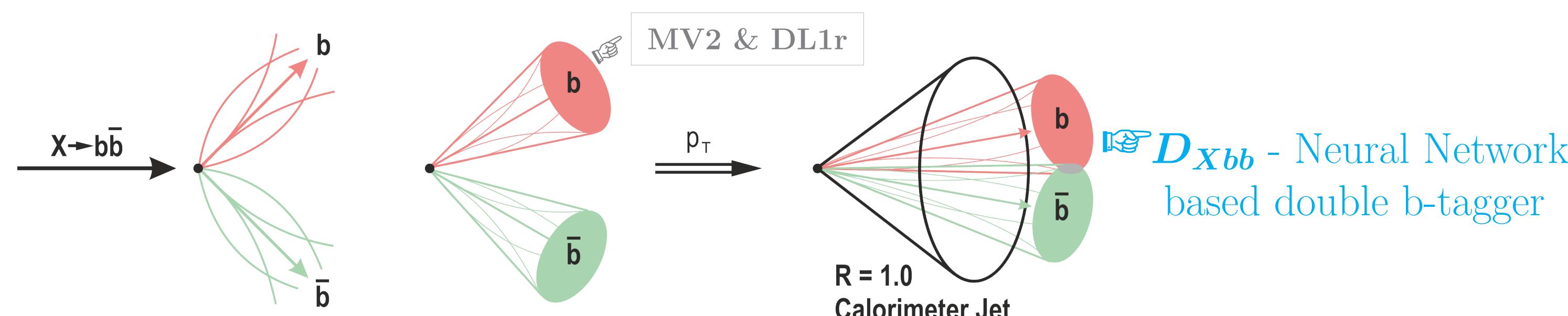


The boosted $X \rightarrow b\bar{b}$ tagger calibration using $Z \rightarrow b\bar{b}$ events collected with the ATLAS detector

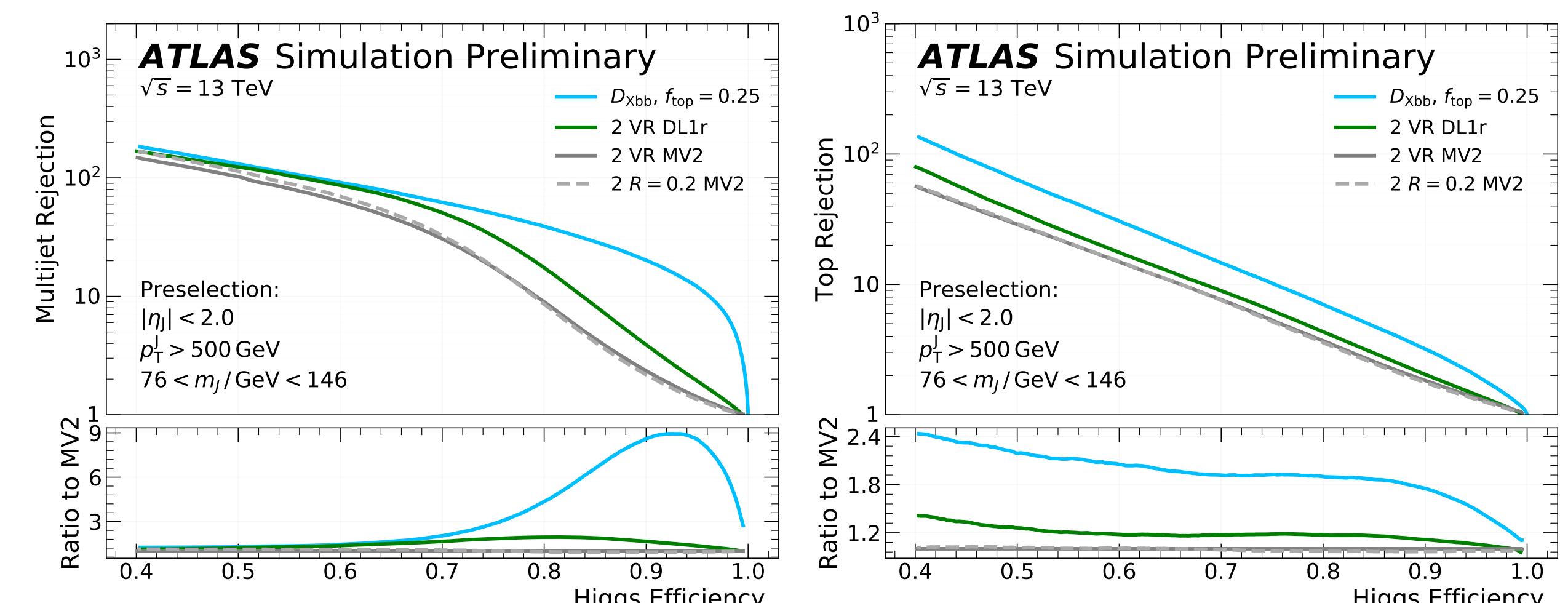
Daariimaa Battulga¹ on behalf of the ATLAS Collaboration

