
CERN

Studies for a New Trigger for the Measurement of the Weak Mixing Angle with the ATLAS Detector

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Theoretical Introduction

The Weak... What Angle?

Fields from $SU(2)_L \times U(1)_Y$

$$SU(2)_L \rightarrow W_\mu^1, W_\mu^2, W_\mu^3$$
$$U(1)_Y \rightarrow B_\mu$$

The $W^\pm$ boson defined as

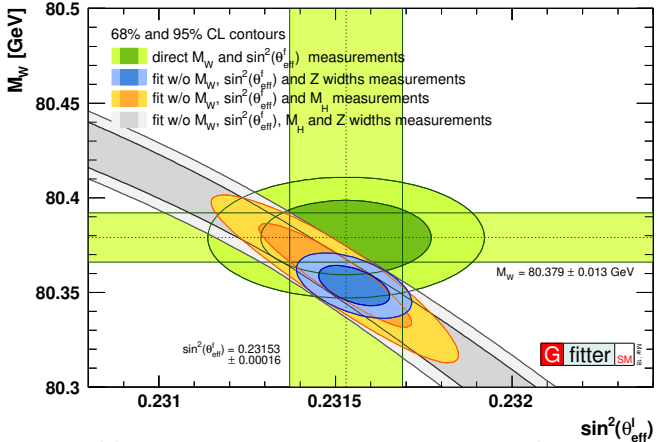
$$W_\mu = \frac{1}{\sqrt{2}}\left(W_\mu^1 - iW_\mu^2\right) \quad W_\mu^\dagger = \frac{1}{\sqrt{2}}\left(W_\mu^1 + iW_\mu^2\right)$$

For the remaining fields: write as rotation over θ_W

$$\begin{pmatrix} W_\mu^3 \\ B_\mu \end{pmatrix} = \begin{pmatrix} \cos\theta_W & \sin\theta_W \\ -\sin\theta_W & \cos\theta_W \end{pmatrix} \begin{pmatrix} Z_\mu \\ A_\mu \end{pmatrix}$$

Motivation

Why (Still) Measuring the Weak Mixing Angle?

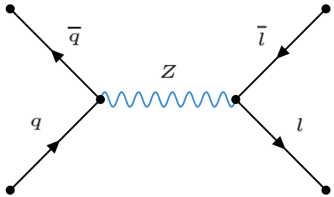


Source: http://project-gfitter.web.cern.ch/project-gfitter/

Method

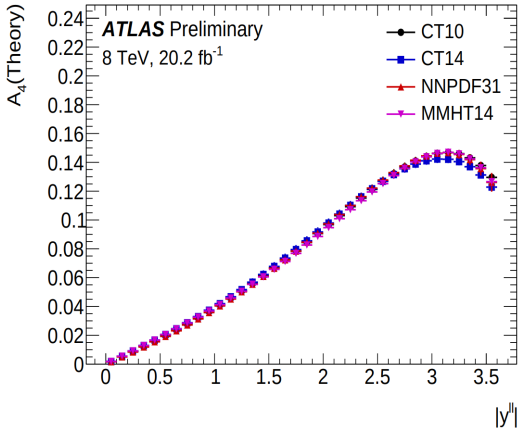
How Measuring the Weak Mixing Angle?

Drell-Yan process: $q\bar{q} \to Z \to \ell\ell$



Cross section decomposed in harmonic polynomials:

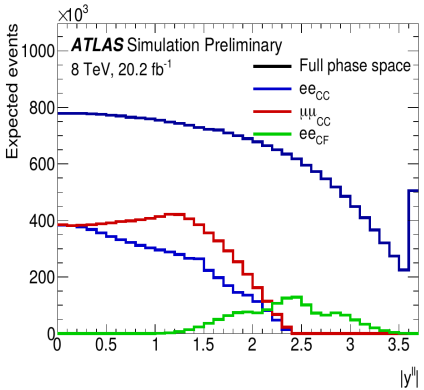
$$\frac{\mathrm{d}\sigma}{\mathrm{d}y_{\ell\ell}\,\mathrm{d}m_{\ell\ell}\,\mathrm{d}\cos\theta} \propto (1+\cos^2\theta) + A_4\cos\theta$$

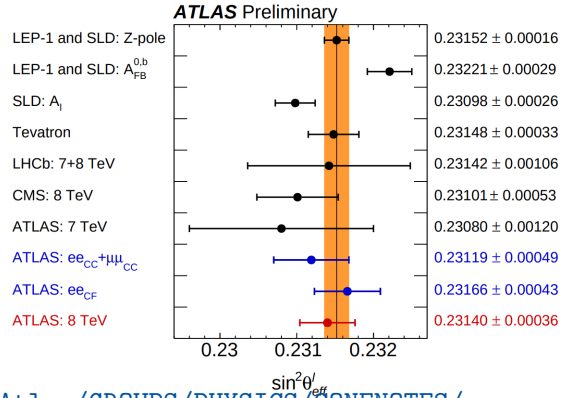


Source: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/

Method

How Measuring the Weak Mixing Angle?





Source: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2018-037/

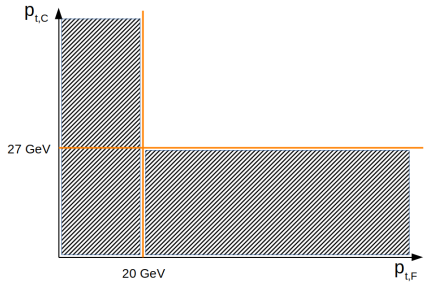
Goal of the Project

What do I do?

Does triggering on the forward electron increase the efficiency?

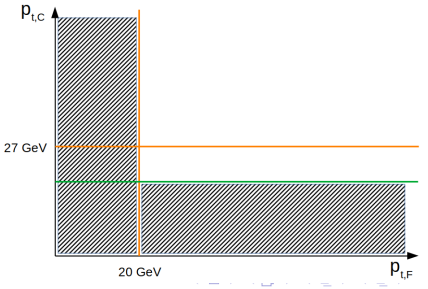
Run 1 & 2:

- Only trigger on central e
- Robust cut on $p_{t,F}$



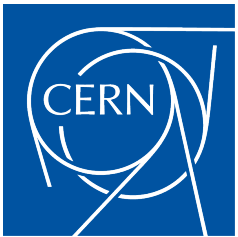
Run 3 proposal:

- Lower cut on $p_{t,C}$
- Further trigger on $\Delta\phi_{\ell\ell}$ & $m_{\ell\ell}$



Summary

- Measurements of high rapidity electrons would increase accuracy on measurements of $\sin^2 \theta_W$.
- Previous runs: only triggered on central electrons.
- Run 3: Accepting more events and triggering on observables concerning the central-forward pair could increase efficiency.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