Introduction

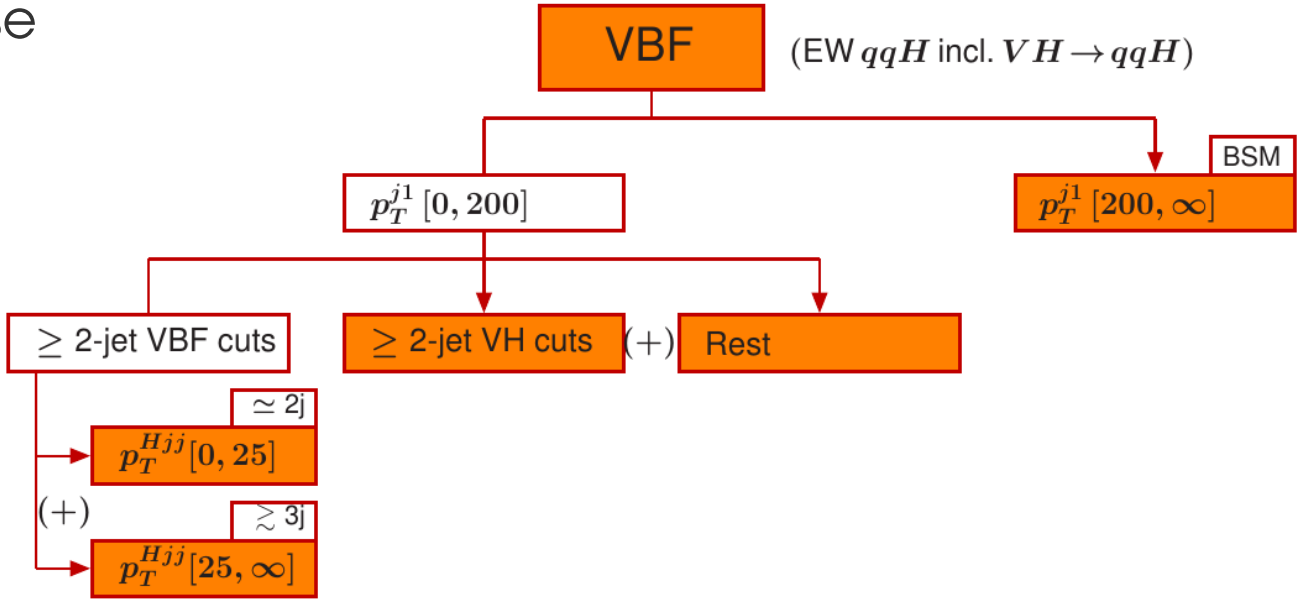
Claudia Bertella (IHEP), Yacine Haddad (Northeastern),
Predrag Milenovic (CERN), Frank Tackmann (DESY)
Nicolas Berger (LAPP)

qq→Hqq Binning

- **STXS "VBF"** (more precisely, **qq→Hqq**) :
  - VBF production
  - VH→had (qq→H(V→qq))

- Current binning:
  - **BSM bin** : pTj1 > 200 GeV
  - **VBF- topology region** : mjj > 400 GeV, $|\Delta\eta_{jj}| > 2.8$

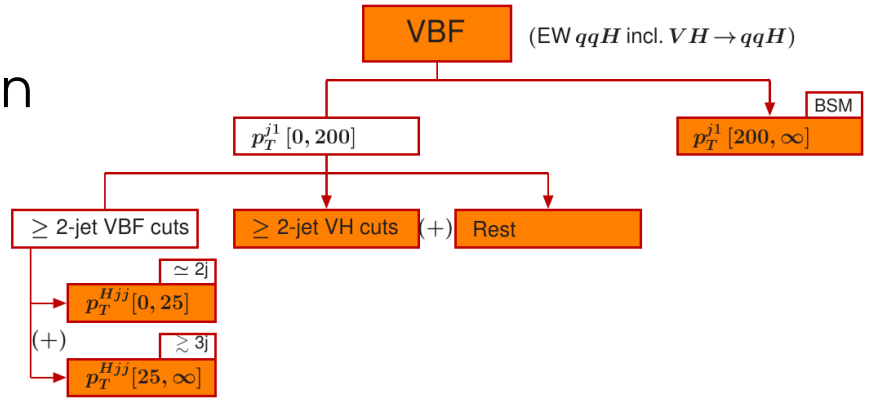
    → Bins with pTHjj < 25 GeV (2j-enriched) and > 25 GeV (≥3-j enriched)
  - **VH region** : 60 < mjj < 120 GeV
  - **"Rest"** : everything else



qq→Hqq : Issues & Improvements

- **"Rest" strongly overlaps with ggF phase space, hard to constrain**
  - Probably unavoidable for some regions (very low m_{jj}), but could find some measurable regions to isolate at medium m_{jj} (also 1-jet) ?

- **Complex cuts for "Rest" and VBF-topo regions**, difficult for theory unc. computation
  ⇒ Remove |Δη| cut ?

