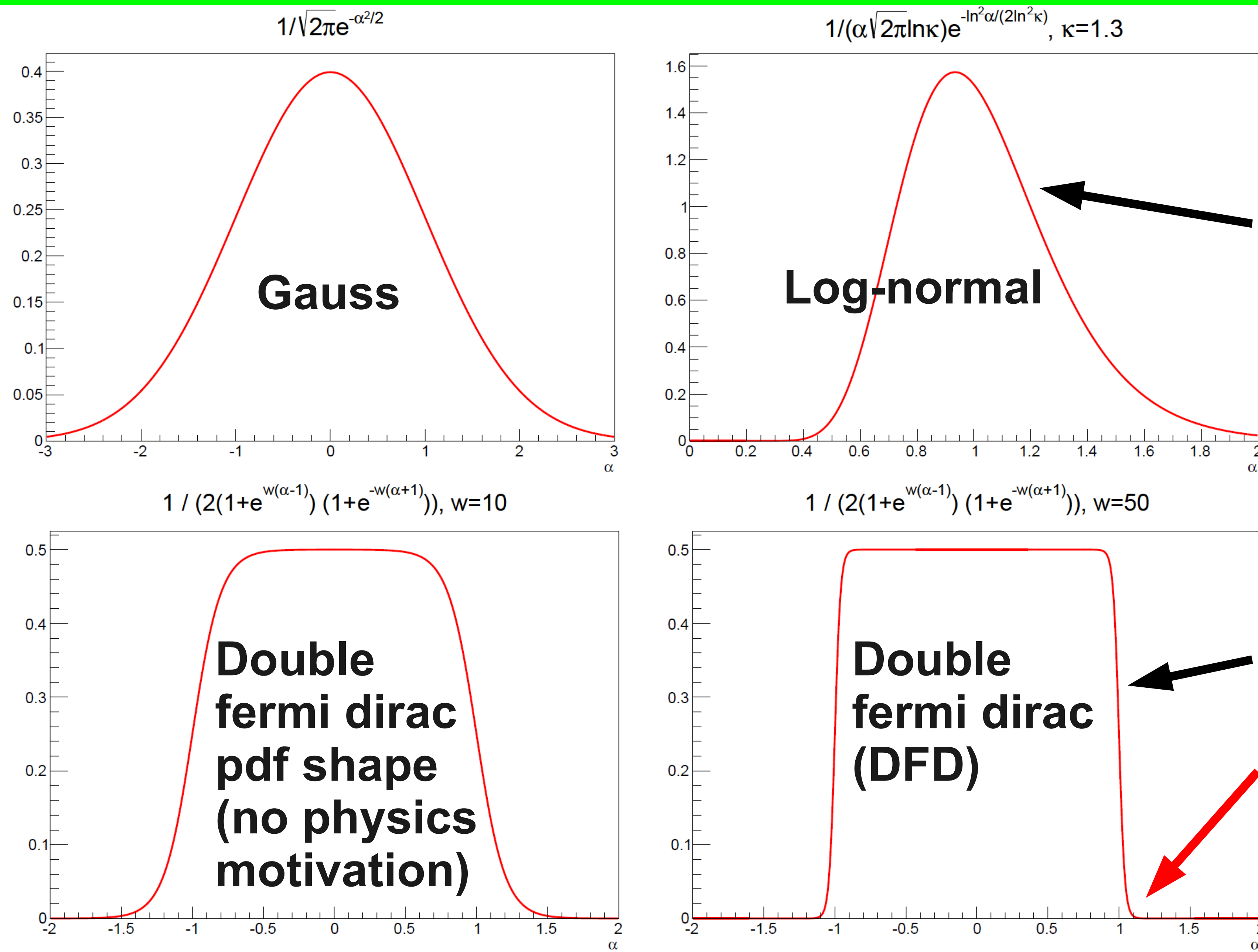
Influence of the pdf shape of theory uncertainties on measurements

THU task force meeting
12.04.2013

pdf shapes



pdf shape used for theory systematics by HCG agreement: gives $\alpha>0$

Simple ad-hoc definition for a flat pdf shape, but less tails than Gauss!

