

Measurement of the branching ratio of $t \rightarrow Ws$ with ATLAS

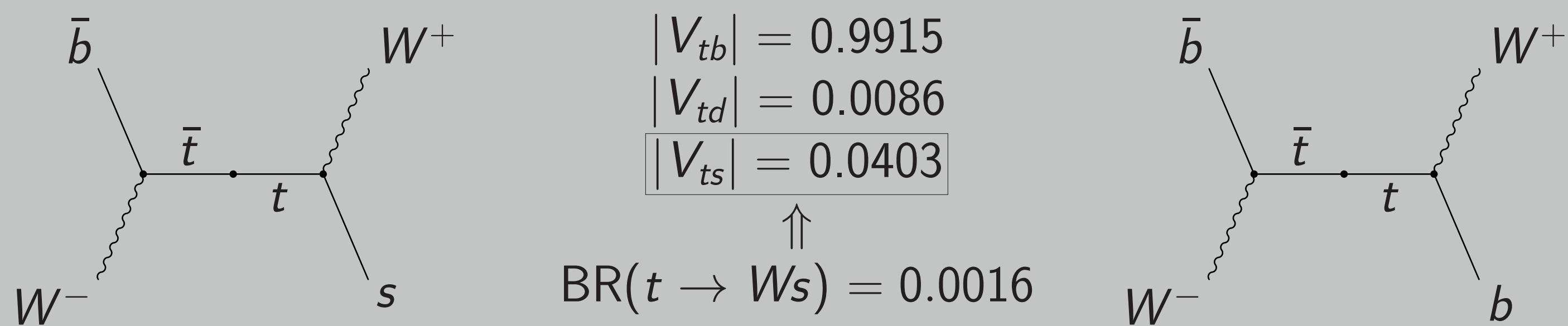
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Introduction

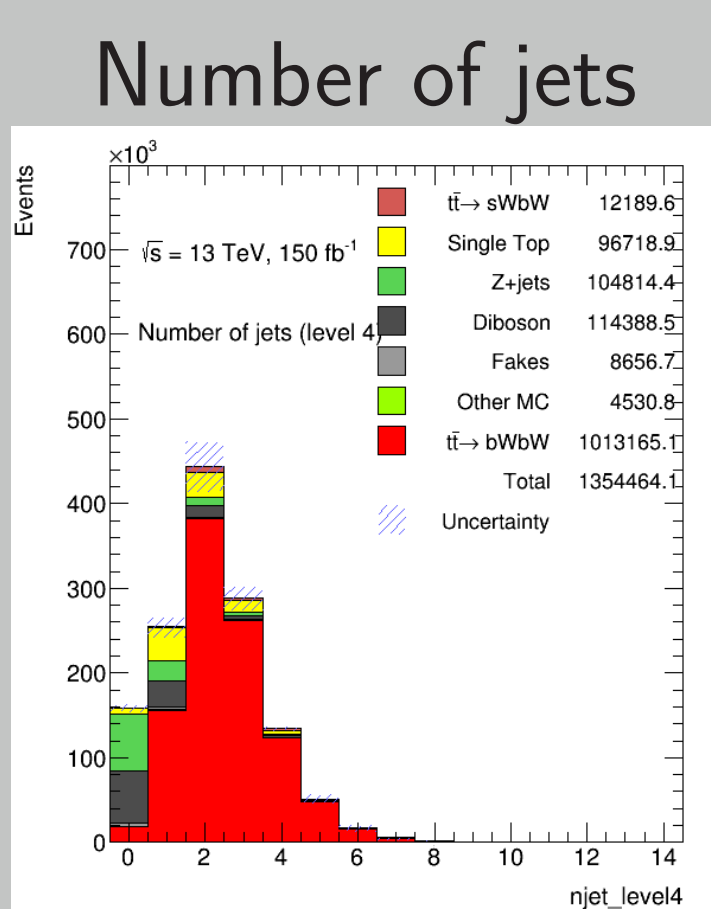
- From the Cabibbo-Kobayashi-Maskawa matrix, we can obtain the branching ratios of the decays of the top quark to the down-type quarks, which, by assuming the matrix is unitary, are just $|V_{tb}|^2$, $|V_{ts}|^2$ and $|V_{td}|^2$. Following the method of [2], we aim to measure $\text{BR}(t \rightarrow sW) = |V_{ts}|^2$, using, for the time being, truth samples for the signal, for the full Run II.



