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# Boosted Higgs boson tagger calibration using Z+jets events

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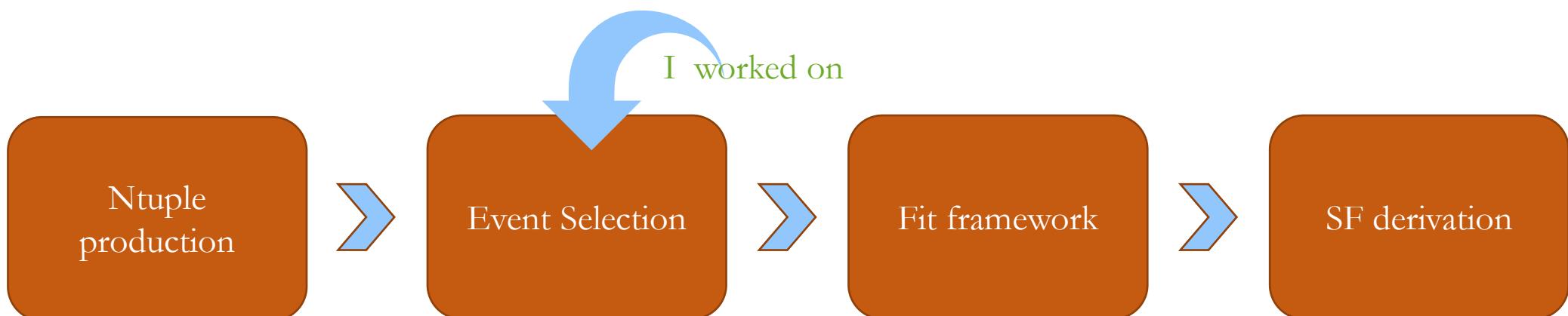
- BSM introduce new heavy resonances **decaying into Higgs boson with high  $p_T$**
- Interested in  $H, W^\pm, Z$  bosons.
  - Important in physics of SM and beyond SM
  - $X \rightarrow b\bar{b}$  sector
- Common observation of Higgs boson decay is in  $b\bar{b}$  pair

- Calibration methods

$Z(\rightarrow b\bar{b}) + jets$

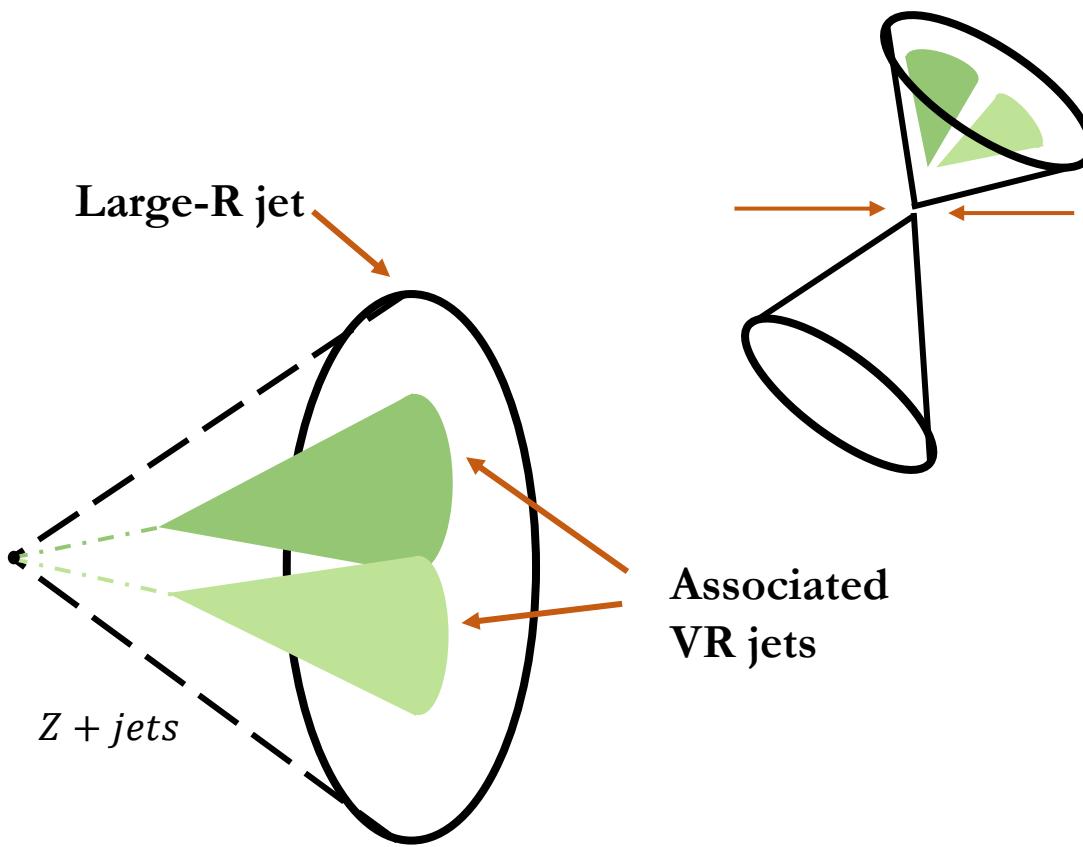
$Z(\rightarrow b\bar{b})\gamma$  **Work topic**

