ggF subgroup: status report and future plans

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The 13th Workshop of the LHC Higgs Cross Section
Working Group, July 14 2017

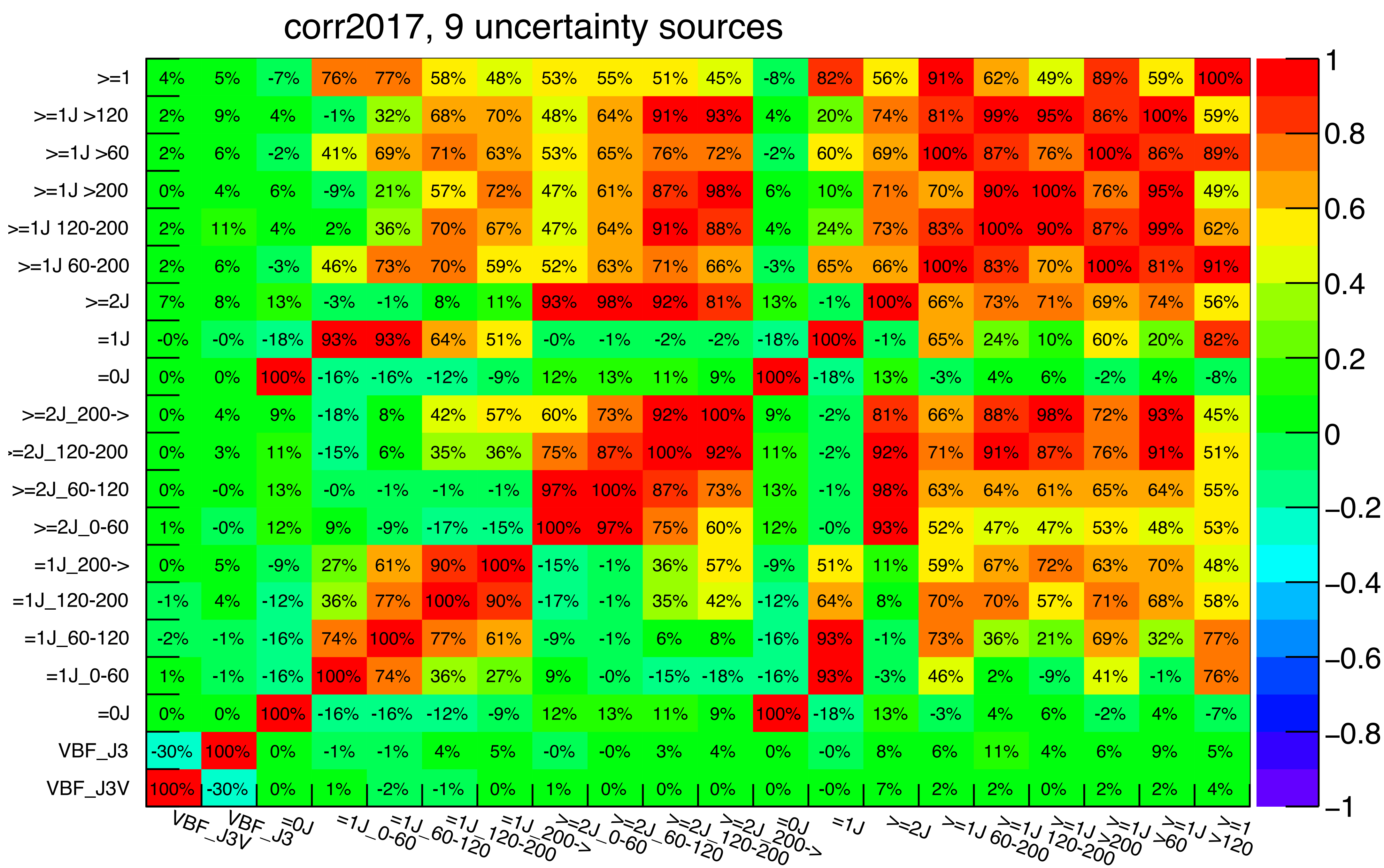
Moving forward from YR4

shift the main focus from inclusive quantities

$\sqrt{s}$ [TeV]	σ^{ggF} [pb]	$\Delta_{\rm TH}[\%]$	$\Delta_{\rm TH}^{\rm Gaussian}[\%]$	$\Delta_{{\rm PDF}\oplus\alpha_s}[\%]$	$\Delta_{\rm PDF}[\%]$	$\Delta_{\alpha_s}[\%]$
6.0	12.65	$^{+4.4}_{-7.1}$	±4.1	±3.3	±1.9	±2.7
6.5	14.70	$^{+4.4}_{-7.0}$	±4.0	±3.3	±1.9	±2.7
7.0	16.85	$^{+4.4}_{-7.0}$	±4.0	±3.3	±1.9	±2.7
7.5	19.09	$^{+4.4}_{-6.9}$	±4.0	±3.3	±1.9	±2.7
8.0	21.42	$^{+4.4}_{-6.9}$	±4.0	±3.2	±1.9	±2.7
8.5	23.84	$^{+4.5}_{-6.9}$	±4.0	±3.2	±1.9	±2.6
9.0	26.33	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
9.5	28.89	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
10.0	31.53	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
10.5	34.22	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
11.0	36.97	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
11.5	39.79	$^{+4.5}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
12.0	42.66	$^{+4.6}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
12.5	45.59	$^{+4.6}_{-6.8}$	±3.9	±3.2	±1.9	±2.6
13.0	48.57	$^{+4.6}_{-6.7}$	±3.9	±3.2	±1.9	±2.6
13.5	51.59	$^{+4.6}_{-6.7}$	±3.9	±3.2	±1.9	±2.6
14.0	54.67	$^{+4.6}_{-6.7}$	±3.9	±3.2	±1.9	±2.6
14.5	57.79	$^{+4.6}_{-6.7}$	±3.9	±3.2	±1.9	±2.6
15.0	60.95	$^{+4.6}_{-6.7}$	±3.9	±3.2	±1.9	±2.6

to more exclusive ones, differential distributions (p_T…)

Correlation matrix "2017 scheme"



[Dag's talk at March's WG meeting]

- main requirement: agreement of NNLOPS with `best prediction'
- correlations depend on underlying assumptions