¹Institut für Physik, Humboldt-Universität zu Berlin

Motivation



- Resonant "X" particle's mass \gg the mass of its decay products
➡ high Lorentz boost
- Large-radius jet encloses 2 variable-radius (VR) b-track-jets
- MV2 & DL1r tag VR track-jets individually
- D_{Xbb} tagger: training uses large-R jet p_T , η and track-jets flavour information. The 3 outputs: Higgs, Top-matched jets, Multijet



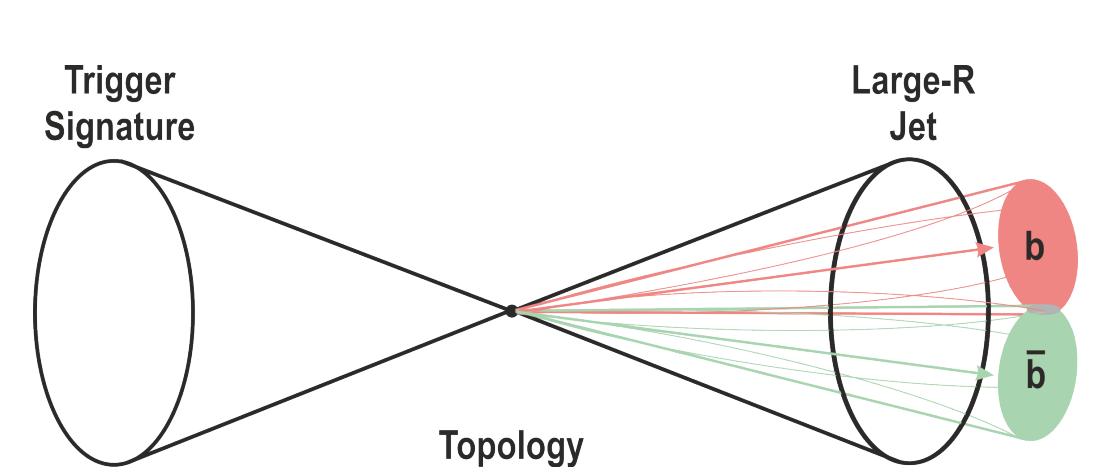
D_{Xbb} tagger outperforms DL1r & MV2:

- ★ in multijet rejection at high Higgs efficiency
- ★ in top rejection

[ATL-PHYS-PUB-2020-019]



Calibration Method



- Signal efficiency calibration uses
 - ★ $Z \rightarrow b\bar{b} + \gamma$ (jets)
 - ★ in p_T bin range of 200 – 1000 GeV
- Working Points: 50%, 60%, 70%,
 - ★ Double-b-tagging efficiency per large-R jet

Data-to-simulation scale factor (SF) is defined by efficiency (ε) ratio:

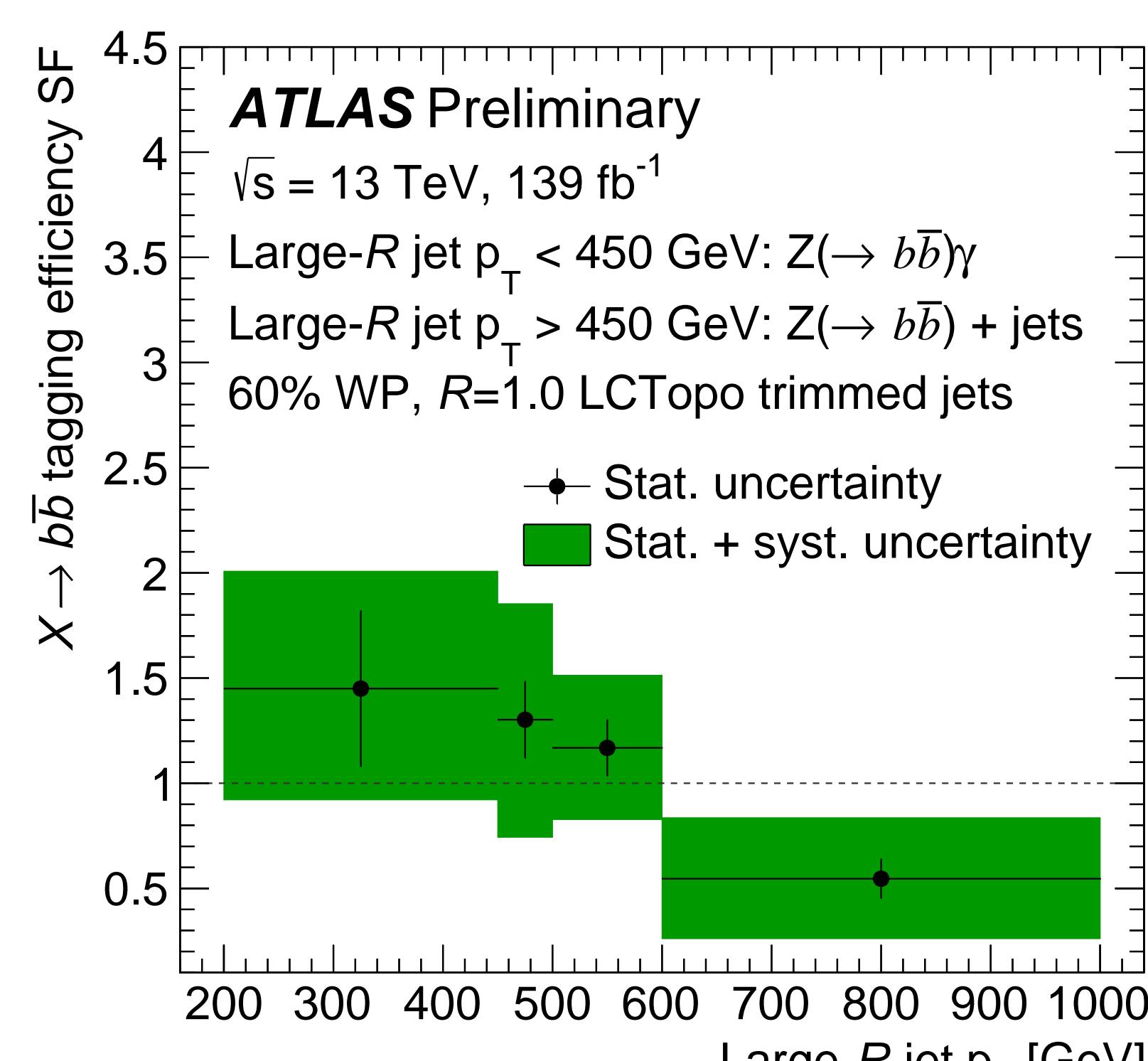
$$SF = \frac{\varepsilon_{\text{data}}}{\varepsilon_{\text{MC}}} = \frac{N_{\text{b-tagged}}^{\text{data}}}{N_{\text{total}}^{\text{data}}} = \frac{N_{\text{b-tagged}}^{\text{MC}}}{N_{\text{total}}^{\text{MC}}} = \frac{\mu_{\text{post-tag}}}{\mu_{\text{pre-tag}}}$$

Derived using $Z \rightarrow b\bar{b}$

Measured in $Z \rightarrow \ell\ell$

- The SF is calculated as the ratio between post- ($\mu_{\text{post-tag}}$) and pre-tag ($\mu_{\text{pre-tag}}$).

