# Gluon fusion: $p_T^H$ & jet multiplicity

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# Overview

- Jet multiplicity
  - $H \rightarrow WW$ analyses separated into 0, 1, $\geq 2$ jets
  - Many VBF analyses depend on third jet

- $p_T^H$
  - low-$p_T$: effects of b-quark mass
  - high-$p_T$: effects of top-quark mass

- Correlations and acceptances

# Jet multiplicity

- Three methods for evaluating jet veto uncertainties
  - Stewart-Tackmann method treats inclusive jet-bin cross sections as uncorrelated
    - E.g. $\sigma_0 = \sigma_{tot} - \sigma_{\geq 1}$
      - Designed to use calculations to a fixed order in $\alpha_s$
  - Jet-veto efficiency method treats total cross section as uncorrelated with veto efficiency
    - E.g. $\sigma_0 = \sigma_{tot}\, \varepsilon_0$
  - BLPTW use a generalized covariance matrix for normalization and migration uncertainties; apply resummation in certain regions to reduce uncertainties

# Third jet and VBF analyses

- Uncertainty historically evaluated with MCFM using Stewart-Tackmann procedure
  - $\sigma_{\geq 2j}$(NLO) - $\sigma_{\geq 3j}$(LO)
- Can improved calculations of $\sigma_{\geq 3}$ reduce the uncertainty?
- Could we correlate with the other jet-bin uncertainties?

# $p_T^H$

- What is the appropriate scale and variations for the b-quark loop?
  - How much does it affect analyses?

- What are the uncertainties at high $p_T$ ($m_t$ and above)?

  How do perturbative calculations and merged multi-leg generators compare?

- NNLO H+jet calculation ongoing
  - finite $m_t$ @ NNLO to follow?

# Correlations and acceptances

- Experiments correlate uncertainties across Higgs analyses
  - How to correlate $p_T^H$ and jet multiplicity? How to correlate these with an analysis using jets in an MVA?
  - Can MC central values and uncertainties approximate those of the preferred theory calculations and methods?
    - Improved generators available: Powheg NNLOPS, Sherpa MEPS@NLO, MG5_aMC@NLO

- Also consider overlap with underlying event and parton shower uncertainties
  - Jet-bin uncertainties assumed to include PS uncertainty
  - How to evaluate underlying event uncertainty on its own?

# Summary

- Ongoing and existing calculations can improve uncertainties on jet multiplicity and $p_T^H$
- Many issues to be discussed for Run 2
- Anticipate at least two half-day meetings on these topics