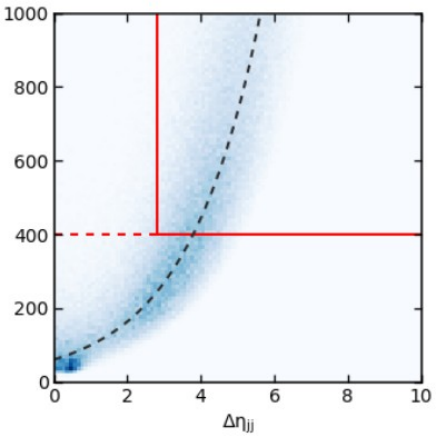


- **Improved m_{jj} binning:**
  - **Define a contiguous binning, not just (60,120) and (400, inf(.**
  - **Reoptimize bin boundaries**

- **High-p_T^{j1} region experimentally close to high-p_T^H region of ggF**, but not quite the same ⇒ **Large correlations**
  ⇒ Switch to cuts that are either identical (⇒ $p_T^H > 200$ GeV for qq→Hqq), or sufficiently different to give small correlations ?

Outcome of previous discussions

Discussions at a dedicated meeeting last November and the LHCHXSWG workshop last month (see Frank's presentation). Outcome so far:



- **Removing |Δη| cut in VBF-topo definition**
  - Cut mostly redundant in pT < 200 GeV phase space
  - ~1% loss in VBF purity due to slightly higher overlap with ggF

  ⇒ OK to remove

- **Implement full m_{jj} binning : (0, 60), (60, 120), (120, xxx) GeV etc.**
  - Possibly finer binning for theory uncertainty computation ("dashed" boundaries)
  - **"Rest" separated into low m_{jj} regions + 0-jet and 1-jet bins**

  → Change 400 GeV boundary as regions just below should be measurable. Options:

  A) Cut at 350 GeV, then 700 GeV and ~1.5 TeV

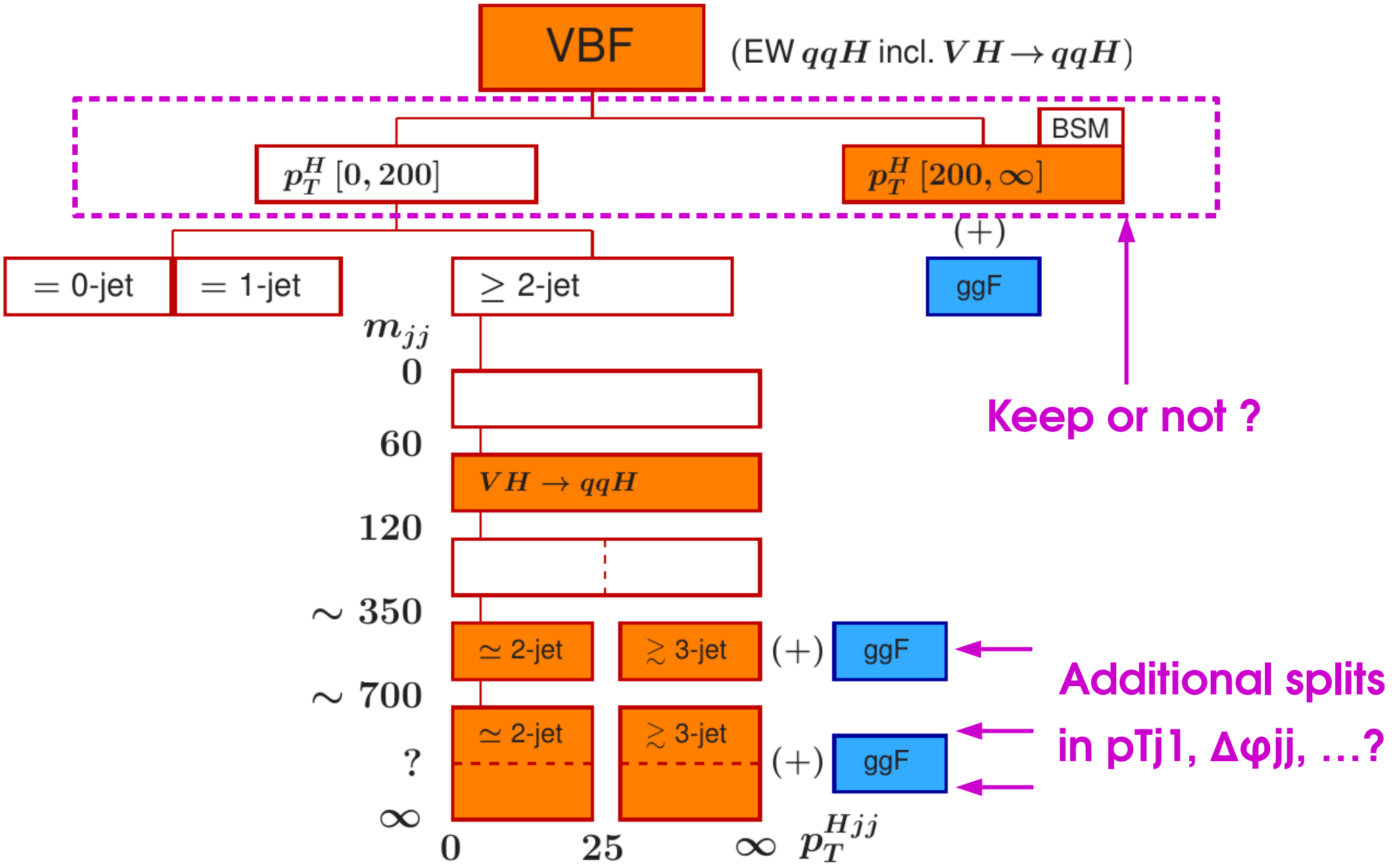
  B) Cut at 250 GeV, then 500 GeV and ~1 TeV