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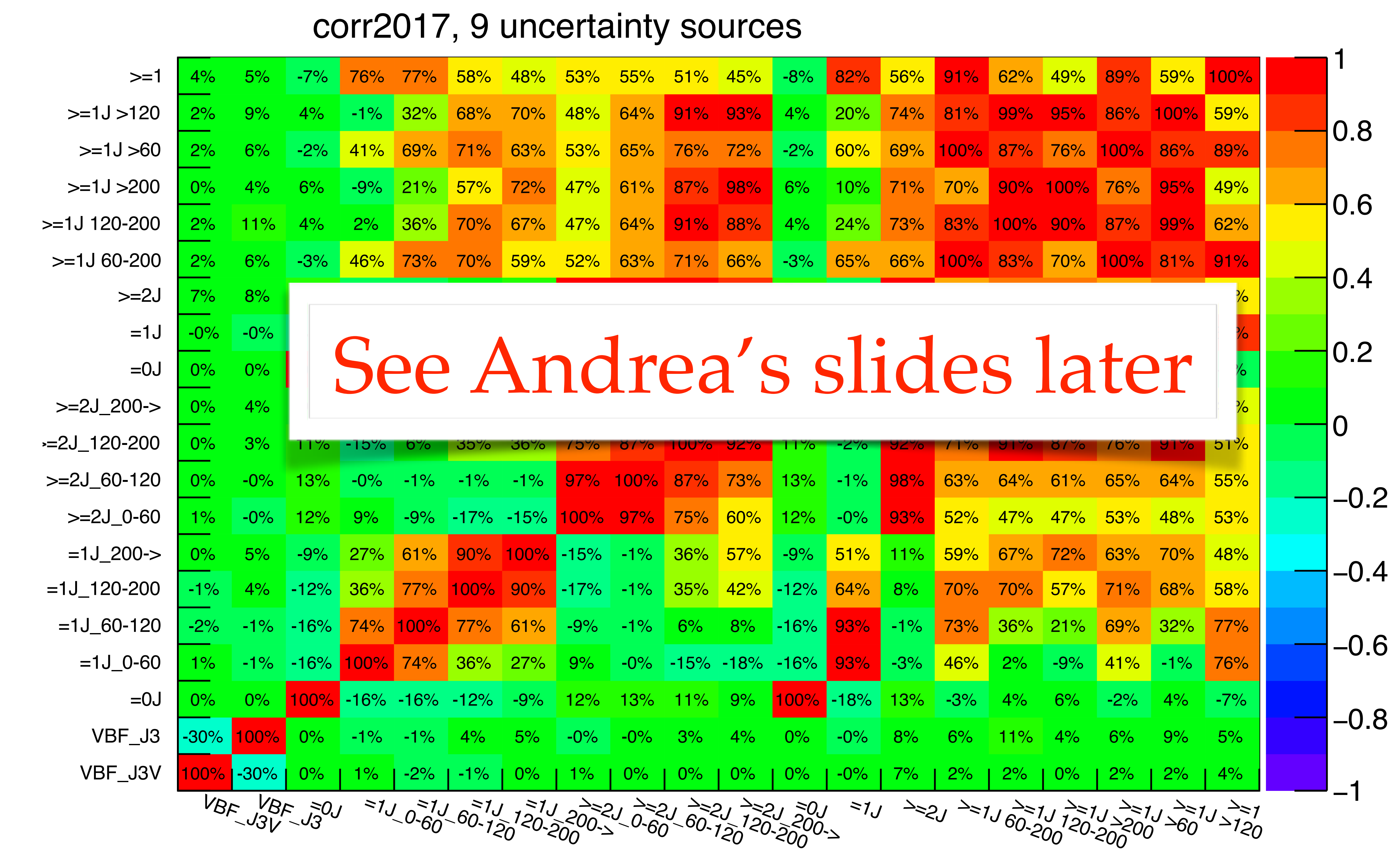