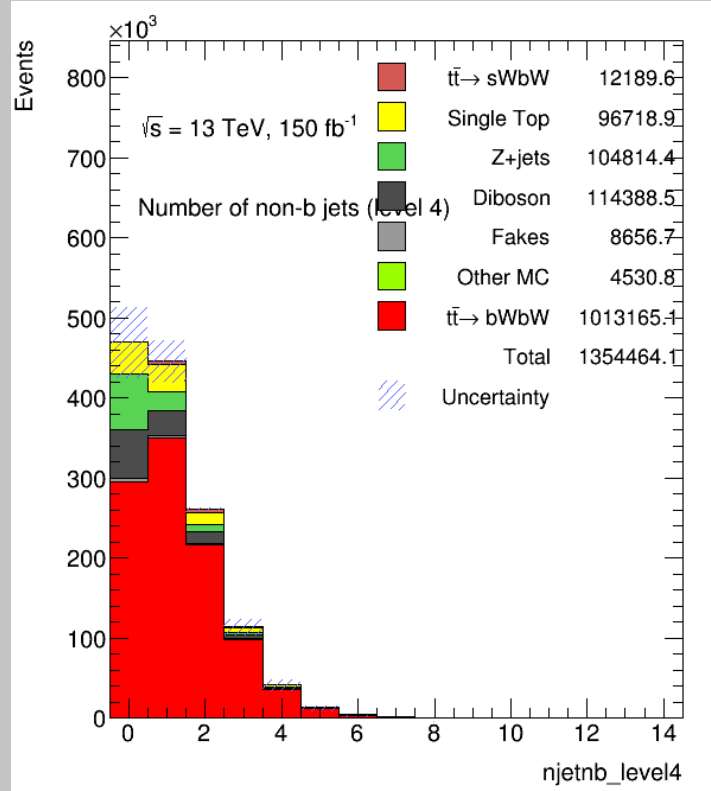
Selection Regions

Inspired by [2]

- Signal Region
 - One e and one μ of opposite charges (avoids $Z/\gamma^* \rightarrow ee/\mu\mu$ background)
 - $\Delta\eta > 0.15$ and $\Delta\phi > 0.15$
- Fake Lepton Control Region
 - One e and one μ of same charges
 - $\Delta\eta > 0.15$ and $\Delta\phi > 0.15$
- Zee Control Region
 - Two e of opposite charges
 - Reconstructed m_Z between 60 and 120 GeV
- $Z\mu\mu$ Control Region
 - Two μ of opposite charges
 - Reconstructed m_Z between 60 and 120 GeV
- All regions: p_T of leptons > 25 GeV
- Additionally, besides [2] cuts, since there is close to zero signal otherwise
 - At least 2 jets
 - At least 1 non-b jet



Number of non-b jets



Method

- Using MC samples scaled up to the full Run 2 ($L = 150 \text{ fb}^{-1}$).
- First, we fitted the fakes, Zee+jets and $Z\mu\mu$ +jets samples in each of its respective control region.
- From the fit, we obtain three separate normalizations for each sample, for events with 0, 1 and 2 b-tagged jets.
- Then, we scaled the samples in each of the bins of the signal region, which has 0, 1 and 2 b-tagged jets, using the normalizations obtained and performed an Asimov fit and limit calculation.