- **p_T^{j1} or p_T^H :**
  - Suggestions p_T^{j1} may have better sensitivity to BSM ? ⇒ studies shown today
  - **Possible options (either or both ?) :**

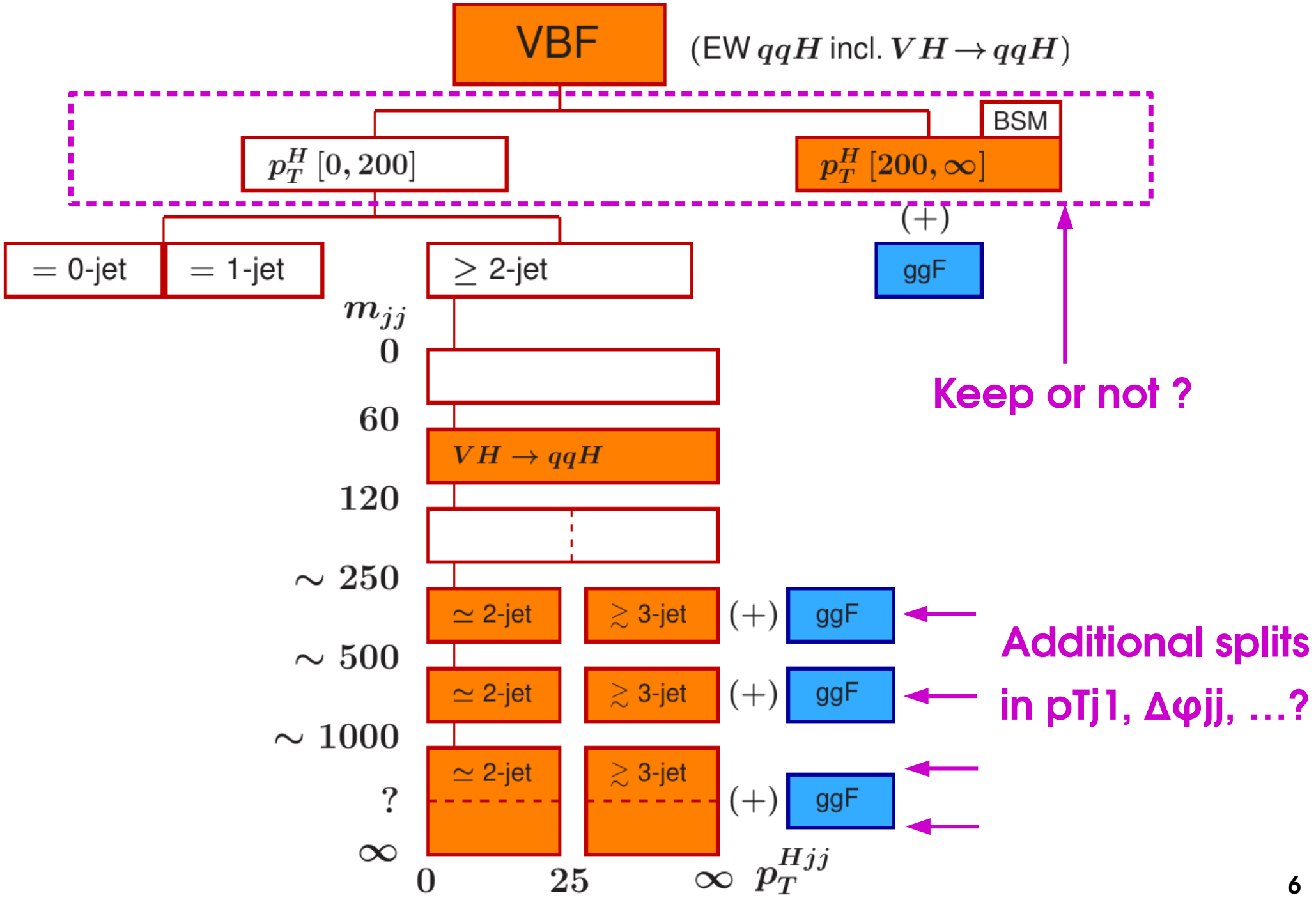
    a) p_T^H>200 GeV at the top of the selection chain (same as ggF)