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- main requirement: agreement of NNLOPS with `best prediction'
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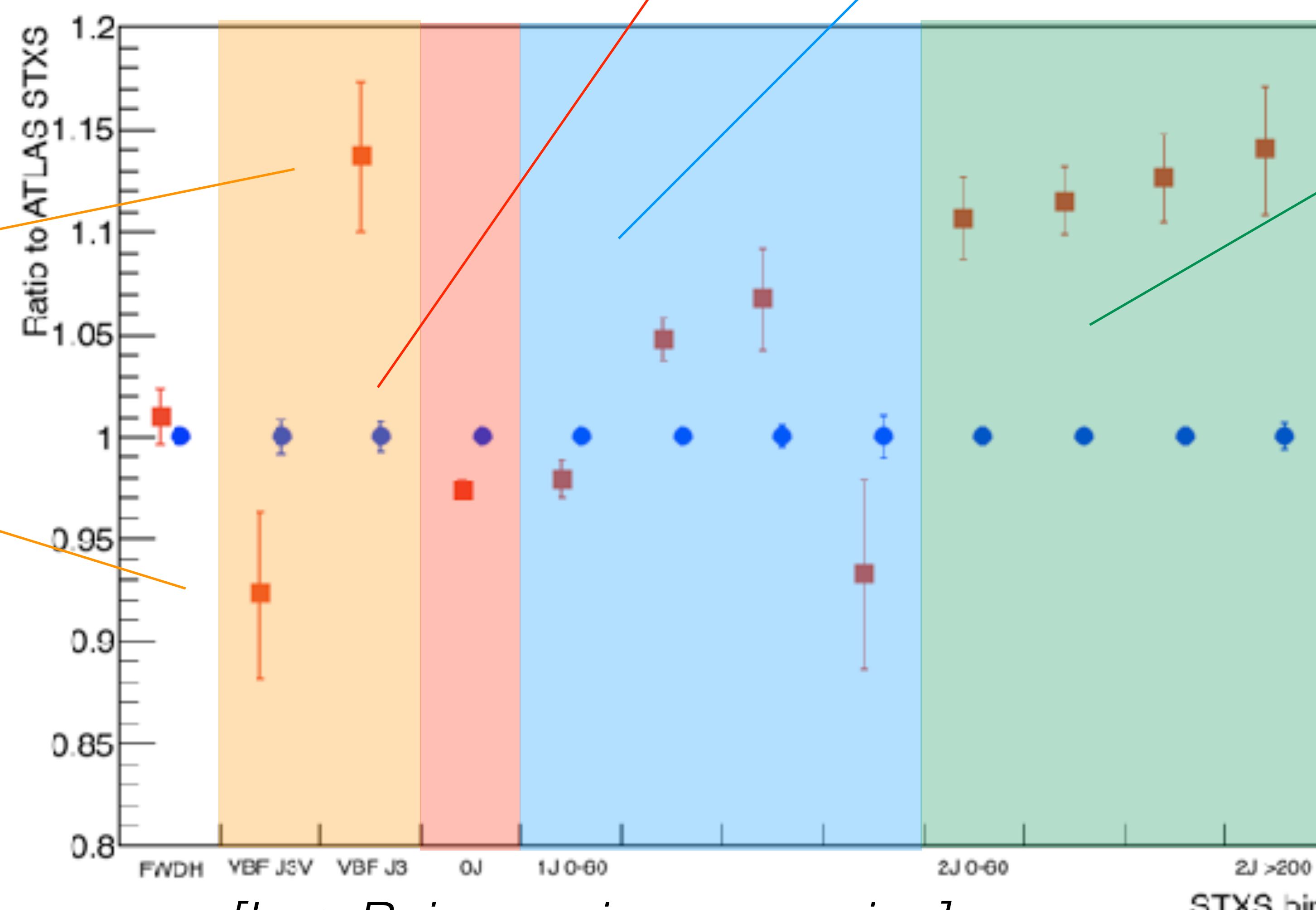
Comparing/benchmarking tunes

[David Sperka, talk at ATLAS-CMS MC workshop 2016]

Subprocess	CMS	CMS+ATLAS PS Tune	ATLAS
FWDH	4.27 ± 0.056	4.27 ± 0.057	4.27 ± 0.01
VBF_J3V	0.23 ± 0.01	0.27 ± 0.011	0.27 ± 0.00
VBF_J3	0.41 ± 0.013	0.37 ± 0.012	0.36 ± 0.00
0J	26.85 ± 0.134	26.95 ± 0.133	27.25 ± 0.03
1J_0-60	6.58 ± 0.059	6.61 ± 0.059	6.49 ± 0.01
1J_60-120	4.54 ± 0.046	4.58 ± 0.046	4.50 ± 0.01
1J_120-200	0.75 ± 0.017	0.75 ± 0.017	0.74 ± 0.00
1J_200	0.14 ± 0.007	0.17 ± 0.008	0.15 ± 0.00
2J_0-60	1.29 ± 0.025	1.24 ± 0.024	1.22 ± 0.01
2J_60-20	1.97 ± 0.029	1.89 ± 0.029	1.86 ± 0.01
2J_120-200	1.08 ± 0.02	1.0 ± 0.02	0.99 ± 0.00
2J_200	0.43 ± 0.012	0.43 ± 0.012	0.42 ± 0.00

[only MC uncertainties]

differences up to 15% in central values for reference STXS



0-jet

1-jet

2-jet

VBF-cuts, ~2j and ~3j ($p_{T,Hjj}$ cut)

[L → R: increasing $p_{T,H}$ region]

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1J_0-60	6.58 ± 0.059	6.61 ± 0.059	6.49 ± 0.01
1J_60-120	4.54 ± 0.046	4.58 ± 0.046	4.50 ± 0.01
1J_120-20[illegible]	[illegible]	[illegible]	[illegible]
1J_200			
2J_0-60			
2J_60-20			
2J_120-2[illegible]			
2J_200			

