

# Sydney group update

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THE UNIVERSITY OF  
SYDNEY

## Carl: fit studies for $tW$ dilepton [Rui Zhang (Bonn)]

- **Recap:** The Asimov fit at 1/fb with  $t\bar{t}$  norm floated looks good.
- At 140/fb some modelling systematics are heavily constrained.
- Work suggesting large constraints are expected with large lumi. [[arXiv:1805.03961](#)]
- But why only for some systematics?

- For bin  $i$ , the Poisson fluctuations are  $\sqrt{n_i}$  and systematic fluctuations  $\Delta_i$  give:

$$\Delta \otimes \Delta \equiv \sum_i \frac{\Delta_i^2}{n_i}$$

- $\Delta \otimes \Delta$  measures how large the systematic is wrt. statistical uncertainty.

$$\hat{\sigma}_\alpha \propto \frac{1}{\sqrt{(1 + \mathcal{L} \cdot \Delta_0 \otimes \Delta_0) - \mathcal{L} \cdot \frac{(s_0 \otimes \Delta_0)^2}{s_0 \otimes s_0}}}. \quad (9)$$

If  $1 \ll \mathcal{L} \cdot \Delta_0 \otimes \Delta_0 - \mathcal{L} \cdot \frac{(s_0 \otimes \Delta_0)^2}{s_0 \otimes s_0}$ , then

$$\hat{\sigma}_\alpha \propto \frac{1}{\sqrt{\mathcal{L}}}. \quad (10)$$

- Further investigation shows the dominant term is  $(1 + \mathcal{L} \text{ DxD})$ :

$$\text{DxD} := \Delta_0 \otimes \Delta_0$$

$$1 + \sum_{\text{bins}} \frac{\Delta_i^2}{n_i} \triangleq 1 + \Delta \otimes \Delta$$

- By calculating this term, we will be able to predict whether a NP will be constrained or not before fitting. For templates scaled to 1/fb, with  $L=140.5\text{fb}$ 
  - If  $\text{DxD} > 0.1$ ,  $1 + \mathcal{L} \text{ DxD} \approx 100$ , heavily constraint!
  - If  $\text{DxD} < 0.01$ ,  $1 + \mathcal{L} \text{ DxD} \approx 2$ , moderate constraint!
  - If  $\text{DxD} < 0.001$ ,  $1 + \mathcal{L} \text{ DxD} \approx 1$ , no constraint!

| NP: Rebin=2, 3 region(s)  | DxD    | Lumi  | Expected | Individual fitted | Global fitted |
|---------------------------|--------|-------|----------|-------------------|---------------|
| tW_DS_FS                  | 1.631  | 140.5 | 0.066    | +0.0690446        | +0.225827     |
| tW_HS                     | 0.225  | 140.5 | 0.175    | +0.292288         | +0.394982     |
| tW_PS                     | 0.677  | 140.5 | 0.102    | +0.176357         | +0.445011     |
| ttbar_HS                  | 7.647  | 140.5 | 0.030    | +0.0315471        | +0.105612     |
| ttbar_PS                  | 12.392 | 140.5 | 0.024    | +0.0278024        | +0.15949      |
| tW_AR                     | 0.070  | 140.5 | 0.303    | +0.314089         | +0.80614      |
| ttbar_AR                  | 0.416  | 140.5 | 0.130    | +0.238656         | +0.348416     |
| EG_RES_ALL                | 0.001  | 140.5 | 0.923    | +0.894918         | +0.912652     |
| EG_SCALE_ALL              | 0.002  | 140.5 | 0.880    | +0.785246         | +0.914841     |
| Jet_BJES_Response         | 0.010  | 140.5 | 0.640    | +0.153673         | +0.539892     |
| Jet_EffectiveNP_Detector1 | 0.001  | 140.5 | 0.962    | +0.916339         | +0.963045     |
| Jet_EffectiveNP_Detector2 | 0.000  | 140.5 | 0.997    | +0.974359         | +0.989216     |
| Jet_EffNP_Mixed1          | 0.001  | 140.5 | 0.947    | +0.865421         | +0.940758     |
| Jet_EffNP_Mixed2          | 0.001  | 140.5 | 0.932    | +0.844878         | +0.940311     |
| Jet_EffNP_Mixed3          | 0.000  | 140.5 | 0.994    | +0.97833          | +0.984879     |
| Jet_EffNP_Modelling1      | 0.050  | 140.5 | 0.352    | +0.155567         | +0.698478     |
| Jet_EffNP_Modelling2      | 0.001  | 140.5 | 0.935    | +0.838842         | +0.9253       |
| Jet_EffNP_Modelling3      | 0.001  | 140.5 | 0.957    | +0.888183         | +0.956658     |
| Jet_EffNP_Modelling4      | 0.000  | 140.5 | 0.994    | +0.981166         | +0.986044     |
| Jet_EffNP_Statistical1    | 0.000  | 140.5 | 0.980    | +0.953993         | +0.97608      |
| Jet_EffNP_Statistical2    | 0.001  | 140.5 | 0.927    | +0.81522          | +0.926097     |
| Jet_EffNP_Statistical3    | 0.000  | 140.5 | 0.986    | +0.969077         | +0.980248     |

If  $DxD > 0.1$ ,  $1 + \mathcal{L} DxD \gtrsim 100$ ,  
heavily constraint!  
If  $DxD < 0.01$ ,  $1 + \mathcal{L} DxD \lesssim 2$ ,  
moderate constraint!  
If  $DxD < 0.001$ ,  $1 + \mathcal{L} DxD \approx 1$ , no  
constraint!

Results of 1j1b region fit  
in backup