Motivation: Flat in the middle, but not completely flat → good for Minuit
Twice smooth differentiable everywhere → good for Minuit

What to test?

In a test combination of Higgs channels, replace for

- gg→H QCD scale uncertainty (~8%)
- gg→H PDF uncertainty (~8%)

the log-normal constrain by a DFD(w=10) and DFD(w=50) constraint (place DFD edges at 1σ from above ~ ±8%).

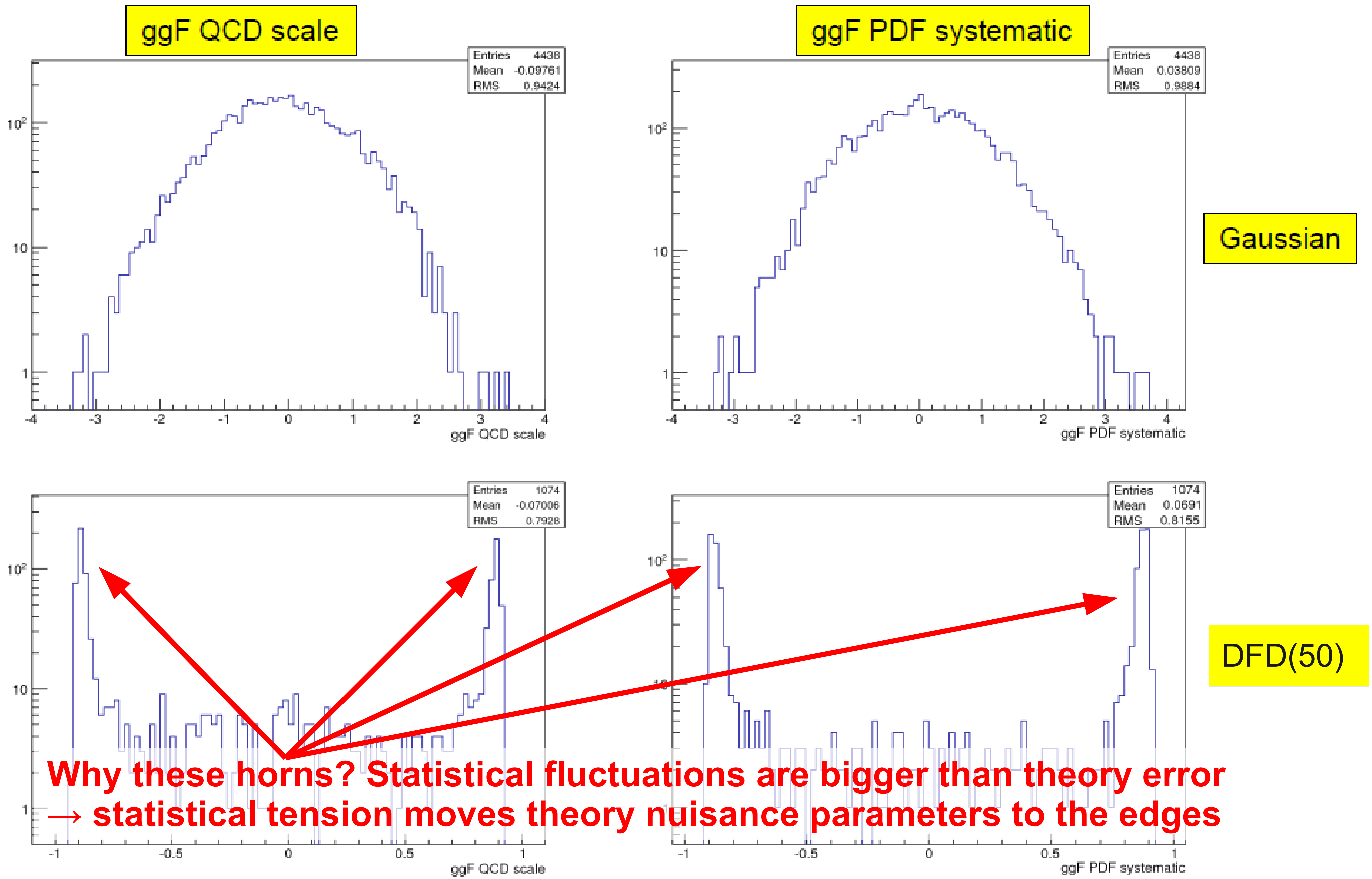
As the DFD is flat in a large range, this should give