$g \rightarrow b\bar{b}$



# Event Selection

Signal	Background	
$Z \rightarrow b\bar{b}$	Sherpa 2.2.8	QCD (not specified)
		Dijets (not specified)



- No  $e/\mu$  with  $p_T > 25 \text{ GeV}$
- At least 2 **Large-R jets** with:
  - $|\eta| < 2.0$
  - $p_{T1} > 450 \text{ GeV}$
  - $p_{T2} > 200 \text{ GeV}$
- $p_T$  asymmetry  $\frac{p_{T1}-p_{T2}}{p_{T1}+p_{T2}} < 0.15$
- $|\Delta y_{12}| < 1.2$
- At least 2 ghost associated Variable Radius (VR) track jets with:
  - $p_T > 7 \text{ GeV}$

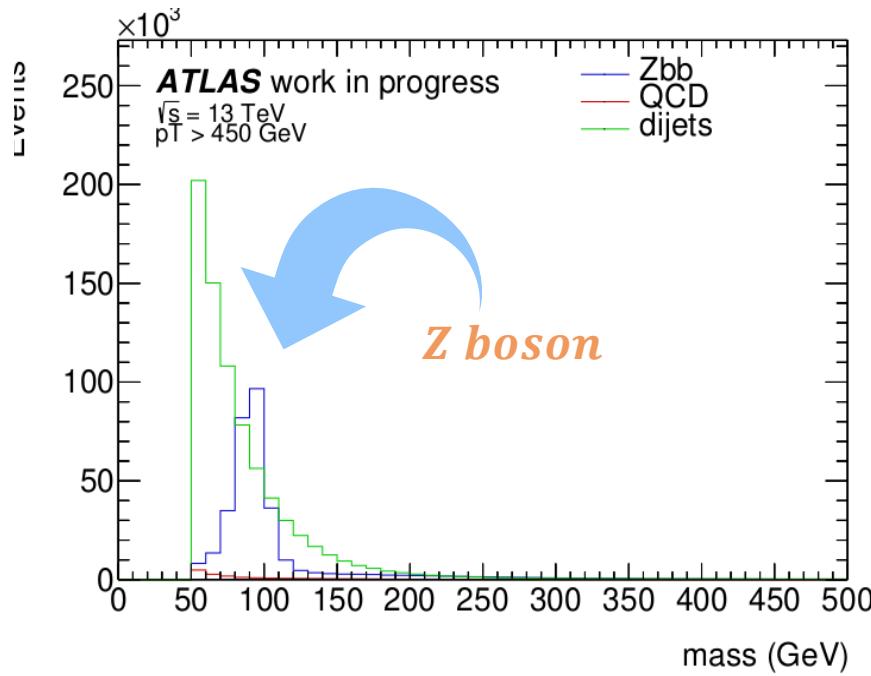
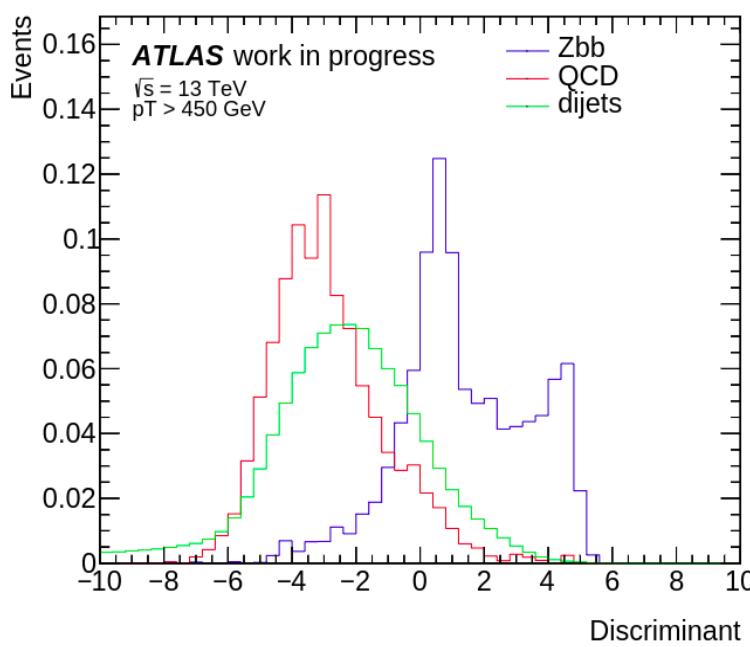
# Flavor Composition

