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Parton Distribution Functions

PDF correlations between Higgs signal and backgrounds

Here is the link for summary page.

PDF prescriptions

Here short guide is given for each PDF set. For further detail, please contact the expert (link to the e-mail address is given below).

ABKM

For ABKM the prescription is described in Phys. Rev. **D81** (2010) 014032. In short, the central value is just the default ABKM set. In the fit 25 parameters are determined, one of them is the strong coupling $_s$ and the uncertainties of all parameters can be determined from the 25 sets for the PDF ($_s$) error. Please note that the PDF errors are symmetric. For Higgs-boson production at the Tevatron and the LHC PDFs in 5-flavor scheme are provided both at NLO and NNLO in QCD. The value of the strong coupling for 5 flavors at the scale M_Z is $_s(M_Z)$ = 0.1179 +- 0.0016 at NLO in QCD, and $_s(M_Z)$ = 0.1135 +- 0.0014 at NNLO in QCD. All fits are available from the LHAPDF library.

(*Comments from Sven-Olaf Moch, June 1st, 2010*).

CTEQ

For CTEQ6.6, there are the standard eigenvector sets handled using the Master Equation as described for example in Rept. Prog. Phys. **70** (2007) 89. We have a new alphas series described in arXiv:1004.4624 and available from LHAPDF. The PDF errors determined from the CTEQ6.6 eigenvectors and the alphas error sets can be added in quadrature. The paper describes a proof of the correctness of this procedure. We have CT10 and CT10W PDF sets that will be available in the near future if you want to use those as well.

(*Comments from Joey Huston, May 20, 2010*).

GJR08/JR09

The PDFs of our group are generally called "dynamical" or "(G)JR", as you prefer. We have LO and NLO sets (GJR08) and NNLO sets (JR09), both in the FFNS and in the VFNS. Our analyses always include s as a free parameter (sometimes this is written as "PDFs + $_s$"-uncertainties, although this way of indicating what is done seems to me to be quite sloppy). At LO we got $_s(M_Z^2)$ = 0.1263 +- 0.0015, at NLO $_s(M_Z^2)$ = 0.1145 +- 0.0018 and at NNLO we got $_s(M_Z^2)$ = 0.1124 +- 0.0020; these values refer always to the "dynamical" distributions (we also generated "standard" sets for reference, this is explained in the papers). The "recipe" for the error calculation follows the standard (symmetric) Hessian method. It is explained to some extent in Sec. 2.3 of arXiv:0902.3947; Eq. 2.10 there gives explicitly the formula to be used.

The reference for GJR08 FFNS is Eur. Phys. J. **C53** (2008) 355, for GJR08 VFNS the previous one and Phys. Lett. **B664** (2008) 133; for JR09 FFNS it is Phys. Rev. **D79** (2009) 074023, and for JR09 VFNS is the previous one and Phys. Rev. **D80** (2009) 114011. The codes for our PDFs ($_s$) can be found, for instance, in here. They are also included in the LHAPDF library.

(*Comments from Pedro Jimenez-Delgado, May 25, 2010*).

HERAPDF

HERAPDF sets are included in LHAPDF since version 5.8.1. Two LHGRID files are need to be downloaded. The first file, HERAPDF10_EIG.LHgrid, contains the central fit and experimental uncertainties. The second file, HERAPDF10_VAR.LHgrid, contains additional model and parameterization uncertainties. Both files contain short description, how these sets should be used. For experimental errors, the prescription is very much standard: *The 20 error PDFs should be treated two by two as the up and down excursions down 10 eigenvectors, such that the symmetric error is calculated as the quadrature sum of: [Sigma i=1,10 of (var i+1- var i)/2].*

We prefer to quote experimental errors after symmetrization. For model and parameterization errors, procedure to calculate them is a bit different: *The first 8 variations are considered as model errors and should be treated one by one, by taking the difference between the variation and the central value, and then adding in quadrature all positive (negative) differences to obtain the positive (negative) model error. Variations 9 to 13 are the maximal parmetrisation variations; the largest positive (negative) difference between the variation and the central value is taken as the positive (negative) parametrisation error and added in quadrature to the model errors to form the parametrisation envelope.* Here we keep asymmetric errors. The preferred value of $_s$ for these sets is 0.1176. In addition, recently we have released sets HERAPDF10_ALPHAS.LHgrid in which we scan $_s$ values from 0.114 to 0.122 in steps of 0.001.

We also performed some cross section calculations, following PDF4LHC benchmarking prescription. The results are given at PDF4LHC WIKI. The reference to the fit is JHEP **01** (2010) 109.

(*Comments from Sasha Glazov, May 21, 2010*).

MSTW

For MSTW the prescription is as in Eur. Phys. J. **C64** (2009) 653-680. As a quick summary, the central value is just that with the default MSTW set. The uncertainty not including $_s$ is obtained using the eigenvector sets as usual. However, there are additional sets, with eigenvectors, for the +0.5 , + 1 , -0.5 , -1 (and same for 90% confidence level) $_s$ uncertainties. The full uncertainty is obtained by repeating for these four additional sets and taking the most extreme variation in either direction away from the central value.

(*Comments from Robert Thorne, May 20, 2010*).

NNPDF

For NNPDF, in principle, there is no preferred value and uncertainty on $_s$: the choice is left to the user, all values of $_s$ from 0.114 to 0.124 are available from LHAPDF. However, I would think that the choice made eg in arXiv:1004.0962 might be reasonable, i.e. $_s(M_Z)$ = 0.119 +- 0.0012 (at 68% C.L.) i.e. +- 0.002 (at 90% C.L.).

For PDF uncertainties, take as central value the mean and as uncertainty the standard deviation of results found using N_rep PDF replicas. For PDF+ $_s$ uncertainties take as central value the mean and as uncertainty the standard deviation of results found using N_rep PDF replicas, gaussianly distributed in $_s$ (see eqs 12-14 of the above paper). For example, with the above value and uncertainty on $_s$, use the following number of (randomly selected) replicas for each alphas value:

0.116 -> 5 reps
0.117 -> 27 reps
0.118 -> 72 reps
0.119 -> 100 reps

0.120 -> 72 reps
0.121 -> 27 reps
0.122 -> 5 reps.

For different total number of replicas just rescale these values. In practice a total number of N_rep=100 should be adequate for all practical purposes, so divide the above number of replicas by 3. Equivalently the addition in quadrature of PDF and $_s$ uncertainties can also be used (the result does not differ in a statistically significant way), however in this case one needs for the same accuracy N_rep replicas for central alpha, N_rep for low alpha and N_rep for high alpha, so this procedure is three times slower than the previous one.

(*Comments from Stefano Forte, May 20, 2010*).

Goal of the group

Group Member

Available Tools

Documents

Meetings

- CERN InDico Agenda

Links

- **LHAPDF**
- **PDF4LHC Wiki**
- **PDF benchmarking for LHC processes (MSTW page)**

This topic: LHCPhysics > LHCHWGPDF
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