

Discussion of Differential Observables.

Frank Tackmann

Deutsches Elektronen-Synchrotron

HXSWG general meeting
October 17, 2019



$H+0$ -jet Born.

Legend: hard/Born variables, resolution variables

Higgs observables

- Higgs: Y_H, p_T^H , eventually 2D $\{Y_H, p_T^H\}$
- $H \rightarrow \gamma\gamma$ decay:
 - ▶ 2D $\{p_{T1}, p_{T2}\}$ (exposes recoil, asymmetric cuts)
 - ▶ equivalent/redundant: $\eta_1, \eta_2, \cos \theta^*, \Delta\eta_{1,2}$
 - ▶ p_{Tt}, ϕ^* (alternatives to p_T^H)
- $H \rightarrow ZZ$ decay: 2D $\{m_{12}, m_{34}\}, \dots$
- $H \rightarrow WW$ decay: 2D $\{p_{T1}, p_{T2}\}, \dots$

Direct resolution observables

- $p_T^{\text{jet}}, \tilde{E}_T$
- $\mathcal{T}_f^{\text{jet}}, \tilde{\mathcal{T}}_f$ (some preference for \mathcal{T}_C over $\mathcal{T}_B, \mathcal{T}_f$ vs. $\mathcal{T}_f^{\text{cm}}$?)
- dedicated track-based measurement: E_T, \mathcal{T}_f
- 2D $\{p_T^{\text{jet}}, \mathcal{T}_f^{\text{jet}}\}$ or $\{p_T^H, \mathcal{T}_f^{\text{jet}}\}$
 - ▶ equivalent/redundant: y^{jet} for $p_T^{\text{jet}} \geq p_T^{\text{cut}}$ or 2D $\{p_T^{\text{jet}}, y^{\text{jet}}\}$

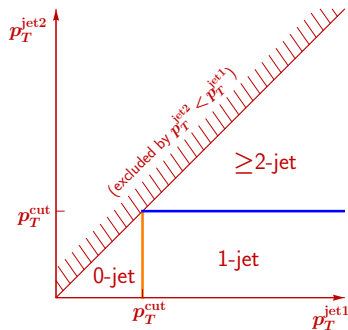
$H+1$ -jet Born.

Possible hard observables

- $pp \rightarrow H j$ is $2 \rightarrow 2$ (ignoring decay now) \rightarrow 3 independent variables
- $p_T^H, Y_H, p_T^{\text{jet}}, y^{\text{jet}}, \mathcal{T}_f^{\text{jet}}, \dots$: already covered, see above
- More options: m_{Hj}, \dots

Resolution observables

- Options: $p_T^{Hj}, p_T^{\text{jet2}}, \mathcal{T}_f^{\text{jet2}}, \mathcal{T}_1, \dots$
- Genuine 2D needed
 - ▶ $\{p_T^H, p_T^{Hj}\}, \{p_T^{\text{jet1}}, p_T^{\text{jet2}}\},$
 $\{p_T^H, p_T^{\text{jet}}\} \equiv \{p_T^H, p_T^H - p_T^{\text{jet}}\}$ (redundant)
 - ▶ $\{p_T^H, \mathcal{T}_1\}$
 - ▶ $\{m_{Hj}, p_T^{Hj}\}, \{m_{Hj}, \mathcal{T}_1\}$



Here we are running into statistics limitations ...

Hard observables

- Previous variables: $p_T^H, p_T^{\text{jet1}}, m_{Hj}, p_T^{Hj}, \dots$: already effectively covered
- $\Delta\phi_{jj}, m_{jj}, \Delta\eta_{jj}, \dots$

Resolution observables

- $p_T^{Hjj}, \Delta\phi_{H,jj}, p_T^{\text{jet3}}, \dots$

In all cases

- Separate genuine $H+2$ region from $H+0, 1$ regions
- e.g. measure in bins of $p_T^{\text{jet1,2}} \leq m_H/2$ and $p_T^{\text{jet1,2}} \geq m_H/2$