VBF off-shell: the normalisation effect of $qqZZ$

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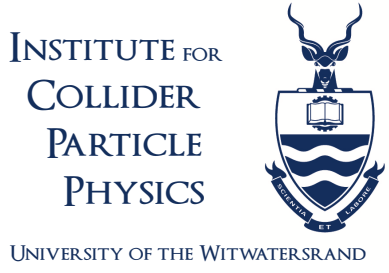


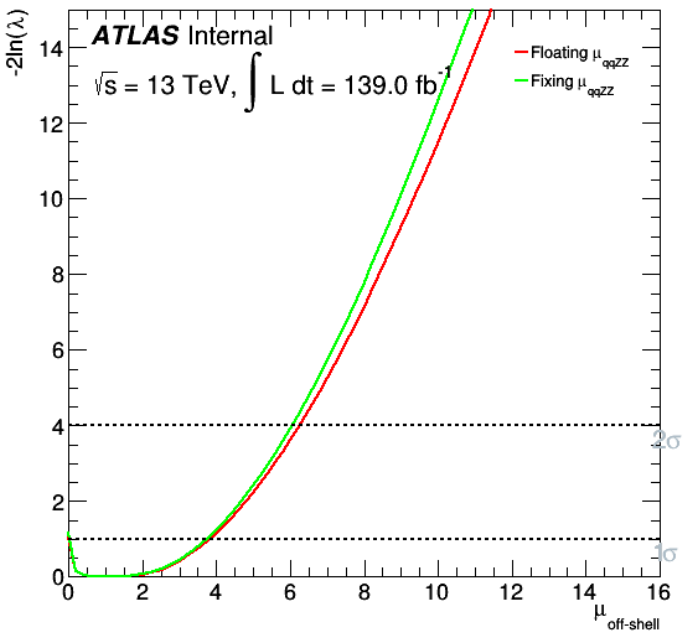
Introduction

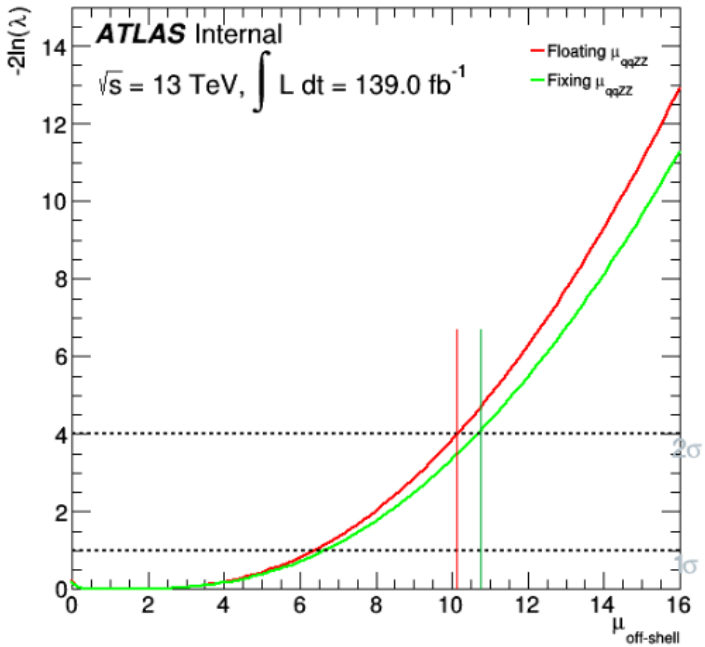
- Study the effect of μ_{qqZZ} normalisation factor of the *qqZZ* background.
- Signal region:
  - $220 < m_{4\ell} < 2000$ GeV
  - $\Delta\eta_{jj} > 4.0$ & $N_{\text{jets}} \geq 2$ GeV
- Adding only the normalisation systematic uncertainties for the samples.

