Summary of $\sin^2\theta_W$ planning discussion

Aram Apyan, Michael Schmitt, and others…

SMP-General Meeting

March 27, 2018

Context

- LHC EWWG General Meeting: April 25 & 26
- PDF4LHC meeting tomorrow (March 28)
- In preparation, a meeting to discuss $\sin^2\theta_W$ was held (March 21).
  - Purpose: reach preliminary agreements about main issues in deriving a LHC value for $\sin^2\theta_W$
  - Attending: representative experts of CMS, ATLAS, and LHCb

How to derive a combined value for $\sin^2\theta_W$?

Range of options:

1. Simply combine values of $\sin^2\theta_W$ taking correlated uncertainties into account.
2. Perform a global fit to A_{FB} values from all experiments.
3. Fit to detector-level differential cross sections from all experiments.

Consensus:

- First option is too crude on the long term; difficult to be sure that correlations are taken into account accurately. Might be OK for a first combined value on the short term.

- Third option is unnecessarily ornate and difficult, requiring sharing a lot of knowledge of reconstruction capabilities that could be burdensome.

- Second option is the way to go…

Plan for a combined value for $\sin^2\theta_W$

- A global value for $\sin^2\theta_W$ will be obtained by fitting either A_{FB} or A_4 as a function of rapidity Y.

- We established the following convention, to distinguish A_{FB} and A_4 :
  - A_{FB} is defined at detector level and depends on the fiducial region for the analysis.
    - Suggested to be based on dressed or post-FSR leptons.
  - A_4 is corrected for resolution and is independent of the fiducial region.
    - Suggested to be based on Born leptons.

- The A_4 values should be the same for experiments in a given (M,Y) bin.
  - Use this to establish consistency of the measurements (formal statistical test).
  - Combine the A_4 values – this is an important public result.

- Given consistency, fit to the A_{FB} values.
  - Use one common theoretical model, including one or two baseline PDF set(s).
  - Apply smearing / resolution functions provided by each experiment, to map the “truth” level information in the theoretical model to the object-level information, i.e., A_{FB}.
  - Careful definition of correlated uncertainties.

Plan for a combined value for $\sin^2\theta_W$

- Profiling of PDF uncertainties would be carried out at the level of the fit.
  - ATLAS & CMS using similar methods; LHCb will follow these methods.
  - PDF4LHC meeting will include a discussion.

- Set up and maintain a fitting framework that allows updates of $\sin^2\theta_W$ when e.g., better PDFs are available.
  - Input data
  - Documentation

- It should not be difficult to merge fitting tools. Not thought to be a critical item.

- Postponed for future meetings:
  - Selection of bin boundaries. Requires some projections of event yields.
  - Precise definitions of systematic uncertainties. Could begin after the general meeting.

- Better definitions of theory uncertainties (e.g., scales) could become available on this time scale.

Summary

- Fruitful discussion led to first steps.
- Good preparation for the general LHCEWWG meeting next month.
- Success will require regular meetings with LHC colleagues and a steady effort internal to CMS.
- Room for people to get involved…