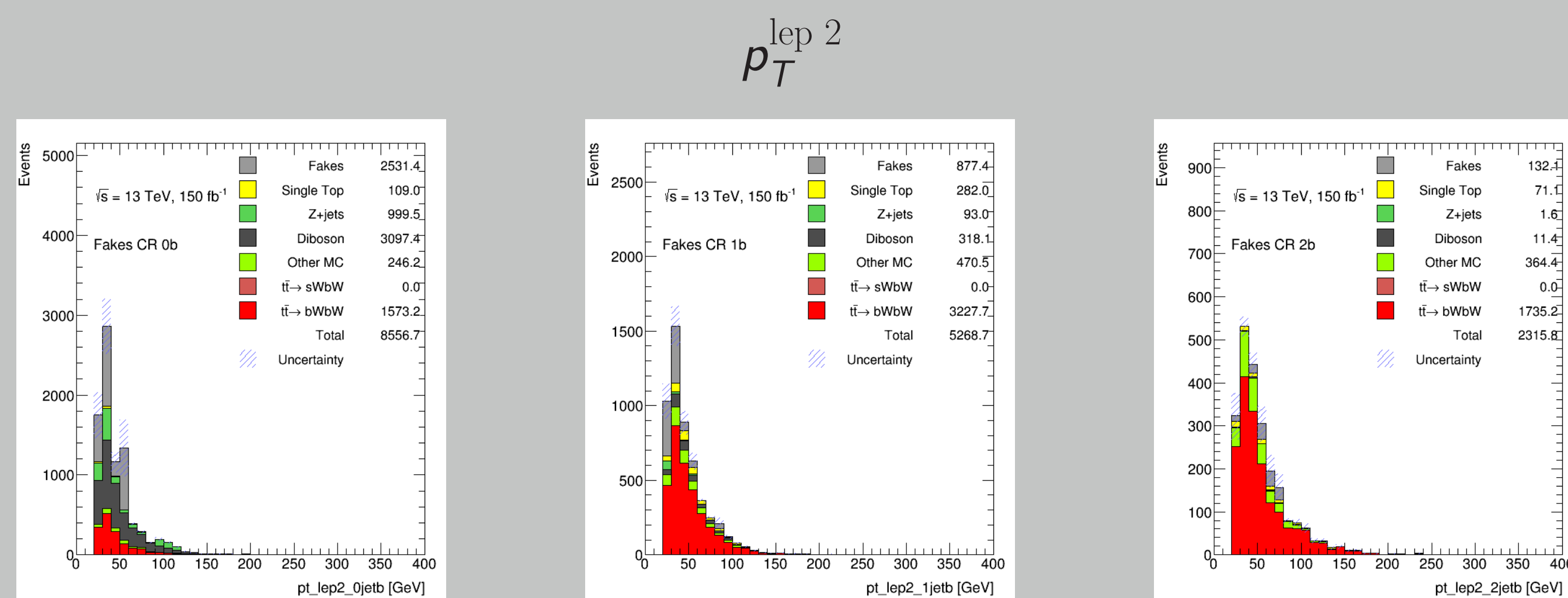
Fit and Limit Results

- Fit
 $\text{BR}(t\bar{t} \rightarrow bWsW) = 0.0009 \pm 0.0011$
- Limit
 $\text{BR}(t\bar{t} \rightarrow bWsW)$
 - (-1σ) 0.0018
 - Expected 0.0025
 - $(+1\sigma)$ 0.0035