	4μ	$4e$	$2\mu 2e$	4ℓ
$qq \to ZZ^*$	18.92±0.35	9.90±0.24	25.58±0.53	54.41±0.68
VBFB	4.27±0.03	2.85±0.03	7.12±0.04	14.24±0.06
SBI	3.47±0.03	2.29±0.02	5.75±0.04	11.52±0.05
SBI5	4.57±0.03	3.11±0.03	7.67±0.04	15.36±0.06
SBI10	6.68±0.04	4.75±0.04	11.35±0.06	22.77±0.08

- Also, the systematic uncertainty for the luminosity is added.
- The signal POI, $\mu_{\text{off-shell}}$, is parametrised using SBI and SBI5 only.
- Simultaneously fit the 4μ, $4e$, $2\mu 2e$ and 4ℓ channels.
- The fit is performed on the Asimov data generated by setting POI to 1.0.
- We compare the use of 20 bins in the $m_{4\ell}$ with the one consider the full range as one bin.
- The 20 bins method uses binned histogram for the fitting.
- The full $m_{4\ell}$ region uses simple count experiment for the fitting.

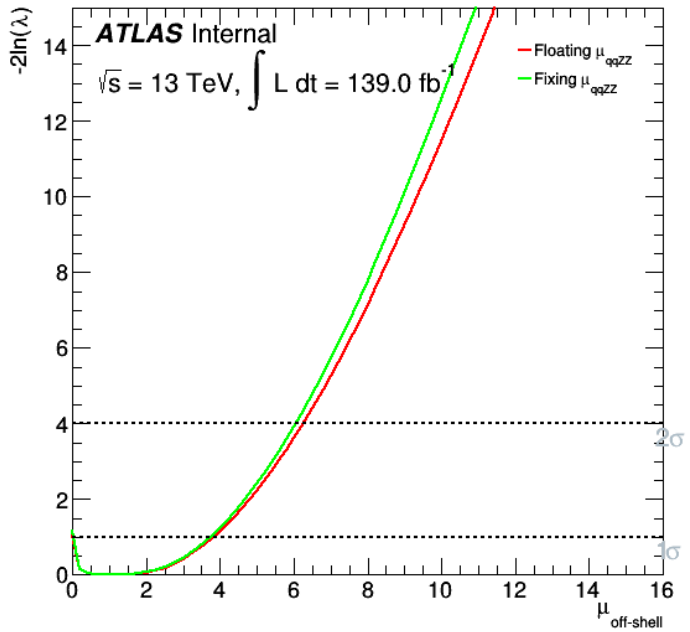
Profile likelihood scan

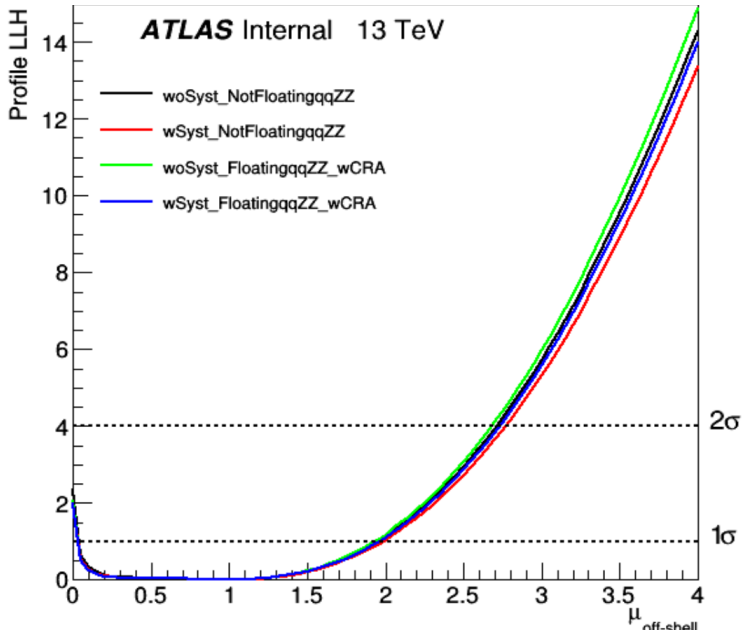




- Using 20 bins in $m_{4\ell}$ (left); it shows $\sim$ 8% difference, but quite the opposite.
- The whole $m_{4\ell}$ as one bin (right); $\sim$ 6% improvement when floating the normalisation.

Profile likelihood scan





- Comparing the left to a study done for the ggF case on the right.

Summary

- We checked the floating and fixing the normalisation when using bins in $m_{4\ell}$ region.
- See 8% improvement, but here the improvement in the case where the normalisation is fixed.
- Still need to investigate so many things.

Thanks!