Simplified Template Cross Sections

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for the Simplified template cross section note contributors

POs and simplified template cross sections note reviews

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Note content.

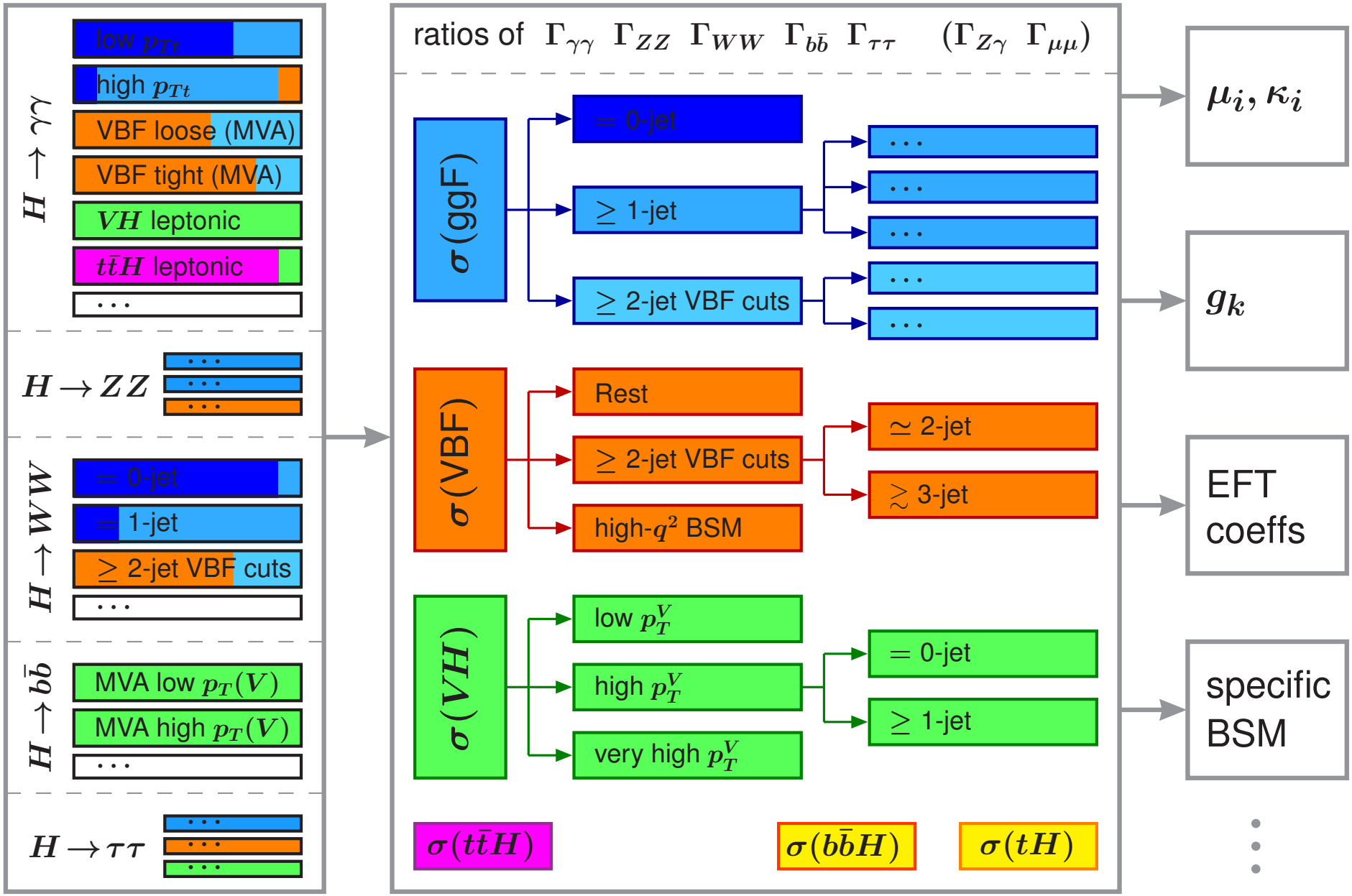
- Introduction with overview and motivation
- Guiding principles for bin definitions
- Staging
- Object definitions: Higgs boson, jets, leptons
- Bin definitions for the different production modes at stage 0, 1 and ideas for stage 2
  - Gluon fusion
  - VBF
  - VH
  - $t\bar{t}H$, $b\bar{b}H$, tH