    b) p_T^{j1} or similar cut ($\Delta\varphi_{jj}$?) within some m_{jj} bins

m_{jj} Binning: Option A



m_{jj} Binning: Option B



Agenda

- Short presentations provide new inputs

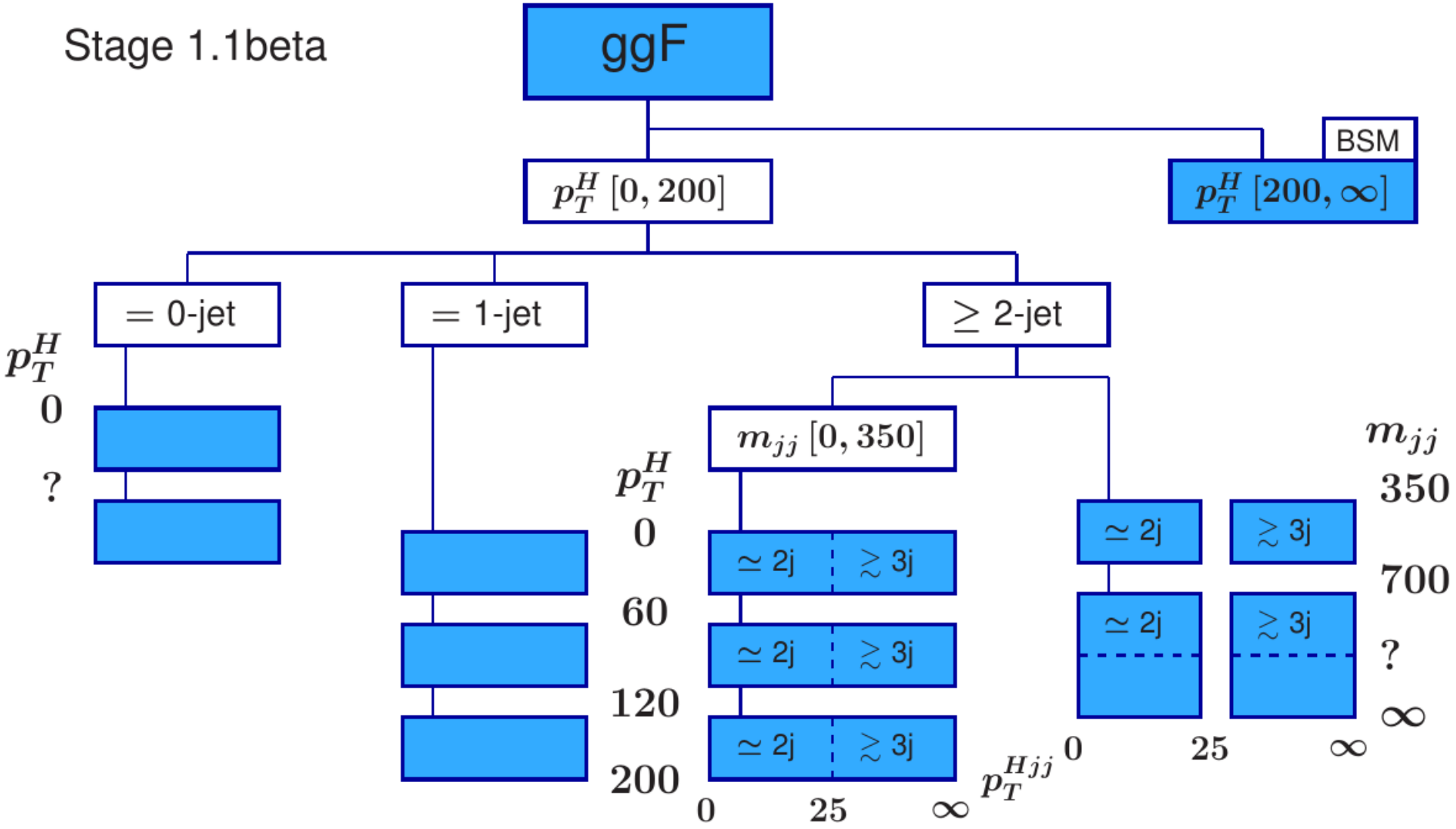
- Discussion – main topics where progress would be welcome:
  - m_{jj} bin boundaries
  - Definition of the BSM bin (p_T^H / p_T^{j1})

