A measurement of the Cross Section of the Z decay in muon channel and prediction of the rate of the Z decay in tau-lepton channel

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The Z at ATLAS

- The Z boson has a very short lifetime, it decays shortly after its production.
- The Z boson is not detected directly in the ATLAS experiment and it must be reconstructed from its decay products.
- The Z boson decays to fermions and anti-fermion pairs.
- \( Z \rightarrow \mu \mu, Z \rightarrow \tau \tau \) have the same rate.

The Z at LHC

- The Drell-Yan process: a quark and anti-quark fuse into \( Z \).
- The NLO mechanism: quark gluon scattering.
- Higgs; \( H \rightarrow ZZ \).

Data collected by ATLAS detector in late 2010.
- The proton beam had energy of 3.5 TeV.
- The integrated luminosity of the machine was 36 pb\(^{-1}\).
- MC sample generated by using PYTHIA.

The Z decays in Muon Channel

Selection

- Initial criteria approved quailed events for the study.
- The authenticity of the muon is checked. Only muons that have expected properties of muons from Z decays selected and muons from backgrounds are rejected.
- Events that carry the specific Z properties passed.

The Invariant Mass

The Invariant Mass:
- MC 91.18 GeV
- Data 90.13 GeV
- established value for Z mass is 91.187 GeV

\[ \sigma_{had} = \frac{N_{MC \text{ gen}}}{N_{MC \text{ gen, off}}} \times \frac{A_{\text{gen}}}{A_{\text{gen, off}}} \times \frac{L}{L_{\text{jet}}}, \quad (1) \]
\[ \sigma_{Z \rightarrow \mu \mu} = \sigma_{Z \rightarrow \tau \tau} \times \frac{\alpha^2}{\alpha^2_{\text{Z,off}}} \times \frac{L}{L_{\text{jet}}}, \quad (2) \]

The Cross Section of the Z decays in Muon channel

- Initial criteria approved quailed events for the study.
- The authenticity of the tau-lepton is checked.
- Events that carry the specific Z properties passed.

The Z decays in tau-lepton channel

Selection

- Initial criteria approved quailed events for the study.
- The authenticity of the tau-lepton is checked.
- Events that carry the specific Z properties passed.

Plots suggest there are considerable background events after selection.

Conclusion

Since the measurement of Z\( \rightarrow \mu \mu \) cross section agrees with theoretical prediction. This indicates that Z\( \rightarrow \tau \tau \) cross section should be well described by theory and can be used to predict the Z\( \rightarrow \tau \tau \) rate in ATLAS.