Note follows what was presented at the January general meeting (`link to talk`)

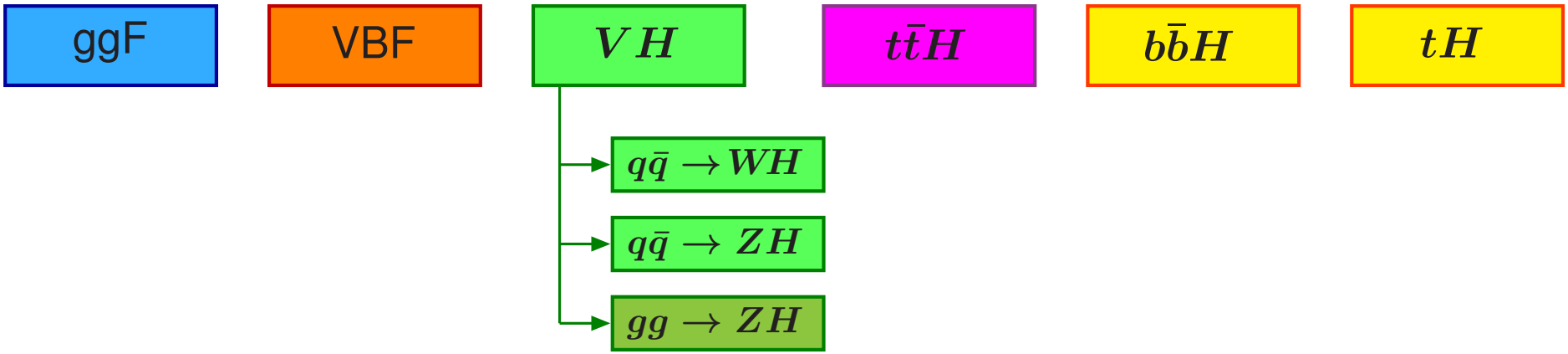
- Apart from evolution of bin definitions as discussed in the following slides
- A few additional points for discussion in the following slides

Thanks to the ATLAS Higgs group for the feedback, which prompted many of the changes shown here!

Simplified template cross section framework.