- The flavor composition  $b$  jets,  $c$  jets, and light jets ( $b = 0, c = 0$ ).
- The working points (WP) are thresholds.
- The higher the efficiency, the less the purity

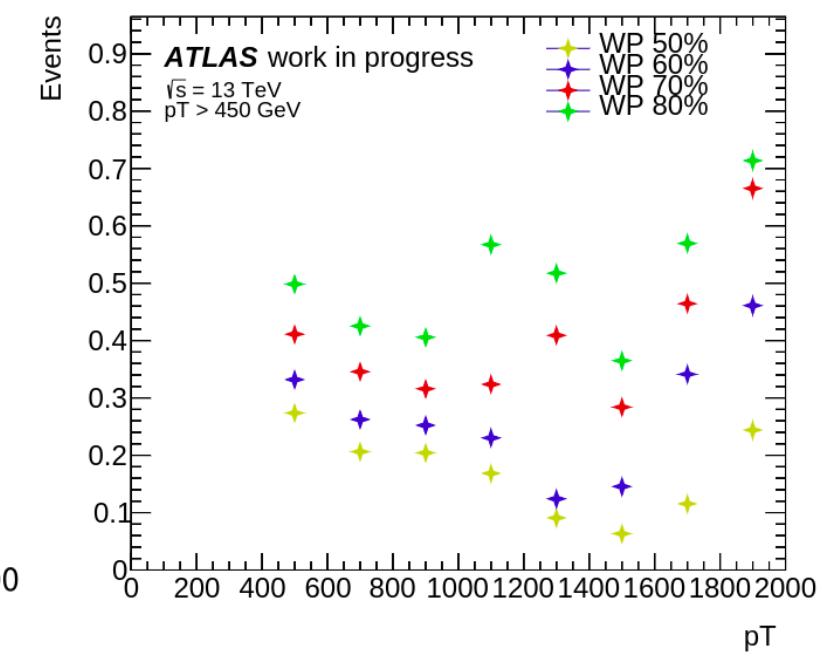
Category	Before Tagging	Signal			
		50%	60%	70%	80%
$b \geq 2$	0.865	0.9609	0.9581	0.9469	0.9303
$b=1$ and $c \geq 1$	0.0085	0.0008	0.0016	0.0029	0.0048
$b=1$ and $c = 0$	0.1111	0.0327	0.0349	0.0442	0.0573
$b=0$ and $c \geq 2$	0.0004	0	0	0	0
$b=0$ and $c = 1$	0.0008	0	0	0	0.0003
$b=0$ and $c = 0$	0.0142	0.0056	0.0054	0.006	0.0067
jets $\geq 3$	0.0612	0.0271	0.0273	0.0306	0.03
jets = 2	0.6562	0.8172	0.7858	0.7572	0.733
jets = 1	0.2765	0.1507	0.1822	0.2071	0.2249
Background					
Category	Before Tagging	QCD			
		50%	60%	70%	80%
$b \geq 2$	0.0134	0.7083	0.6579	0.4366	0.312
$b=1$ and $c \geq 1$	0.0042	0.0417	0.0789	0.0704	0.056
$b=1$ and $c = 0$	0.0311	0.0833	0.1053	0.2817	0.296
$b=0$ and $c \geq 2$	0.0249	0	0	0.0423	0.048
$b=0$ and $c = 1$	0.0919	0.1667	0.1316	0.0704	0.16
$b=0$ and $c = 0$	0.8346	0	0.0263	0.0986	0.128
jets $\geq 3$	0.0946	0.417	0.0526	0.0563	0.05
jets = 2	0.3679	0.625	0.5789	0.5634	0.552
jets = 1	0.5118	0.3333	0.3684	0.338	0.352
Dijets					
Category	Before Tagging	Dijets			
		50%	60%	70%	80%
$b \geq 2$	0	0	0.2509	0	0