- A linear addition of QCD scale and PDF uncertainties.
  - log-normal: ~10.5% for QCD scale+PDF together
  - LHC XS WG value: 15% (linear sum)
- DFD has no preference for any value within the flat pdf region
- DFD is just empirical and has no physics motivation. Anything with a large "flat" range should be equivalent.

- Other implications? → run toy experiments to check

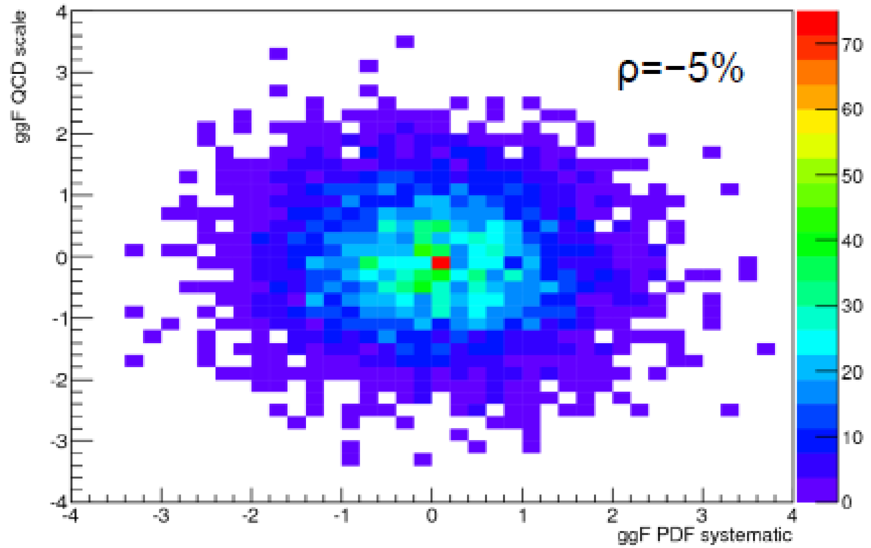
gg→H QCD scale and PDF uncertainty

Fitted theory NP for toys

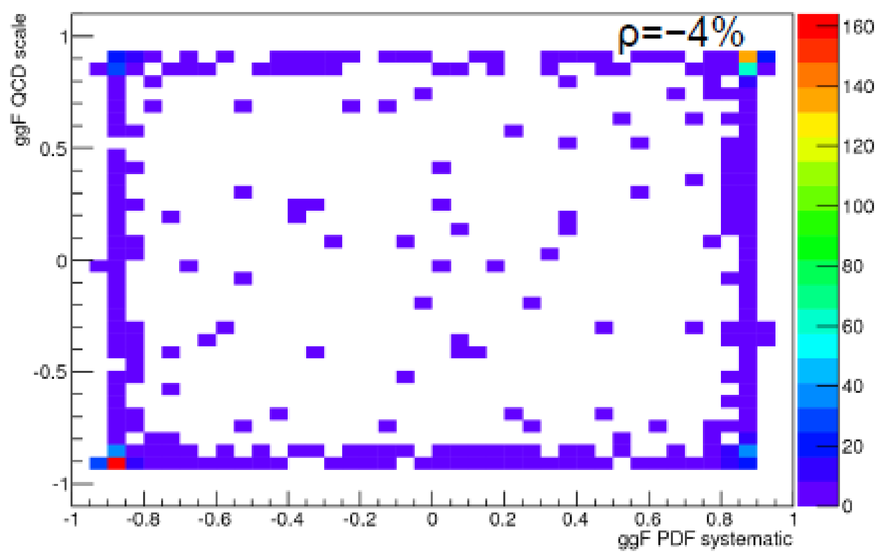


gg→H QCD scale and PDF uncertainty

Fitted theory NP correlation with toys



Gaussian

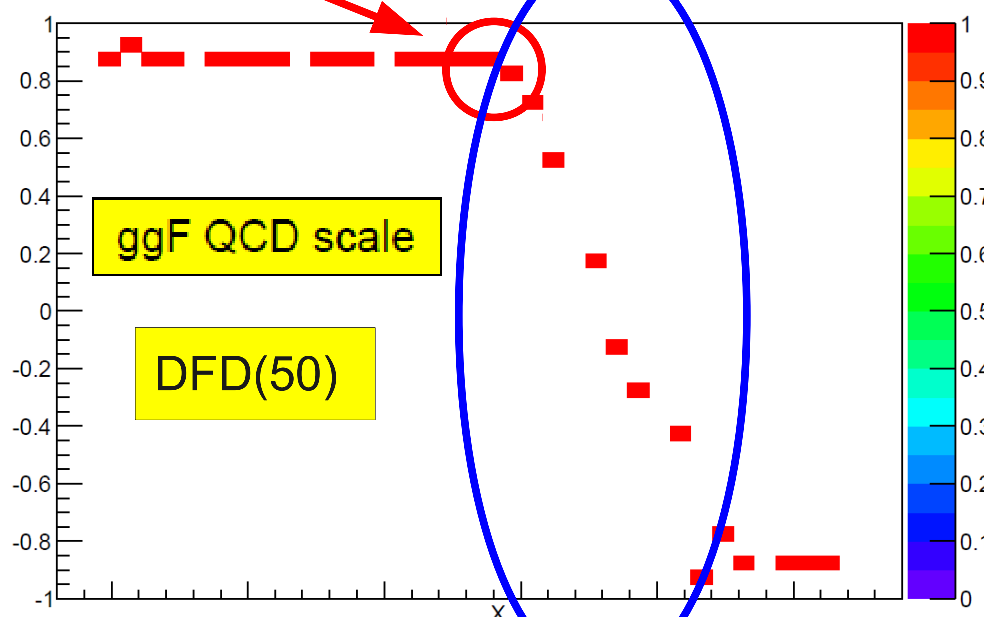


DFD(50)