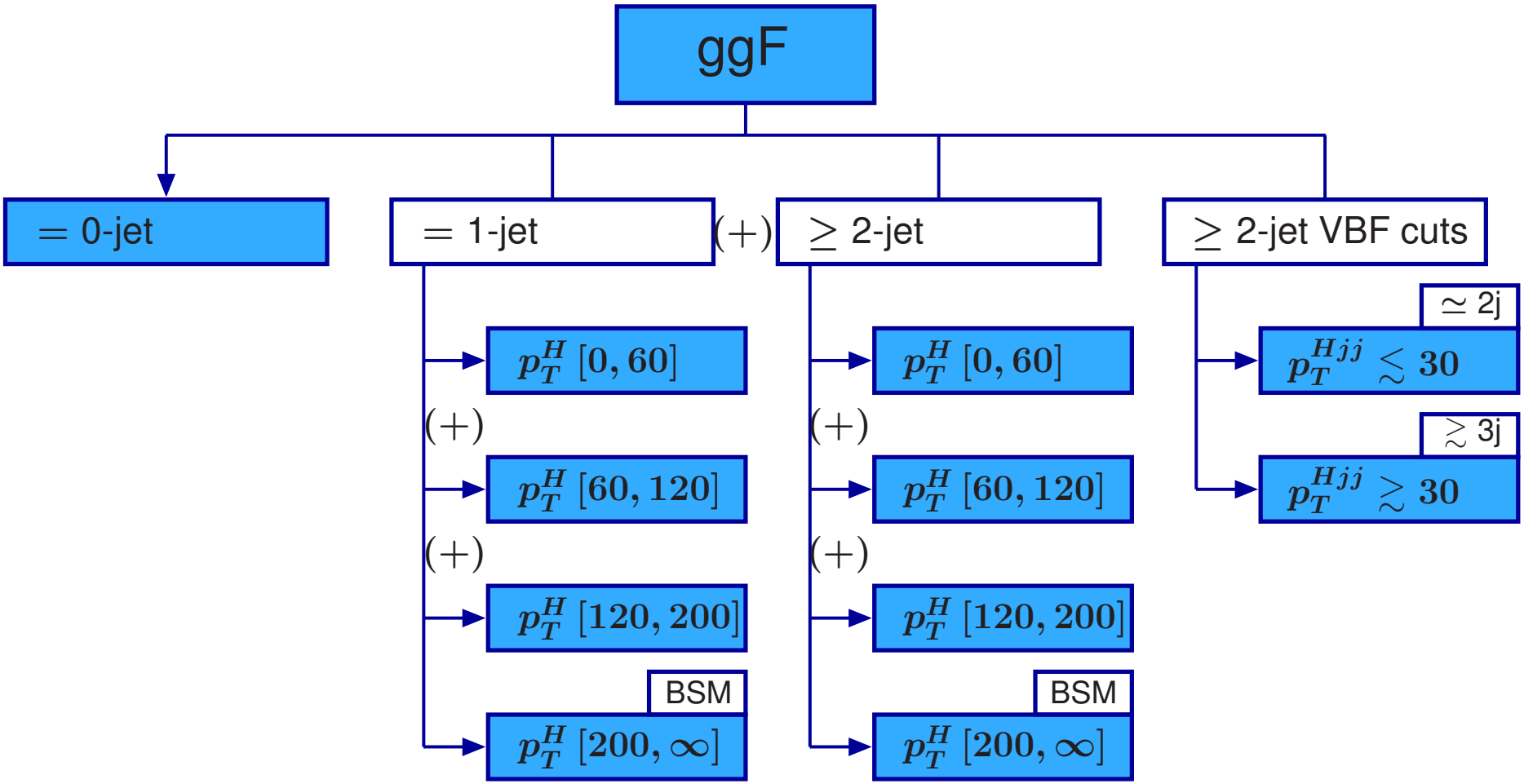


Stage 0 bins.



