



VBF off-shell

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PARTICLE
PHYSICS

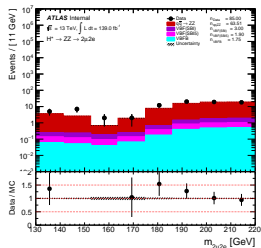
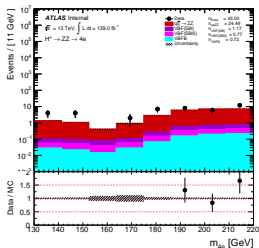
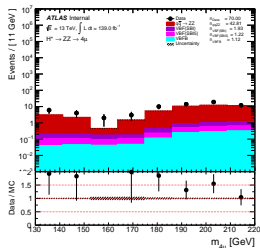
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Kinematic distributions on the CR

$m_{4\ell}$ distribution

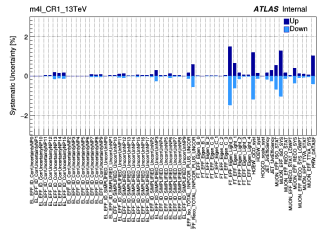
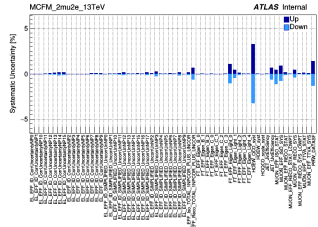
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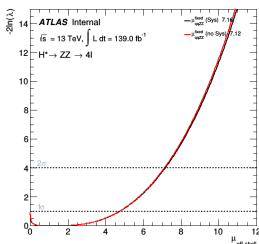
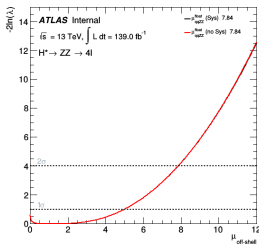
- $130 < m_{4\ell} < 220$ GeV, and $N_{\text{jets}} \geq 2$
- This region will be divided into 8 bins and then added to the SR.
- Currently, we use the MC numbers in the CR instead of the data.

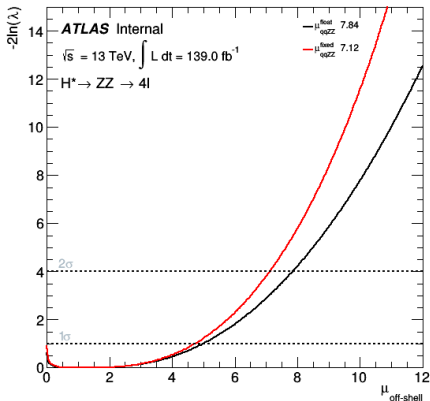
Including only normalisation systematic

- I checked the new ntuples and systematic still the same.
- Overall normalisation systematic uncertainties are less than 5%.
- Need to check the shape systematic soon.

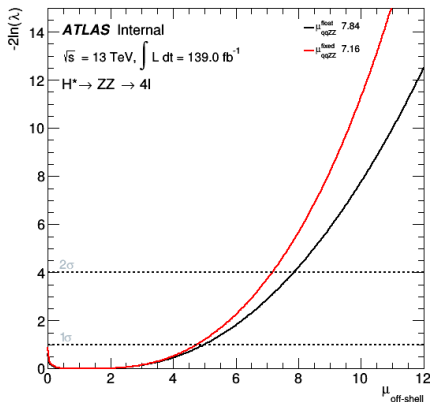


- The fit was performed by considering SR+CR.
- Floating the $qqZZ$ normalisation:
 - Systematic has no effect.
 - @ 95% 7.80
- Fixing the $qqZZ$ normalisation:
 - Systematic has small effect.
 - with Sys: @ 95% 7.16
 - no Sys: @ 95% 7.12

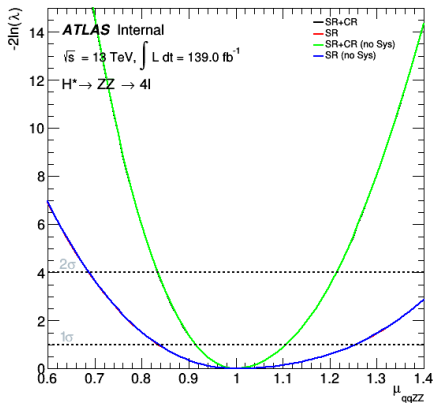




- Fixing vs floating the $qqZZ$ normalisation (no Sys)