Calibration Results



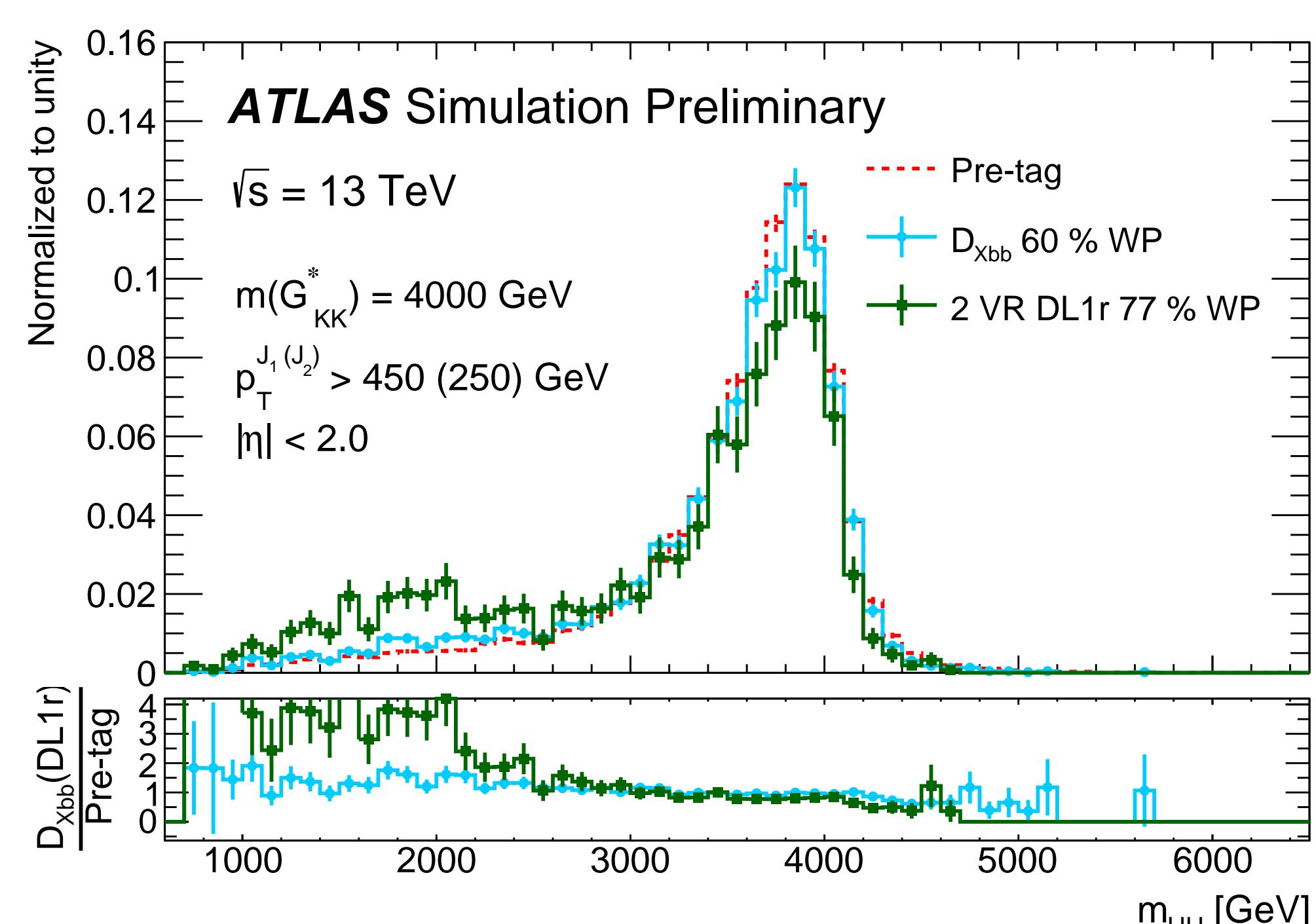
The SF of $X \rightarrow b\bar{b}$ 60%
Main uncertainties:

- Z-boson modelling
- $Z + \gamma$
- Statistical
- Spurious signal
- $Z + \text{jets}$
- Fit Model
- Jet Mass Resolution

