

$H^+ \rightarrow \text{taunu}$

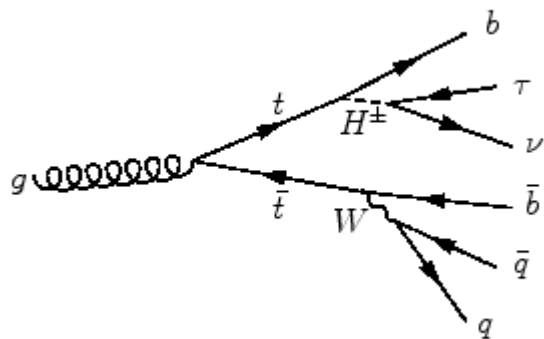
M. Flechl (Freiburg),
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Reminder, light charged Higgs channels

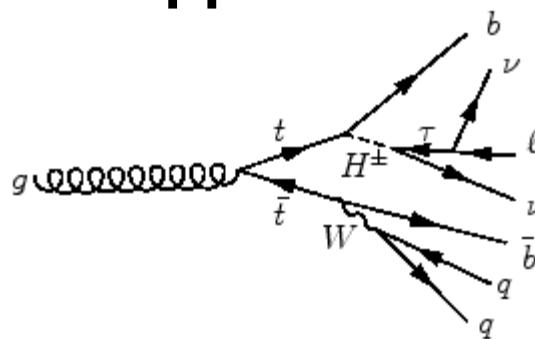
$$[pp \rightarrow tt \rightarrow bH^+(-\rightarrow taunu)bW]$$

hadrons
↑
W

bbqqtau+MET

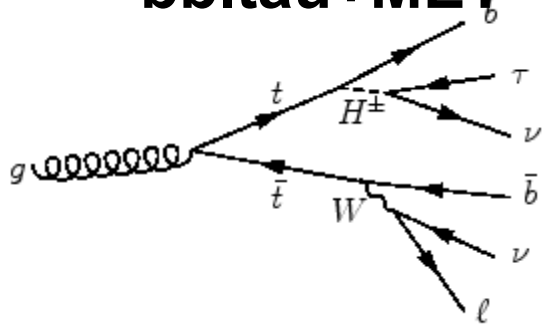


bbqq+l+MET

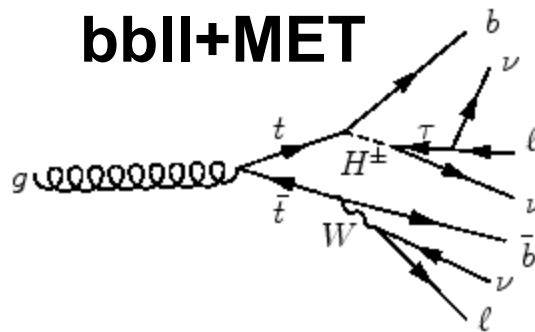


leptons
↑
W

bblltau+MET



bbll+l+MET

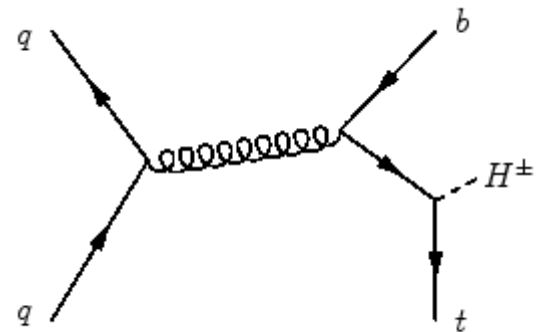
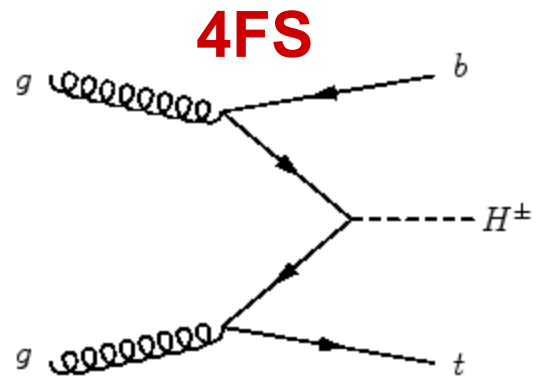
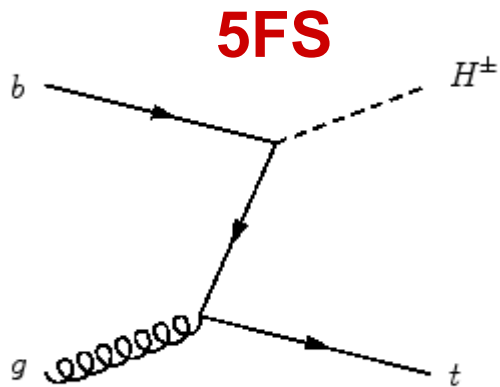