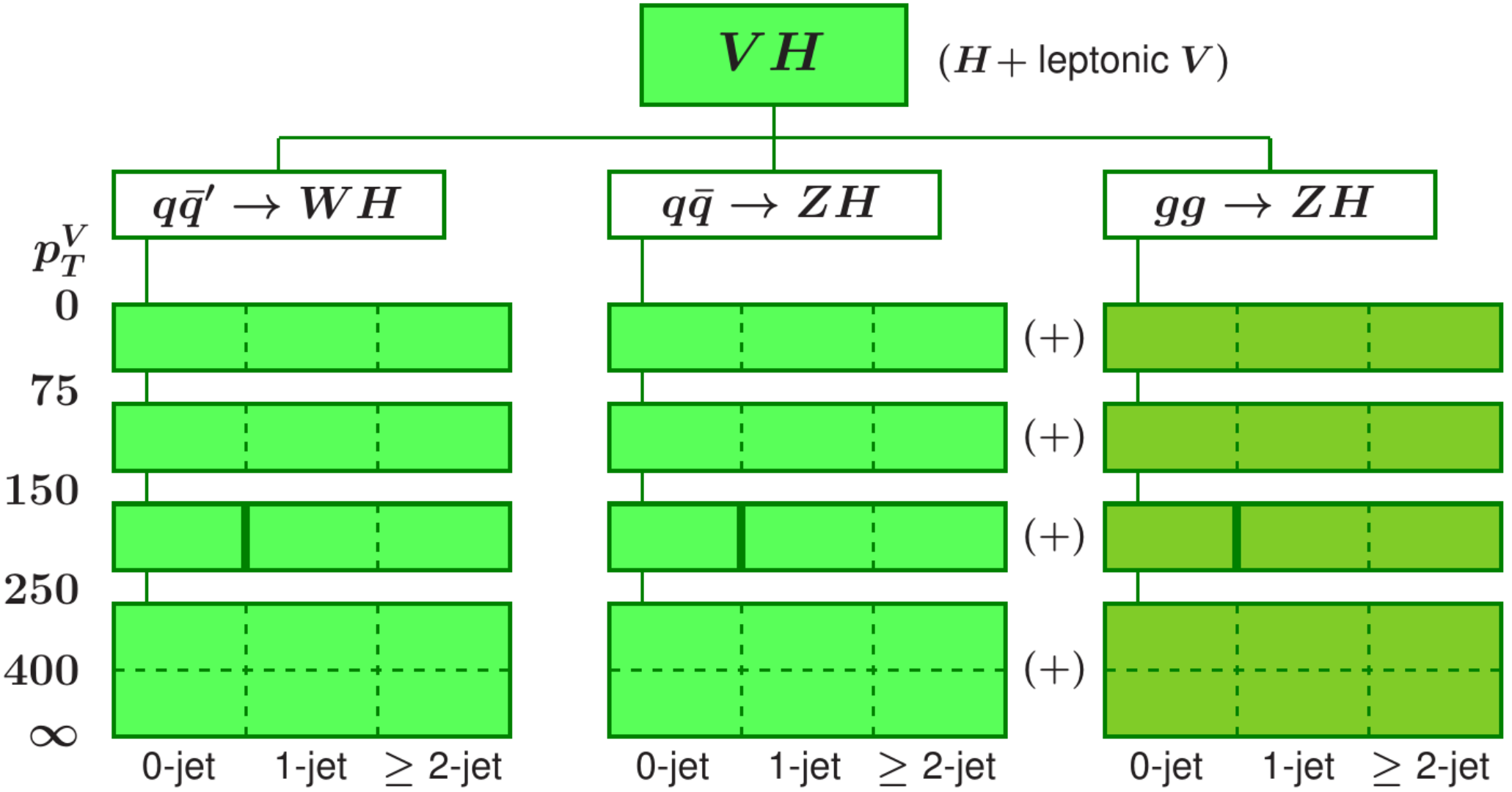
Reference Material for the Discussion

VBF event fractions (from Yacine)

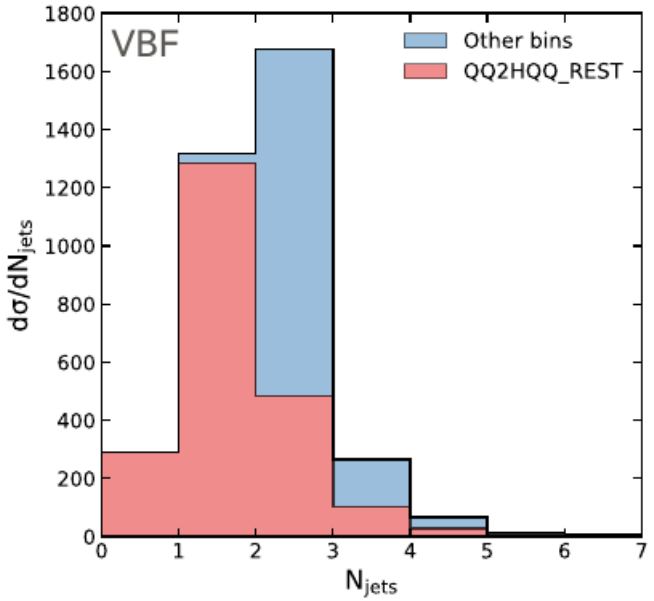
	0+1 jet	mjj < 350 GeV	mjj > 350 GeV
pTH < 200 GeV	44%	16%	34%
pTH > 200 GeV	1%	1%	4%