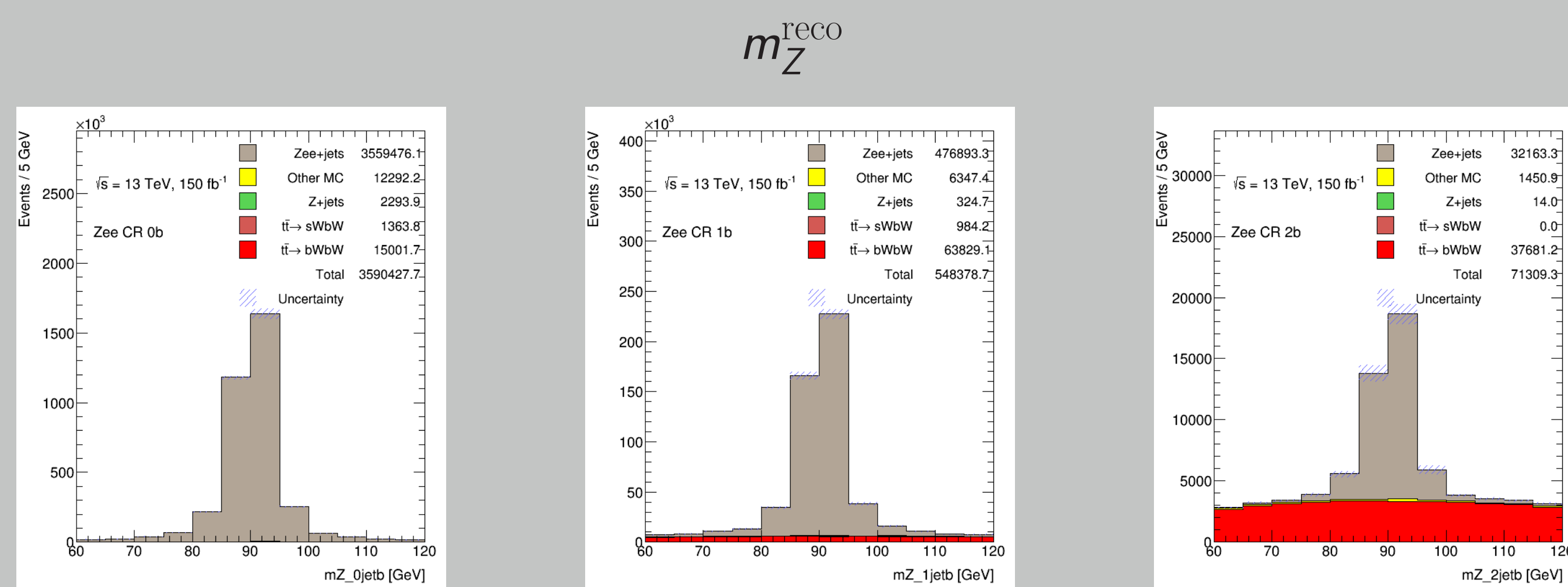
References

- [1] M. Kobayashi and T. Maskawa.
CP Violation in the Renormalizable Theory of Weak Interaction.
Prog. Theor. Phys, 49:652–657, 1973.
- [2] ATLAS Collaboration.
Measurement of the $t\bar{t}$ cross-section in pp collisions at $\sqrt{s} = 13$ TeV using $e\mu$ with b-tagged jets.
Phys.Lett. B, 761:136–157, 2016.

