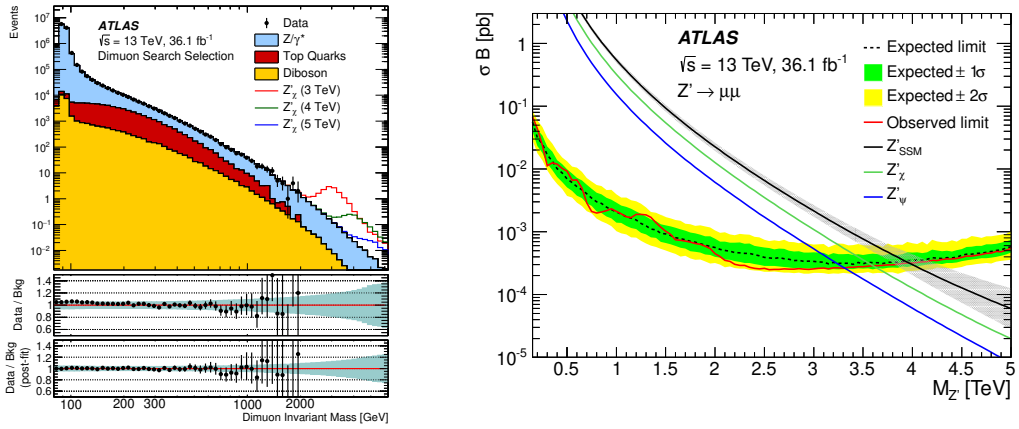
The Standard Model (SM) is generally believed to be an effective theory valid only in a low energy regime, and does not account for some experimental observations such as neutrino masses or dark matter. While high mass resonances do not offer a complete solution to such problems, many new physics theories predict their existence. The ATLAS experiment [1] at the Large Hadron Collider (LHC) has collected 36.1 fb^{-1} of data at $\sqrt{s} = 13$ TeV in 2015 and 2016. Using this dataset, we have searched for new high mass phenomena with dimuon final states.

In order to select events with two muons in the final state, a series of cuts is applied to each event. Each event is required to contain at least two combined muons. Each selected muon must have $p_{\mathrm{T}} > 30$ GeV, and satisfy the high-p_{T} working point [2]. The invariant mass of a dimuon pair, $m_{\mu\mu}$, is chosen as the discriminating variable for this search. The invariant mass distribution of the dimuon system is shown in Figure 1a. In order to quantify any potential excess of data compared to background processes, we calculate the p-value as a function of mass. No significant excess was observed in the dimuon invariant mass distribution. Therefore, various theoretical models are constrained by setting limits on parameters of the models. Upper limits on the cross-section times branching ratio (σB) are set for different Z' models. Figure 1b shows the limits set for the resonant Z' models. In particular, a Sequential Standard Model [3] Z' resonance is excluded for masses below 4.0 TeV, and a Z'$_\chi$ resonance is excluded for masses below 3.6 TeV.



(a) (b)

Figure 1: (a) Dimuon invariant mass distribution after event selection. b 95% C.L. upper limits on σB as a function of mass for several Z' models [4].

To conclude, a search for high-mass dimuon resonances was performed using 36.1 fb^{-1} of data recorded by the ATLAS detector. No significant excess above the Standard Model expectation was found, therefore lower limits at the 95% C.L. were set on the mass of the Z' boson for various Z' models.

References

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