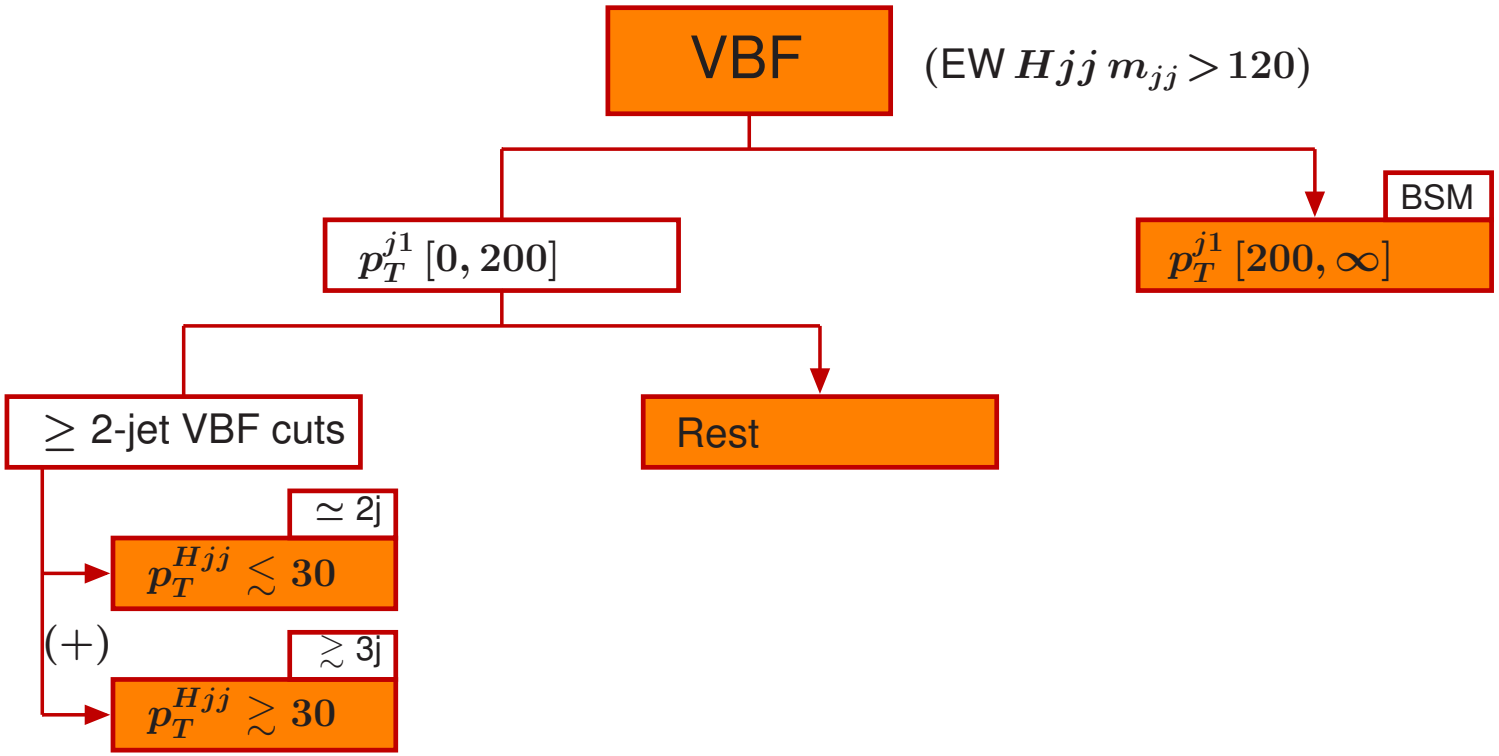
- Inclusive cross section per production mode
  - ggF, VBF, VH and $t\bar{t}H$
    - Split VH into WH and ZH, and/or $q\bar{q} \to VH$ and $gg \to VH$
  - Once meaningful, $b\bar{b}H$ and tH
- Closest correspondence to production-mode μ measurements, but expressed in terms of cross sections and restricted to $|Y_H| < 2.5$
  - If any sensitivity to $|Y_H| > 2.5$, then add bin for $|Y_H| > 2.5$

Gluon fusion stage 1.