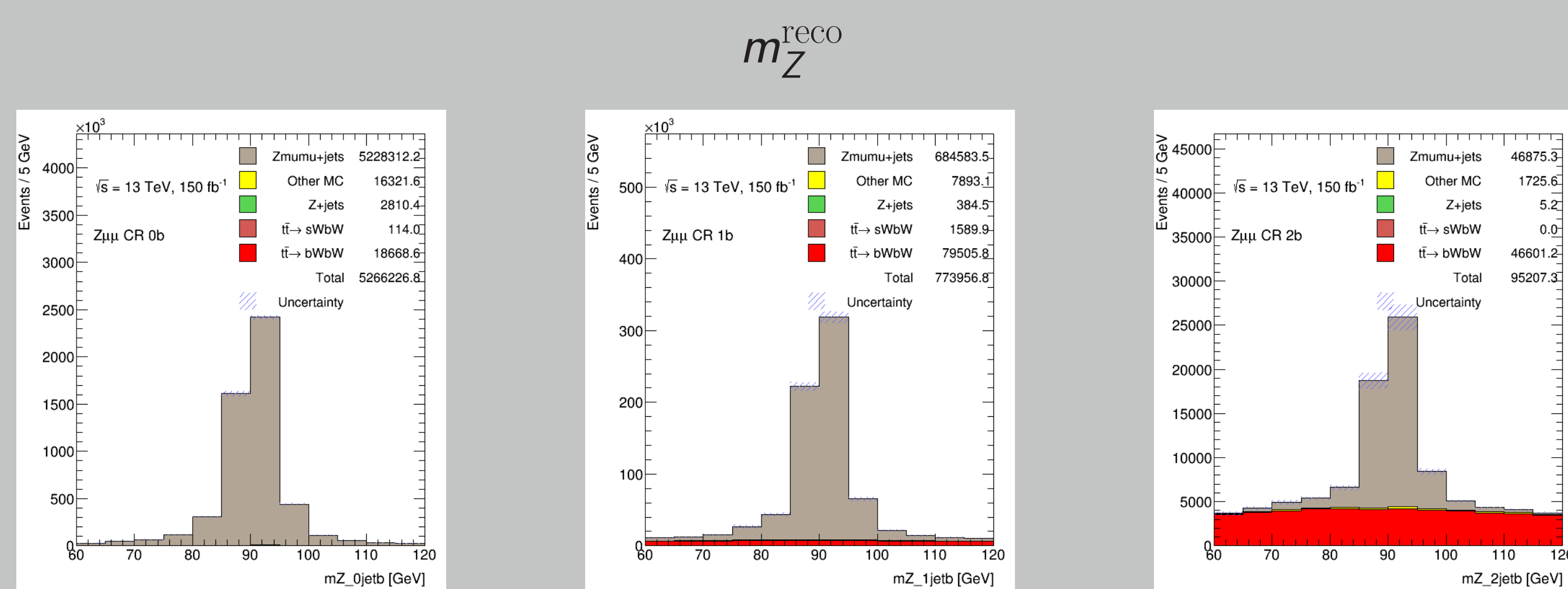
Fake Lepton Control Region Plots



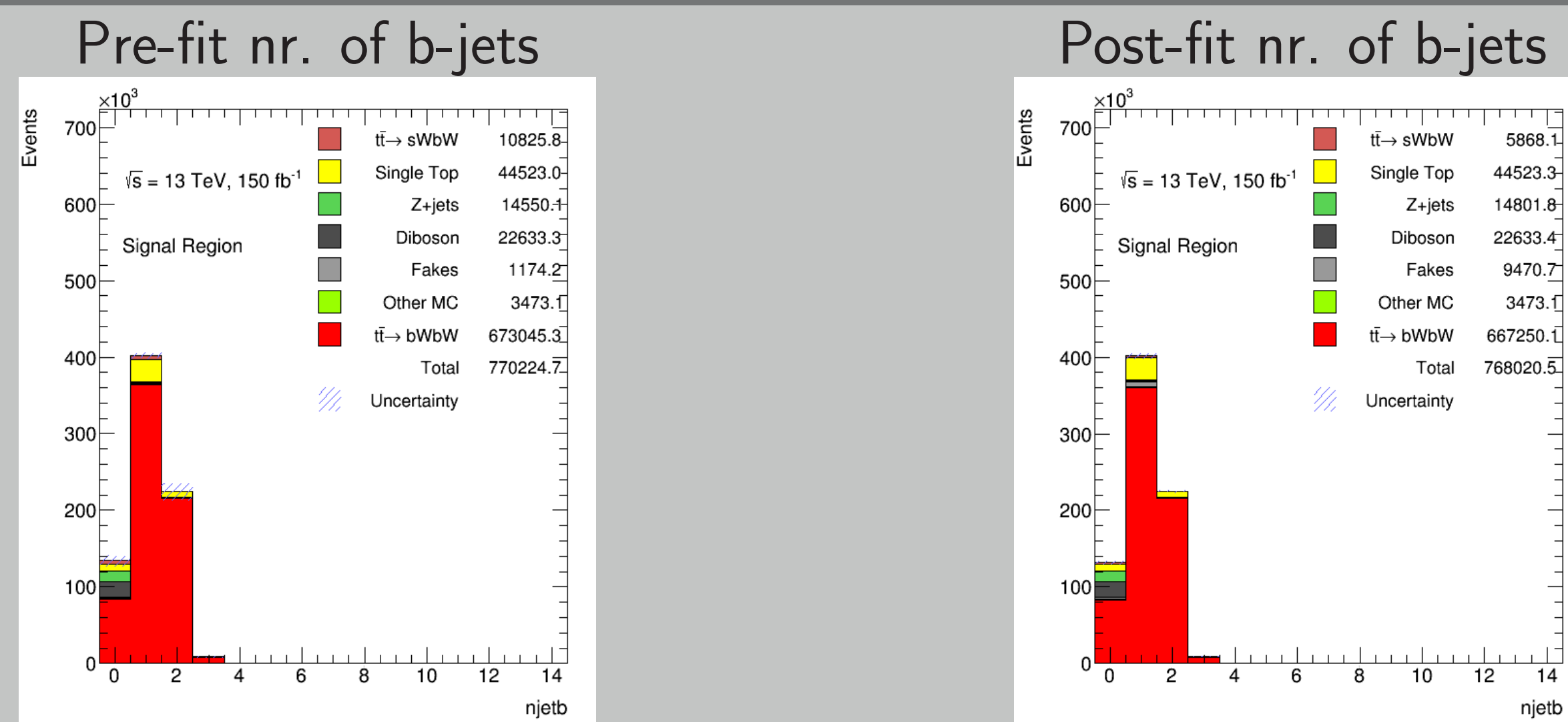
Zee Control Region Plots



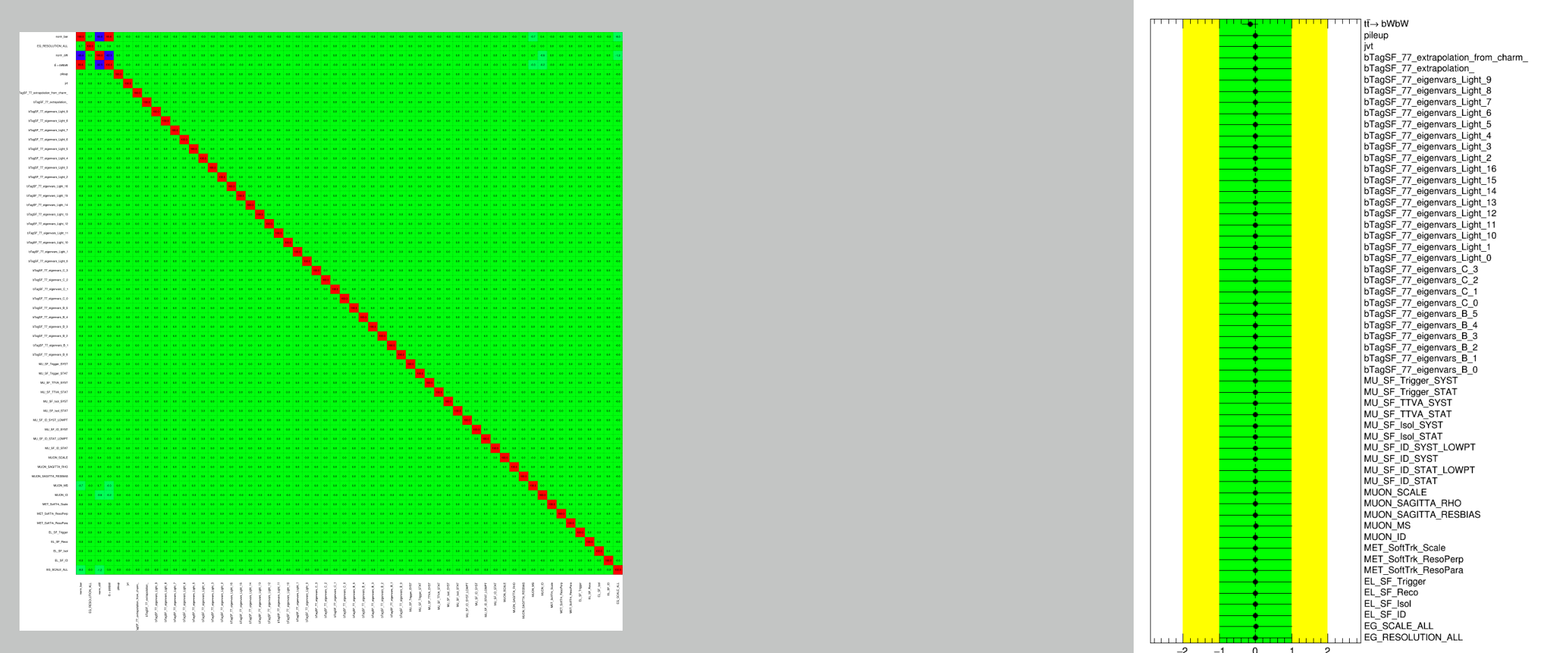
$Z\mu\mu$ Control Region Plots



Fit Plots: Signal Region



Correlation Matrix and Pull Plot



Conclusions and Ongoing work

- $t \rightarrow Ws$ BR measurement seems possible even without s-tag, but an s-tag would improve it much
- Run with reconstructed level sW sample, as soon as it is available
- Do a global fit using control regions instead of the one done in [2]
- Unblind analysis
- Work on s-tag development to improve measurement