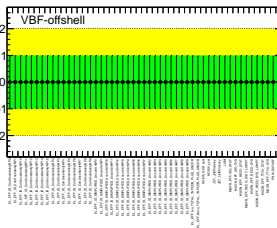
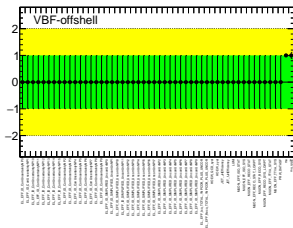
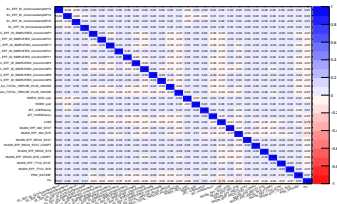
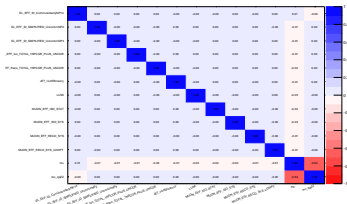
- Fixing vs floating the $qqZZ$ normalisation with systematic included.
- Floating the normalisation is $\sim 9\%$ worse than fixing it.



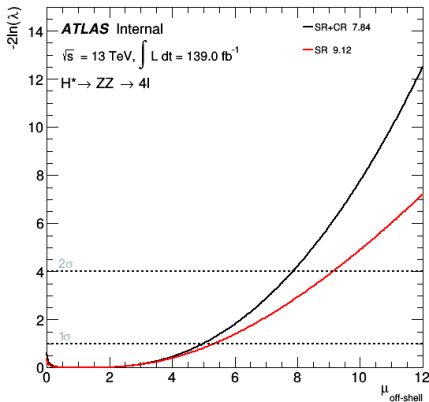
□ SR+CR: Best $\mu_{qqZZ}: 1^{+0.1}_{-0.08}$

□ SR: Best $\mu_{qqZZ}: 1^{+0.25}_{-0.17}$

NP correlation matrix and pulls

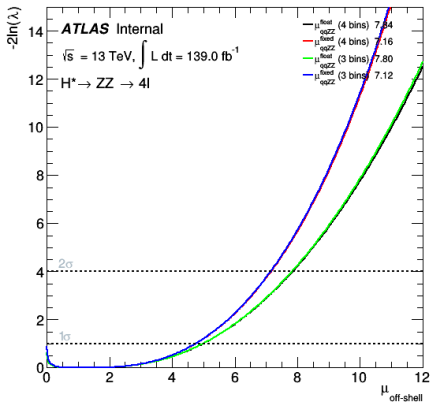


□ Weaker NPs less than 0.005 were removed.



- We get 23% improvement with the CR.

Comparing 4 bins to 3 bins fit



□ 3 bins fit gives 0.5% improvement.

- Including the CR to the SR improve the fit by $\sim 23\%$.
- Normalisation systematic has small effect.
- Fixing the $qqZZ$ normalisation is $\sim 9\%$ better than floating it.
- However, we get better NP estimation when floating the normalisation.
- Using 3 bins fit is 0.5% better than 4 bins.
- MELA in 13 bins gives negative yield during the fit.

To-do ...

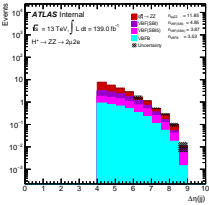
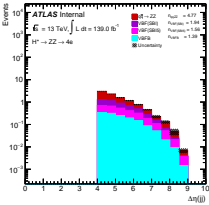
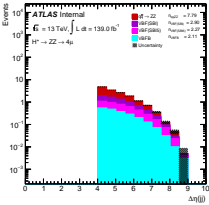
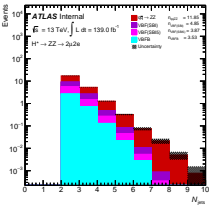
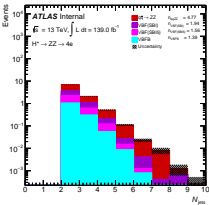
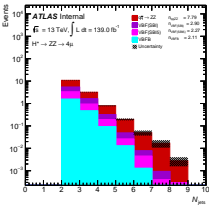
- Adding all the systematic and then try to check the Ranking.
- Still feel like we need to put the rest of the systematic.

Thank you!



Additional slides

Kinematic distributions on the SR



\square $220 < m_{4\ell} < 2000 \text{ GeV}$, $N_{jets} \geq 2$, and $\Delta\eta(jj) > 4.0$