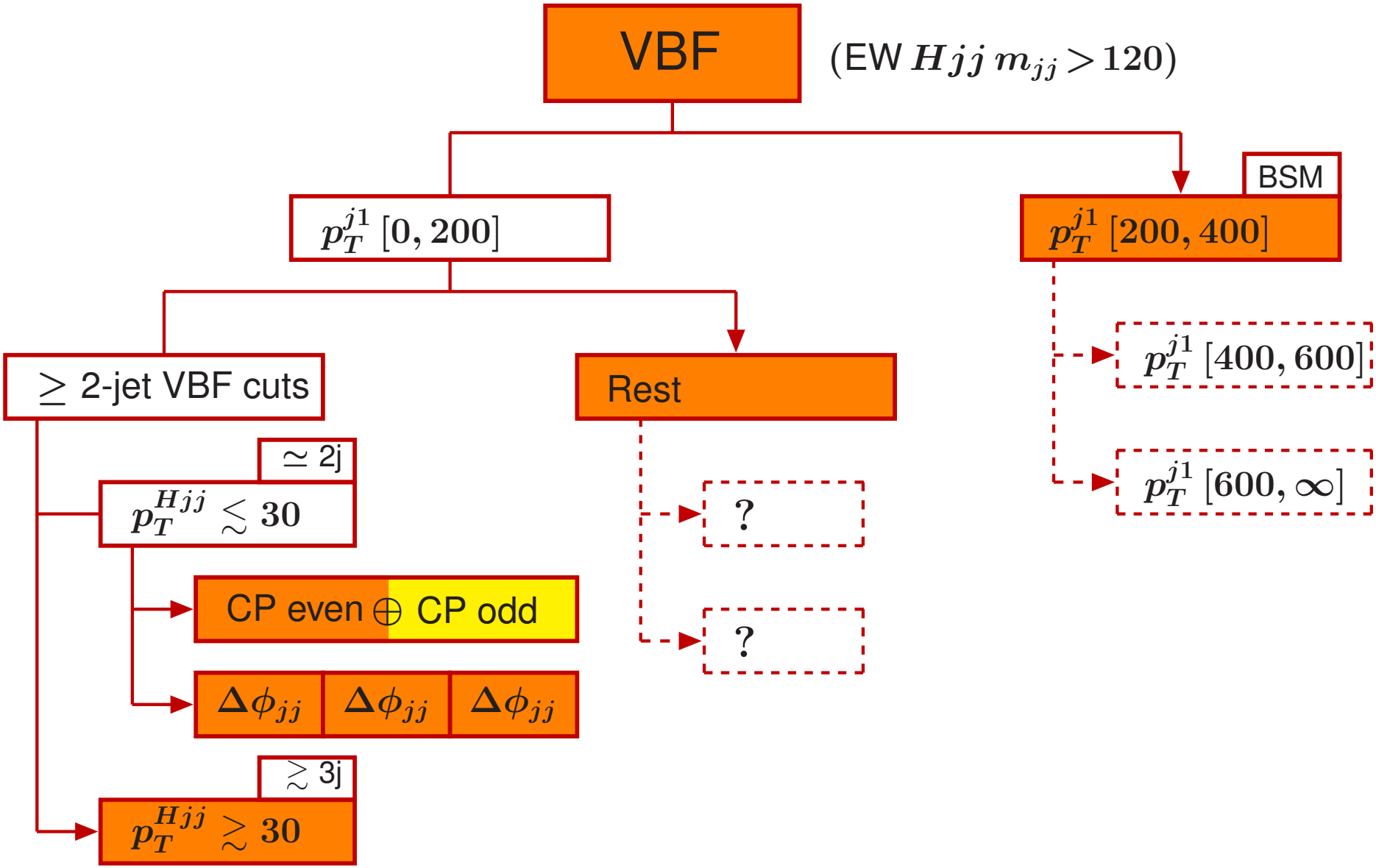
- Restrict $\geq$ 2-jet VBF bin to $p_T^H < 200$ GeV?
- Options for stage 2: split high p_T^H bin, potentially split low p_T^H region further, potentially split $N_J \geq 2$ into $= 2$ and ≥ 3

VBF stage 1.