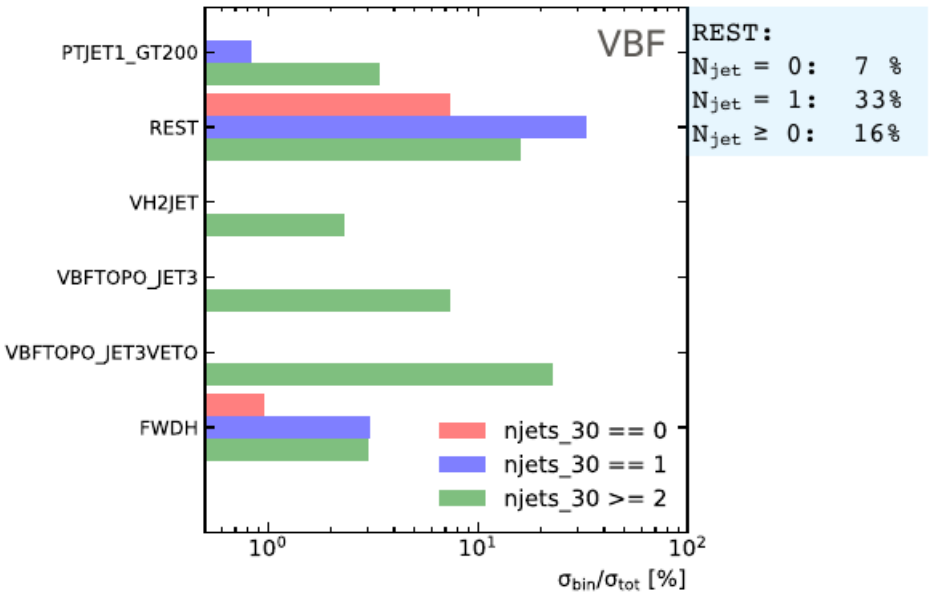
Stage 1.1beta

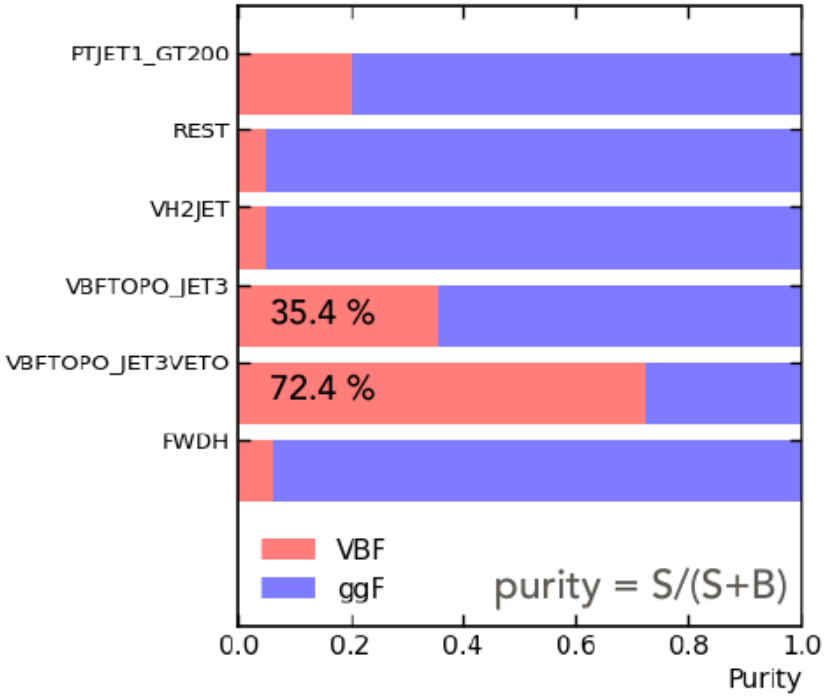


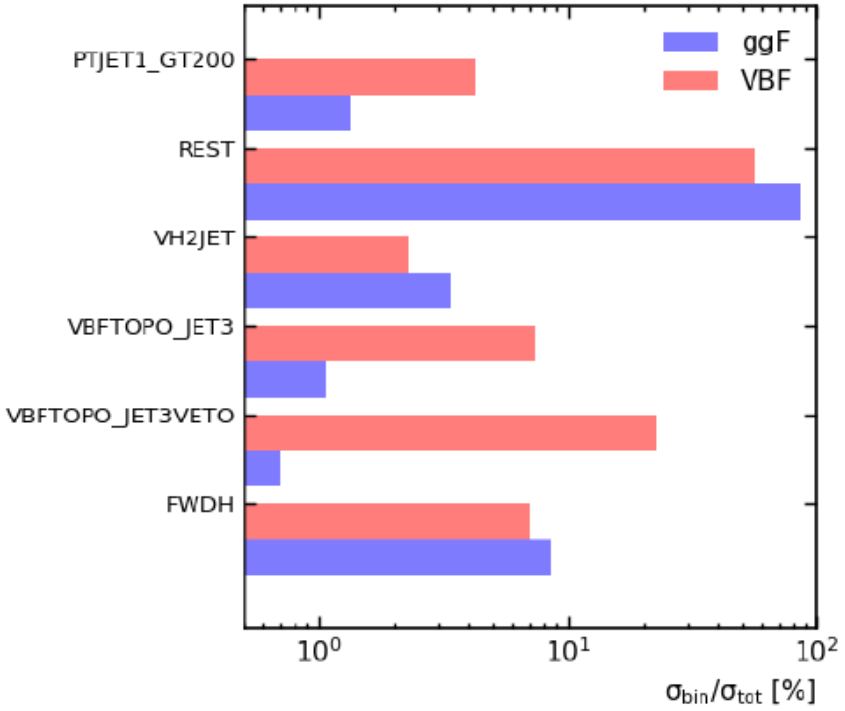

VH
(H + leptonic V)
$q\bar{q}' \to WH$
$q\bar{q} \to ZH$
$gg \to ZH$
p_T^V
0
75
150
250
400
∞
(+)
(+)
(+)
(+)
0-jet
1-jet
≥ 2-jet
0-jet
1-jet
≥ 2-jet
0-jet
1-jet
≥ 2-jet

Current VBF binning (from Yacine)