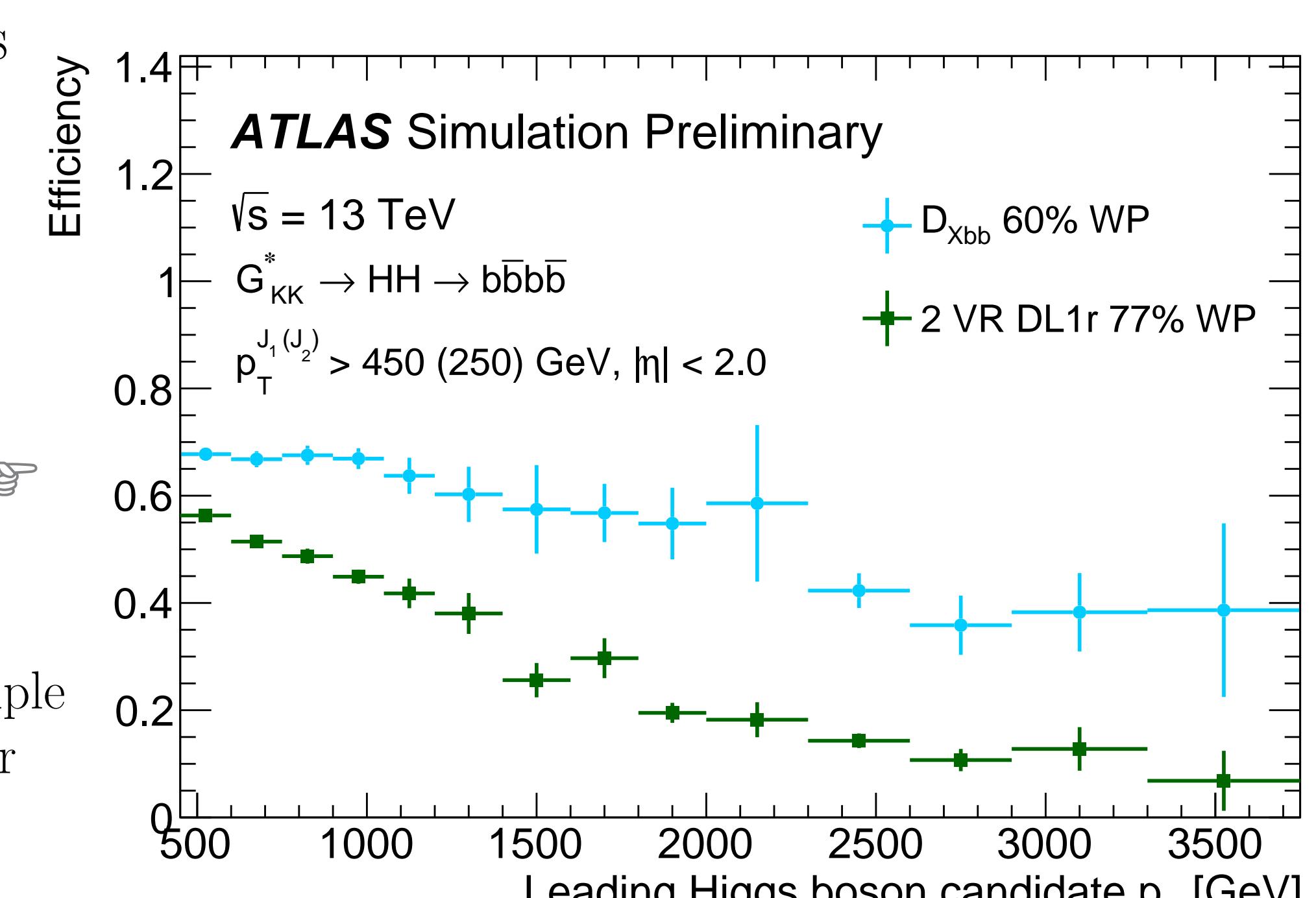


[ATL-PHYS-PUB-2021-035]

Performance Study of $X \rightarrow b\bar{b}$ Tagger in $G_{KK}^* \rightarrow HH \rightarrow b\bar{b}b\bar{b}$ Signal



- The Randall-Sundrum Gravitons ($G_{KK}^* \rightarrow HH \rightarrow b\bar{b}b\bar{b}$)
- Better mass resolution of diHiggs system with D_{Xbb} tagger than DL1r
- $H \rightarrow b\bar{b}$ tagging efficiency (ε) for leading large-R jet
- Increased 20 – 110% efficiency for $p_T \in [450, 3750]$ GeV Graviton sample with D_{Xbb} tagger compared to DL1r



[FTAG-2022-002]

Conclusions

- First calibration of $X \rightarrow b\bar{b}$ tagger using $Z \rightarrow b\bar{b}$ events.
- The $X \rightarrow b\bar{b}$ tagging efficiency is studied in boosted resonant $G_{KK}^* \rightarrow HH \rightarrow b\bar{b}b\bar{b}$.

- The acceptance has increased 50 – 350% for two b-tagged large-R jets of Graviton masses at [1, 6] TeV compared to 100% in the multijet background when using the $X \rightarrow b\bar{b}$ tagger.