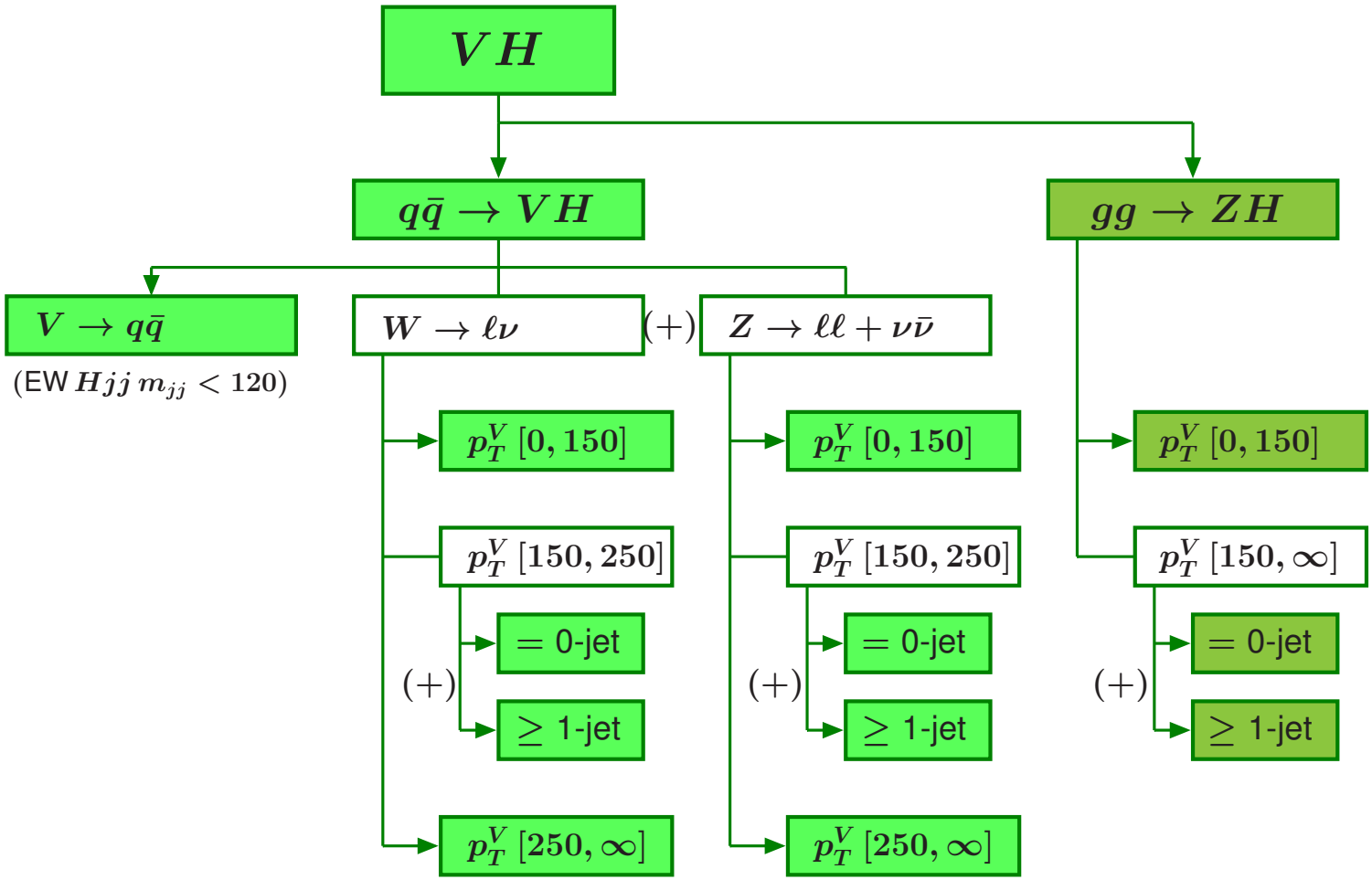


- New: p_T^{j1} split at 200 GeV (was 100 GeV) to have most SM VBF in the small p_T^{j1} bins
- New: VBF cuts defined as $m_{jj} > 400$ GeV and $\Delta\eta_{jj} > 2.8$
- Use p_T^H instead of p_T^{j1} to align with ggF bin?
- Tighten p_T^{Hjj} cut to 20 to improve VBF/ggH separation?

VBF stage 2.