ggF QCD scale vs ggF PDF systematic

Correlation with POI for one example

X=Best fit point for this example



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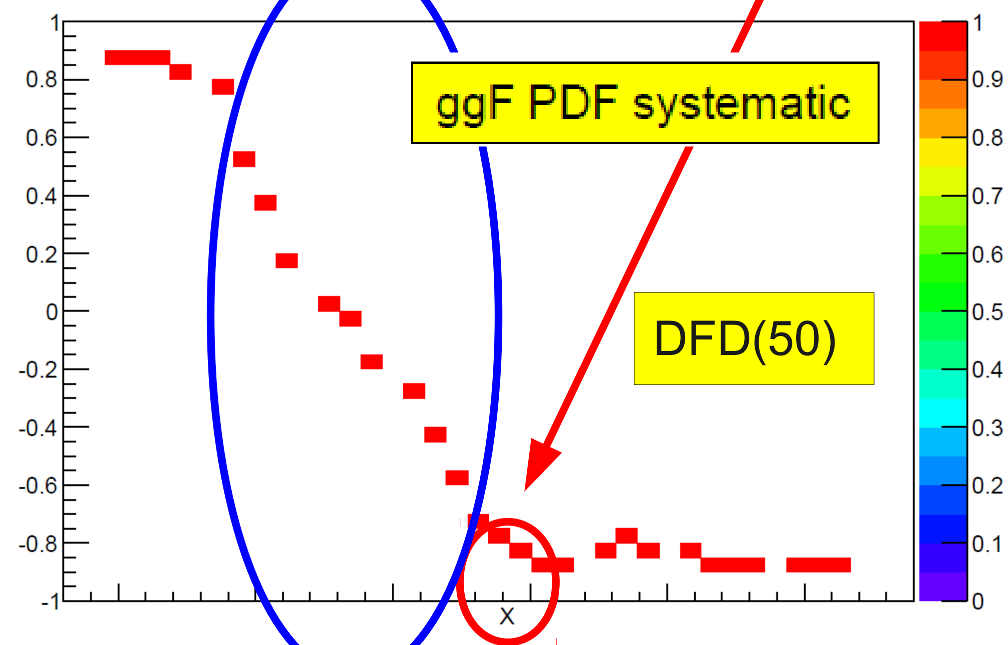
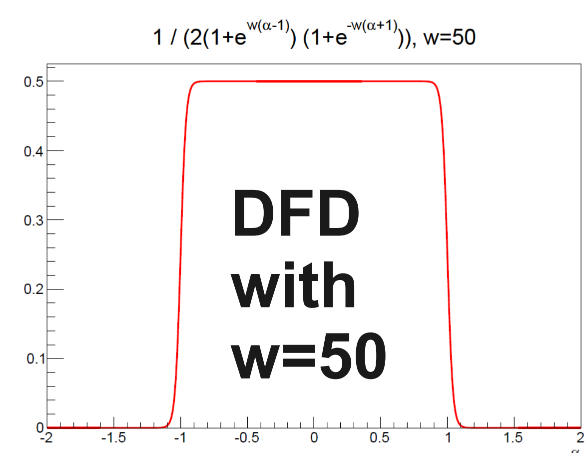
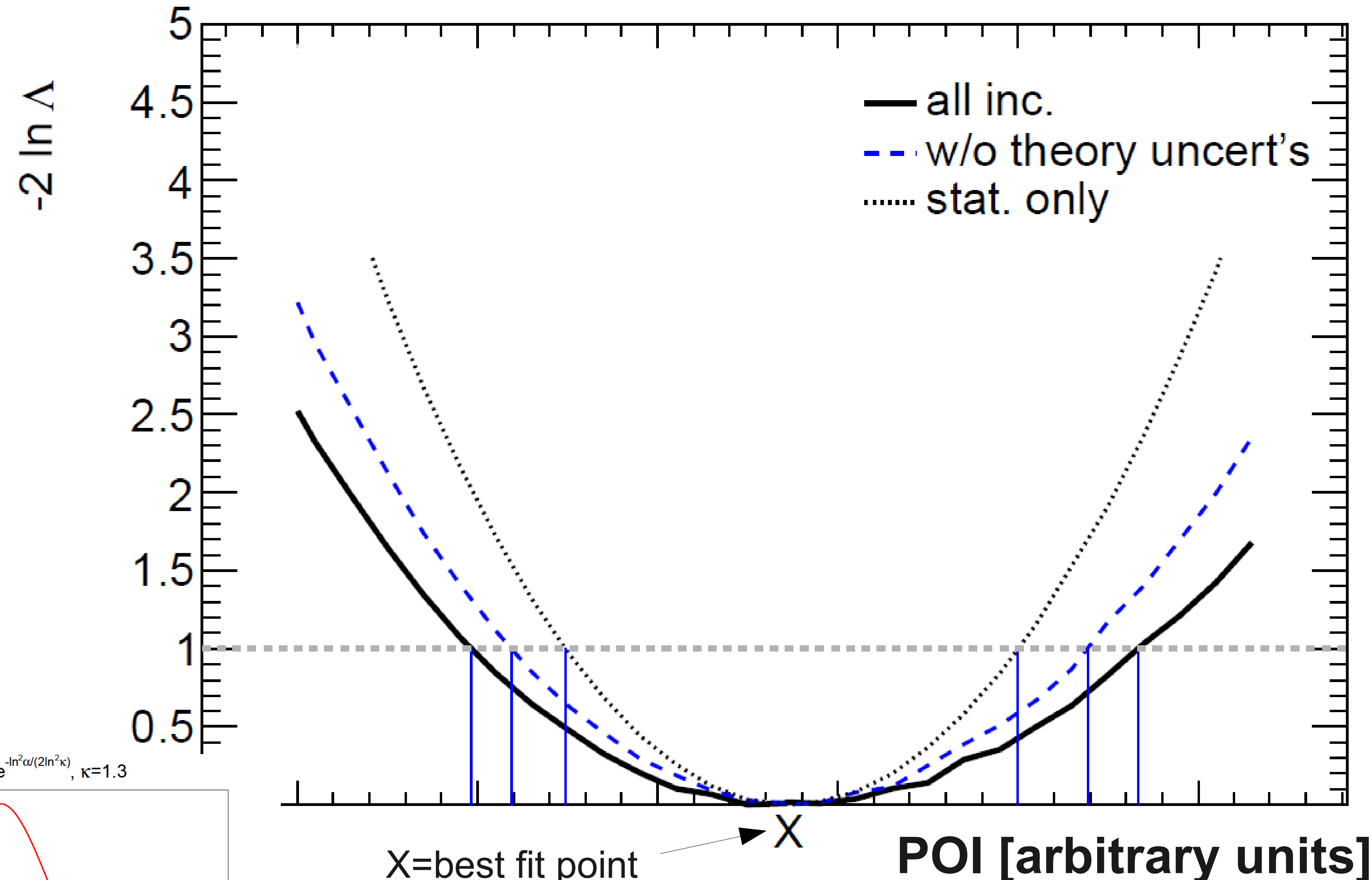
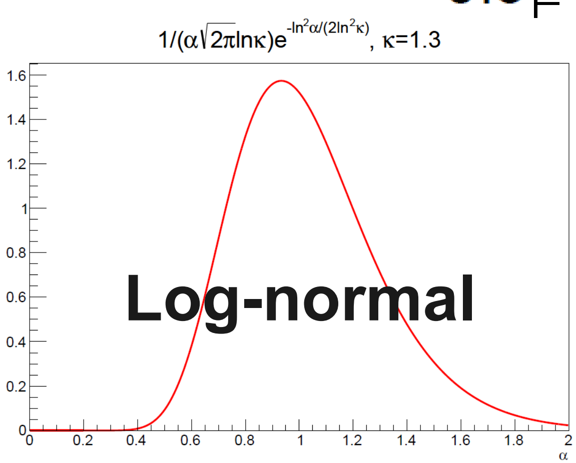