# Performance

$$D_{Xbb} = \ln \frac{p_Z}{f_{QCD} \cdot p_{QCD} + (1 - f_{QCD}) \cdot p_{multijet}}$$



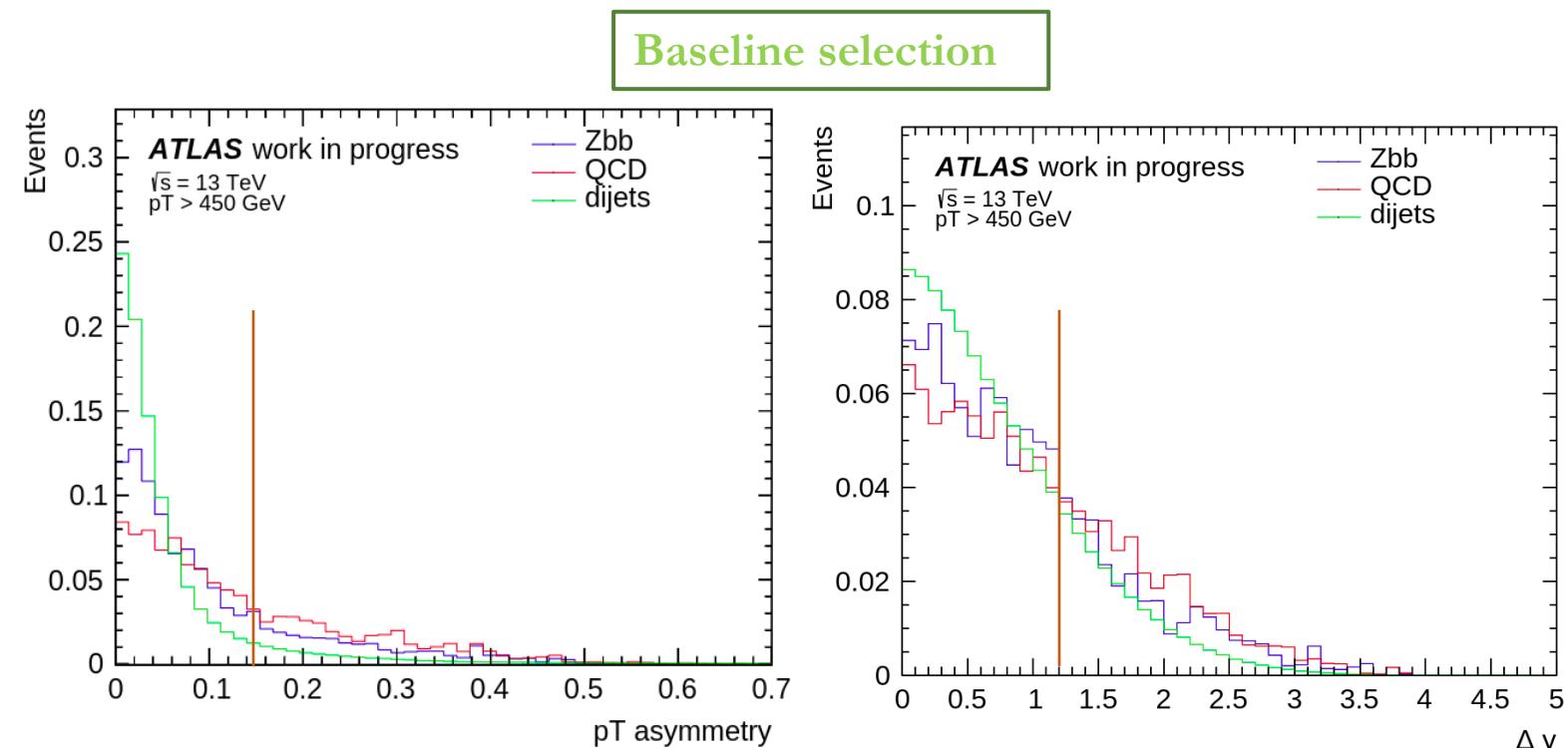
Tagger of signal efficiency  
$$\epsilon = \frac{\text{Number of events tagged as signal}}{\text{Number of total signal events}}$$