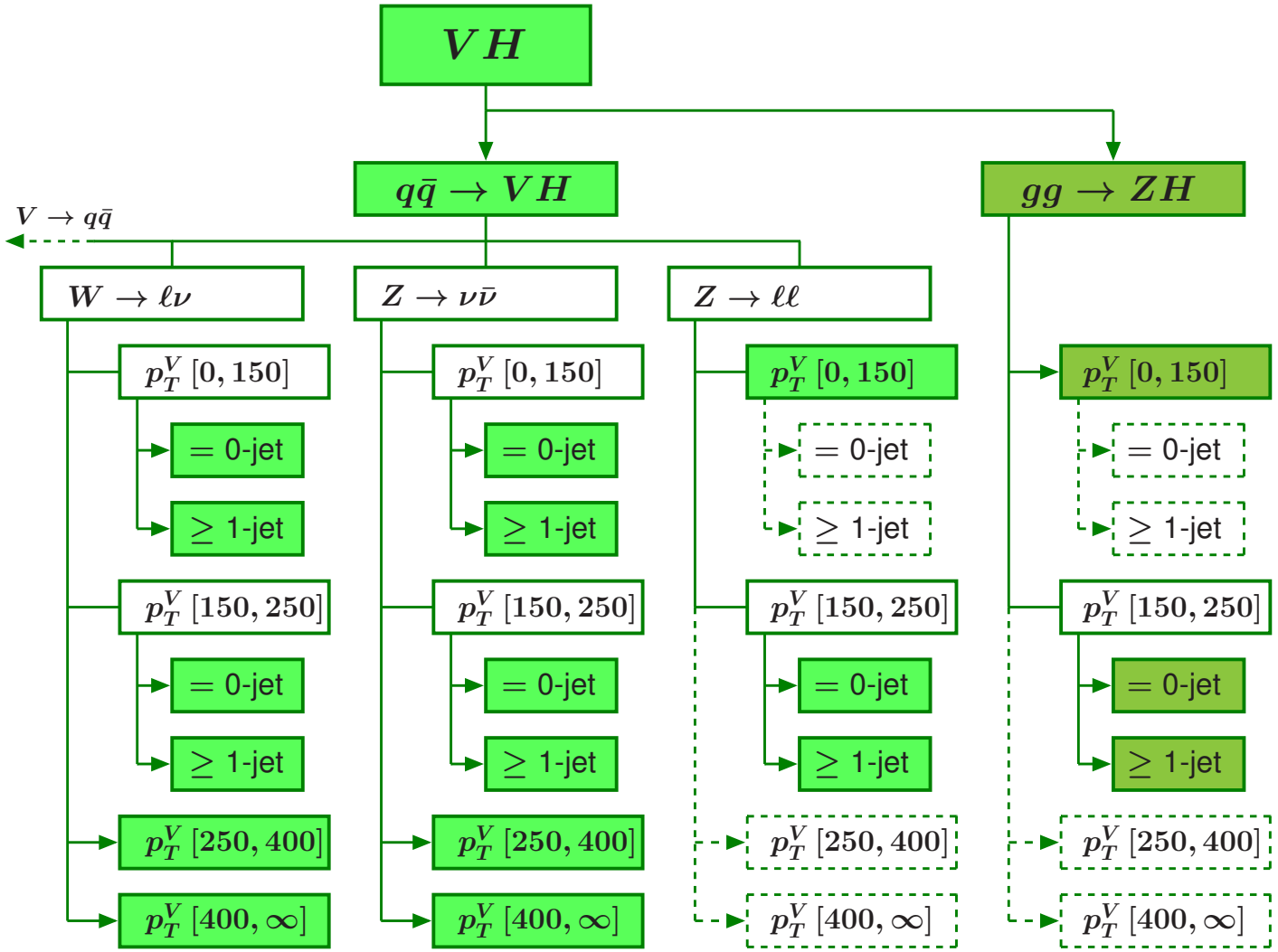

VBF
(EW Hjj $m_{jj} > 120$)
BSM
p_T^{j1} $[0, 200]$
p_T^{j1} $[200, 400]$
p_T^{j1} $[400, 600]$
p_T^{j1} $[600, \infty]$
$\geq$ 2-jet VBF cuts
Rest
?
?
$\simeq$ 2j
$p_T^{Hjj} \lesssim 30$
CP even $\oplus$ CP odd
$\Delta\phi_{jj}$
$\Delta\phi_{jj}$
$\Delta\phi_{jj}$
$\gtrsim$ 3j
$p_T^{Hjj} \gtrsim 30$

VH stage 1.



- New: p_T^V splits at 150 GeV and 250 GeV (was 120 GeV and 200 GeV), adapted to Run2 MET trigger

VH stage 2.



- New: high p_T^V bin at 400 GeV (was 500 GeV), which is the boundary between resolved and boosted analyses

Jet definition.

- Experimentally prefer jet definition with p_T^j >30 GeV due to pileup

- Include $|y_j| < 4.5$ cut?
  - Pro: Would reduce some extrapolation in measurement
  - Con: Complicates theory predictions, in particular since $|y_j| > 4.5$ remnants would effectively be moved to lower jet bins
  - Proposal: Select at level of bin definitions
    - No $|y_j|$ cut in ggF (and VH) jet bins, as extrapolation is very minor effect
    - Explicitly include in VBF bins for signal jets, since fraction of VBF events beyond $|y_j| > 4.5$ is still significant?