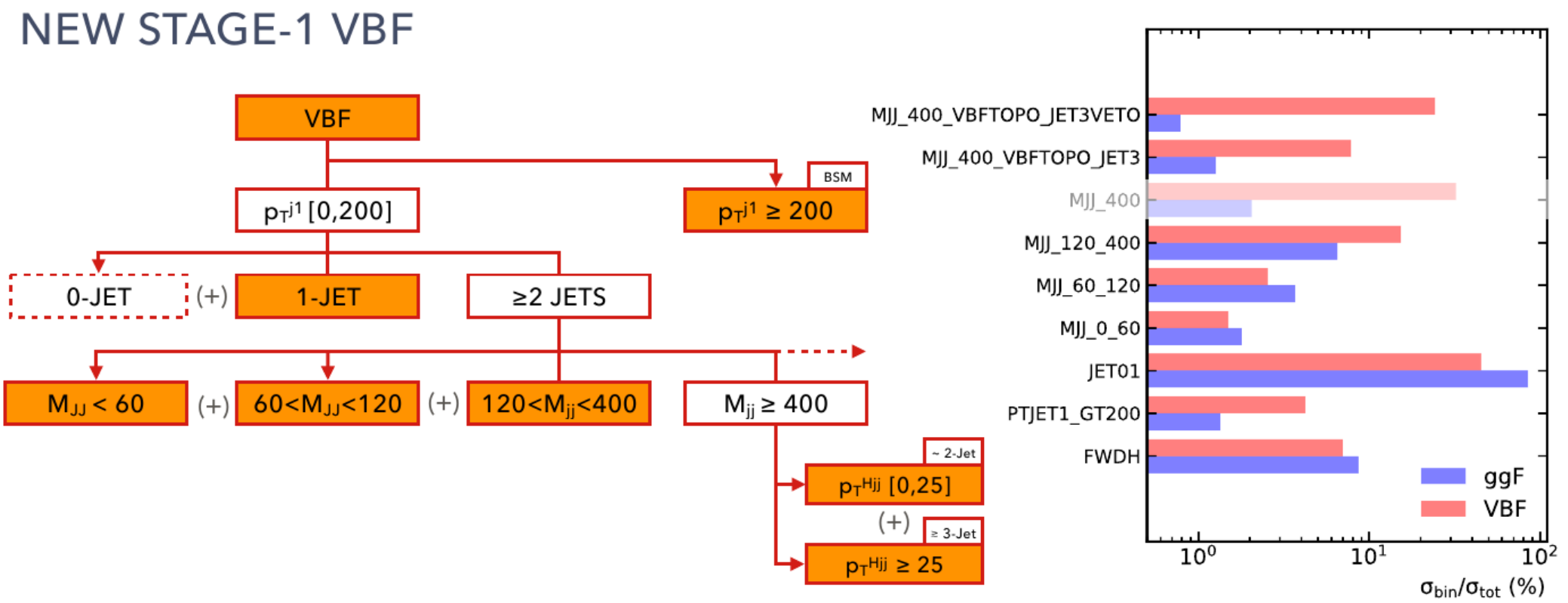




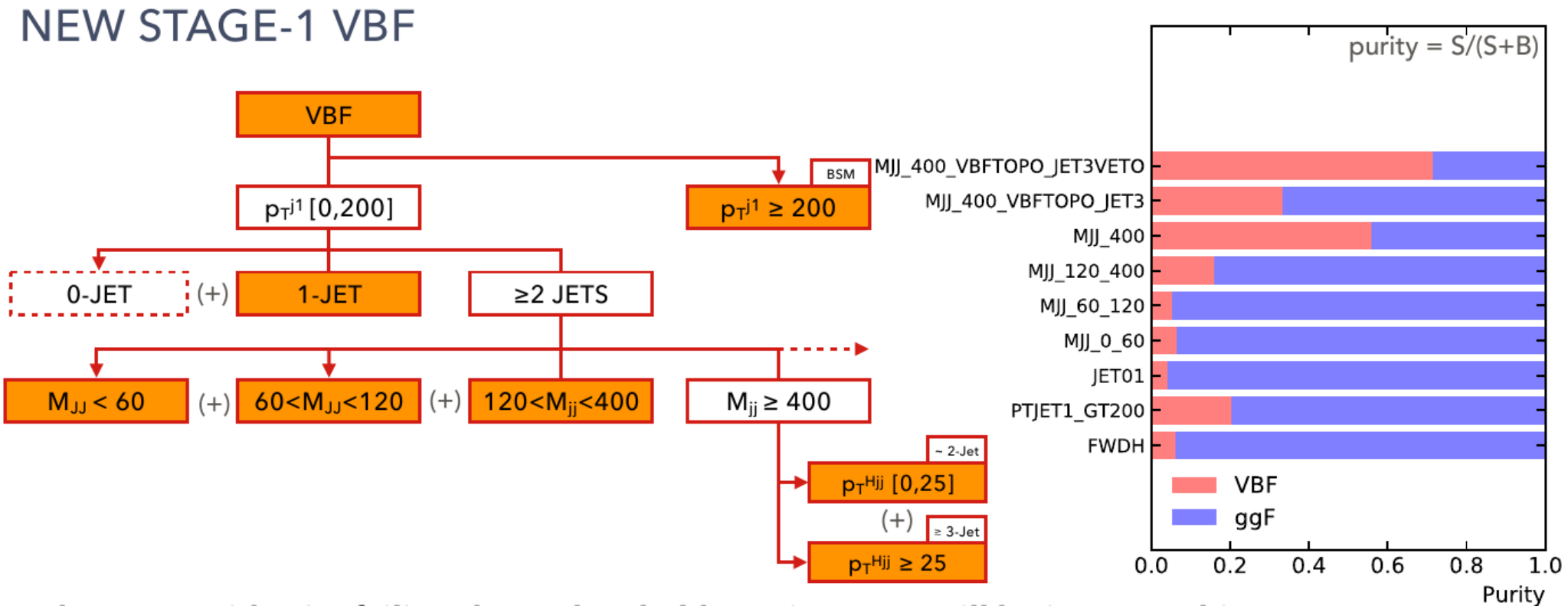


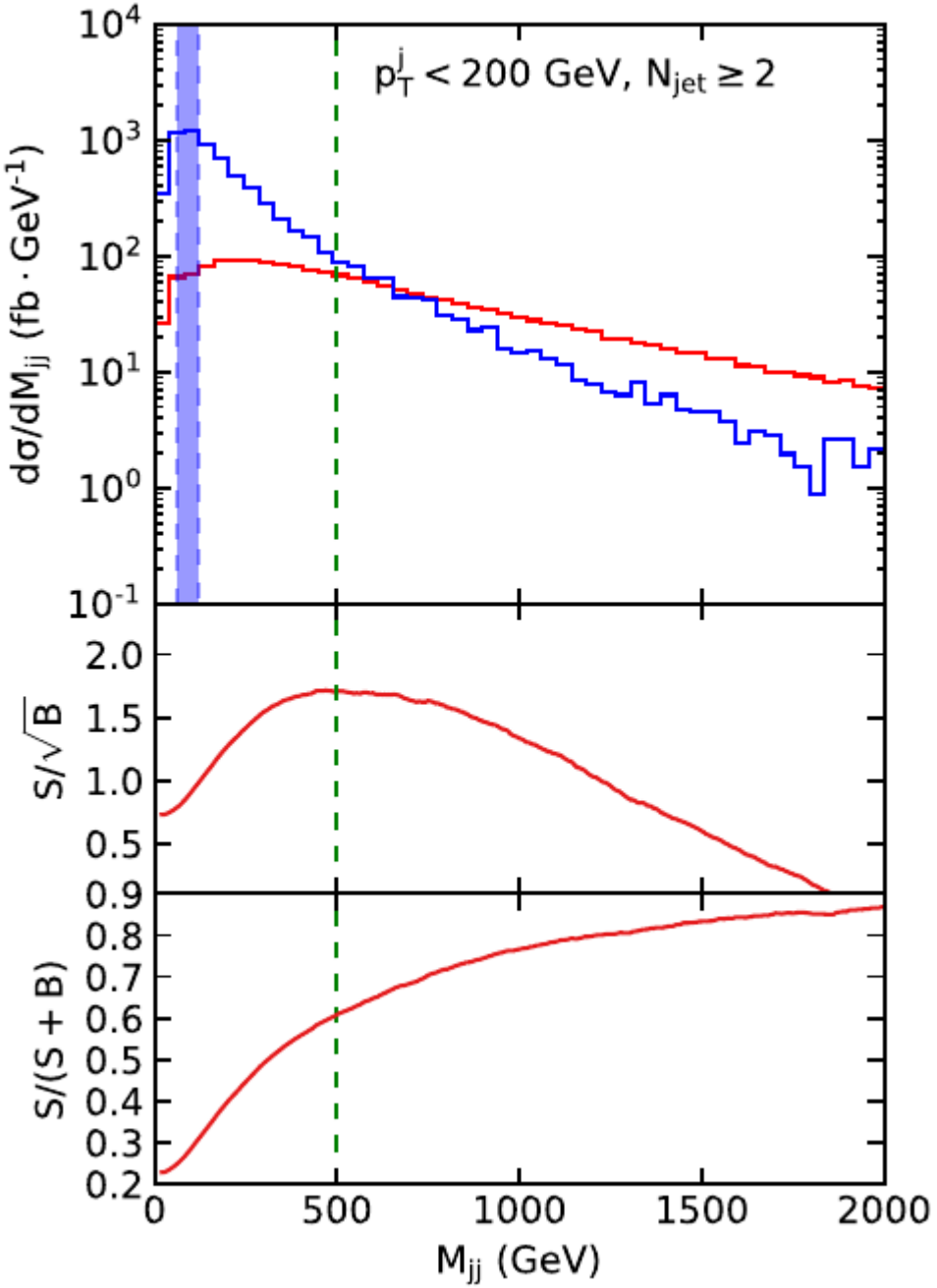


New VBF binning (from Yacine)



New VBF binning (from Yacine)




$p_T^j < 200$ GeV, $N_{jet} \geq 2$
$d\sigma/dM_{jj}$ (fb · GeV^{-1})
$S/\sqrt{B}$
$S/(S+B)$
M_{jj} (GeV)