Hadronic tau decays

Leptonic tau decays

Reminder, heavy charged Higgs production

- Either 4 or 5 flavor scheme
- Born level diagrams:



Plan of the activity

- Background estimation:
 - Tau fake rate measurement from data
 - Measuring the QCD background from data
 - Muon replacement method for measuring the tt/W +jets from data

=> do not need precise theoretical estimates here
- Exclusive cross sections
 - k factors after cuts versus without
 - Differential k-factor: e.g. wrt missing energy

List of LO/NLO used

Signal: tt H+X

Pythia6 (+Tauola)

MadGraph (+Tauola)

MatCHig (+Pythia & Tauola)

Backgrounds:

Pythia6 (+Tauola), Pythia8,

MadGraph(+Tauola), MC@NLO, Alpgen

Tauola is needed for the tau polarization

Wish list for theorists

- Full implementation of H^+ in MC@NLO and Powheg
 - Highest priority is H^+ in $t\bar{t}$ decays (i.e. light H^+)
 - $pp \rightarrow t\bar{t} \rightarrow bH^+(\rightarrow t\nu) bW(\rightarrow qq/\ell\nu)$
 - $2 \rightarrow 6$, thus factorized in $t\bar{t}$ production/decay
=> typically spin polarisation are lost, but they are important since a scalar replaces a vector boson in our signal (wrt the main background)
 - MC@NLO: Status 2008: $t \rightarrow bH^+$ not in; need a hacked Herwig version (not possible for official ATLAS/CMS production), spin correlations are lost
 - Powheg

Wish list for theorists

- Full implementation of $t \rightarrow bH^+$ in MC@NLO and/or Powheg, keeping spin correlations
- Theoretical uncertainty on $BR(t \rightarrow bH^+)$

Common cuts

W ↑ hadrons

bbqqtau_H+MET

Tau (from H+)

$$pt > 30, \text{abs}(\eta) < 2.5$$

At least 3 jets

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 5$$

At least 1 b-tagged jet

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 2.5$$

bbqq+l+MET

Lepton (from tau from H+)

$$pt > 15, \text{abs}(\eta) < 2.5$$

At least 3 jets

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 5$$

At least 1 b-tagged jet

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 2.5$$

W ↑ leptons

bblltau_H+MET

Lepton (from W)

$$pt > 15 \text{ GeV}, \text{abs}(\eta) < 2.5$$

Tau (from H+)

$$pt > 30, \text{abs}(\eta) < 2.5$$

At least 2 jets

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 5$$

At least 1 b-tagged jet

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 2.5$$

bbll+MET

Lepton (from tau from H+)

$$pt > 15, \text{abs}(\eta) < 2.5$$

Lepton (from W)

$$pt > 15, \text{abs}(\eta) < 2.5$$

At least 2 jets

$$E_t > 20 \text{ GeV}, \text{abs}(\eta) < 5$$

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Hadronic tau decays

Leptonic tau decays

Common cuts

Open questions for common cuts:

- Add a MET cut? (which is very important in the analysis)
- To avoid overlap between the different H⁺ channels, need to make sure objects come from particular parents (“lepton from tau from H⁺”)
- Jet definitions?
- does it make sense to have common CMS / ATLAS event generation done? LHA-compliant?
Tools actually exist: <http://mcdb.cern.ch>
(from Sinead)

Conclusions

- Common cuts defined
 - a few open questions
- Full implementation of $t \rightarrow bH^+$ in McatNLO / Powheg is our priority-1 wish
- **Need manpower!**
 - In particular, help from theorists to run the actual (exclusive and differential) cross section calculations