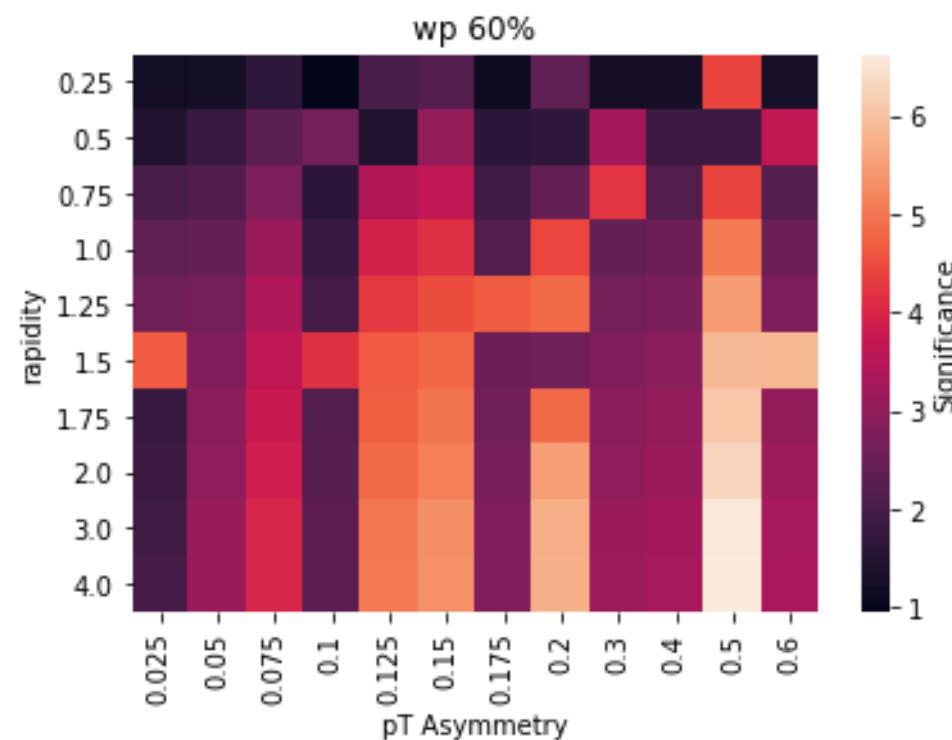


- In order to optimize the signal significance, it is calculated for the actual event selection.

$$Z_0 = \begin{cases} \sqrt{2 \left( n \ln \frac{n}{b} + b - n \right)}, & \hat{\mu} \geq 0 \\ 0, & \hat{\mu} < 0 \end{cases}$$

- Appropriate variations will be made.





- Data was an iteration of  $p_T$  asymmetry by an iteration of rapidity.

- Best criteria: WP 60%
- $p_T$  asymmetry  $< 0.15$
- $\Delta y_{12} < 1.5$
- Rapidity is not a significant cutoff

# Thank you!