In this range the POI can move more easily, as the QCD scale and PDF uncertainty nuisance parameters can adjust to the best fitting values without any penalty in the Likelihood (flat range in their pdf shape)



Error decomposition for one example





Use log-normal, DFD(10) and DFD(50) for two parameters:
gg → H QCD scale and PDF uncertainty

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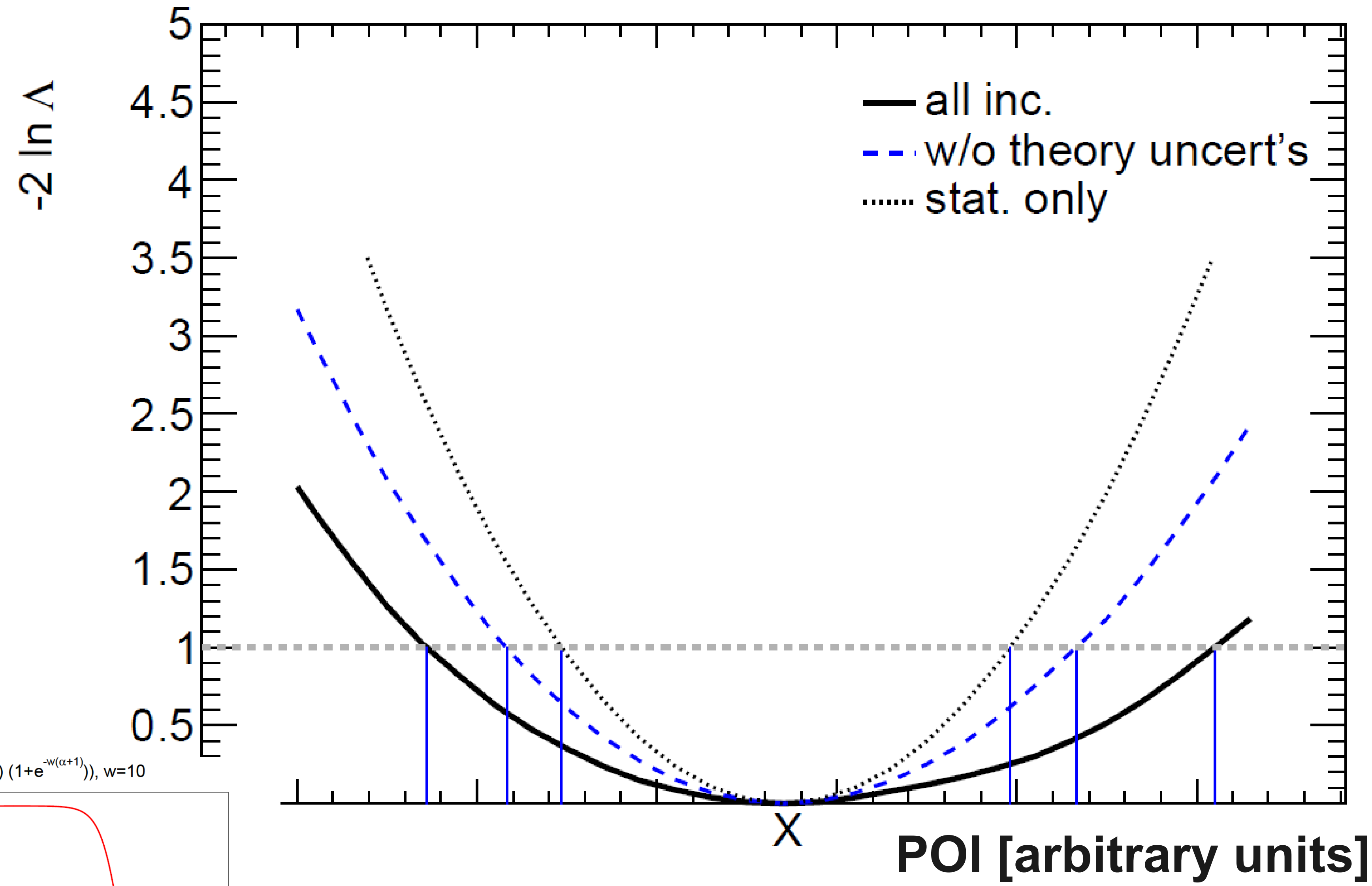

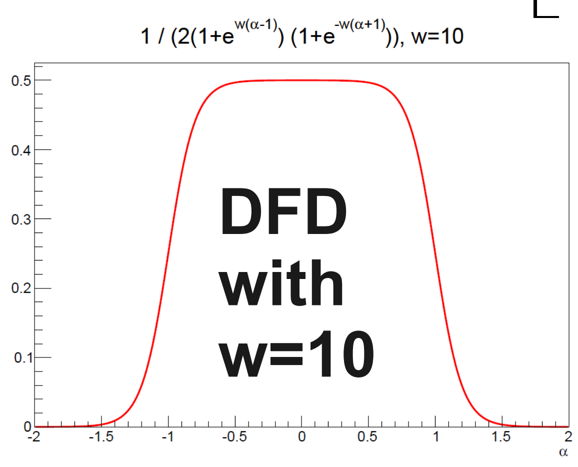

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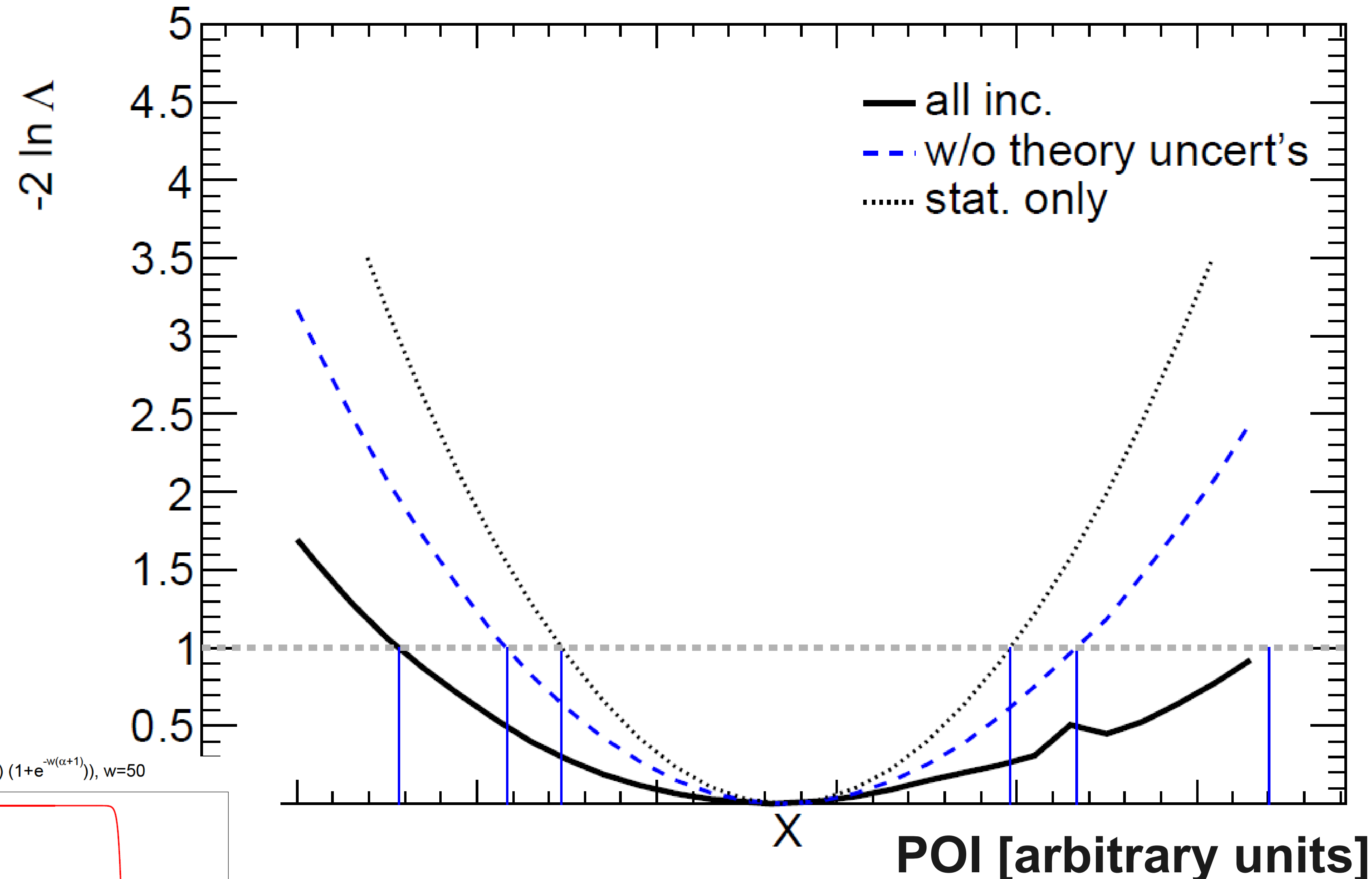

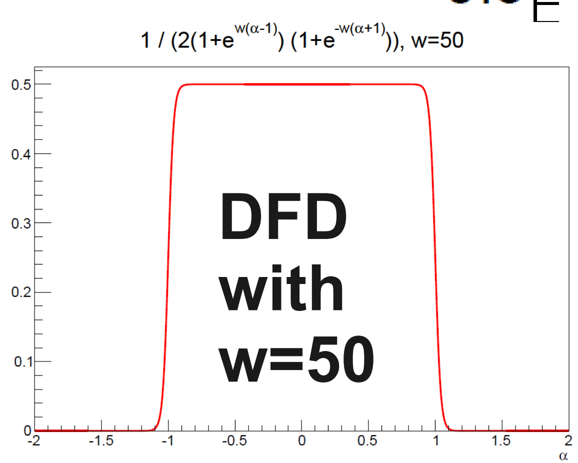

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