[only MC unc

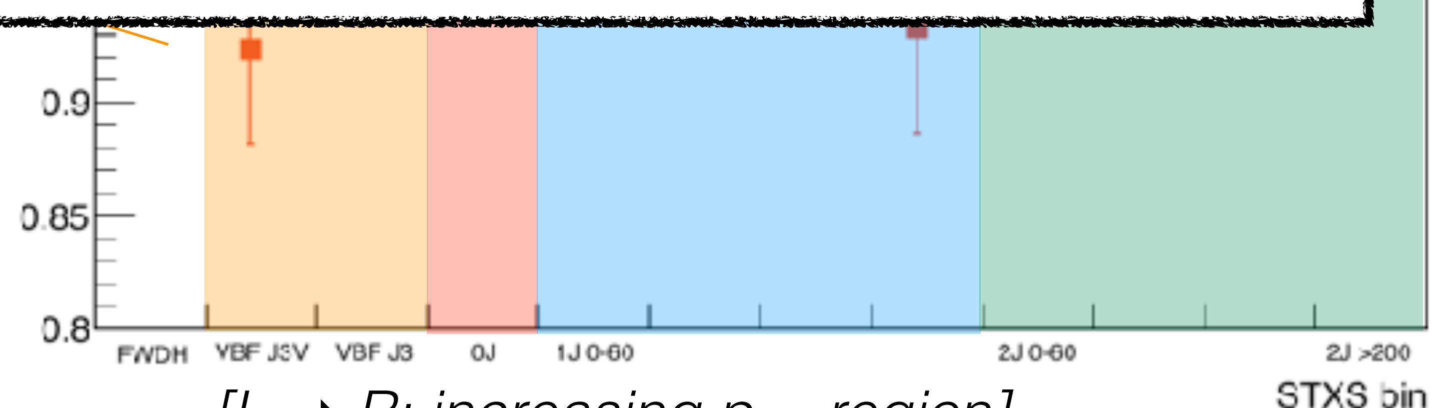
differences up to 15% in central values for reference STXS

- Validation with perturbative calculation may not be enough for some relevant observables
- Use ``clean'' observables to check against state-of-the-art prediction, to help constrain the different tuning / settings
- Especially for internal PS details, interaction with tune experts would be highly beneficial / necessary

2-jet

VBF-cut

($p_{T,Hjj}$ cu



[L → R: increasing $p_{T,H}$ region]

Comparing/benchmarking tunes/settings

- NNLOPS studies with ATLAS tune show very good agreement with more accurate state-of-the-art predictions
- Ongoing investigation to ascertain the tune-dependence

```
    pythia8CUEP8M1Settings = cms.vstring(
        'Tune:pp = 5',
        'PDF:pSet=LHAPDF6:cteq6l1',
        'BeamRemnants:primordialKThard = 1.74948',
        'SpaceShower:alphaSorder = 2',
        'SpaceShower:alphaSvalue = 0.118',
        'SpaceShower:pT0Ref = 1.923589',
        'MultipartonInteractions:pT0Ref = 2.002887'),
    pythia8CommonSettings = cms.vstring('Tune:preferLHAPDF = 2',
        'Main:timesAllowErrors = 10000',
        'Check:epTolErr = 0.01',
        'Beams:setProductionScalesFromLHEF = off',
        'SLHA:keepSM = on',
        'SLHA:minMassSM = 1000.',
        'ParticleDecays:limitTau0 = on',
        'ParticleDecays:tau0Max = 10',
        'ParticleDecays:allowPhotonRadiation = on'),
    pythia8PowhegEmissionVetoSettings = cms.vstring('POWHEG:veto = 1',
        'POWHEG:pTdef = 2',
        'POWHEG:emitted = 0',
        'POWHEG:pTemt = 0',
        'POWHEG:pThard = 0',
        'POWHEG:vetoCount = 3',
        'SpaceShower:pTmaxMatch = 2',
        'TimeShower:pTmaxMatch = 2')
)
```

PYTHIA definition of pT

ATLAS tune (AZNLO)

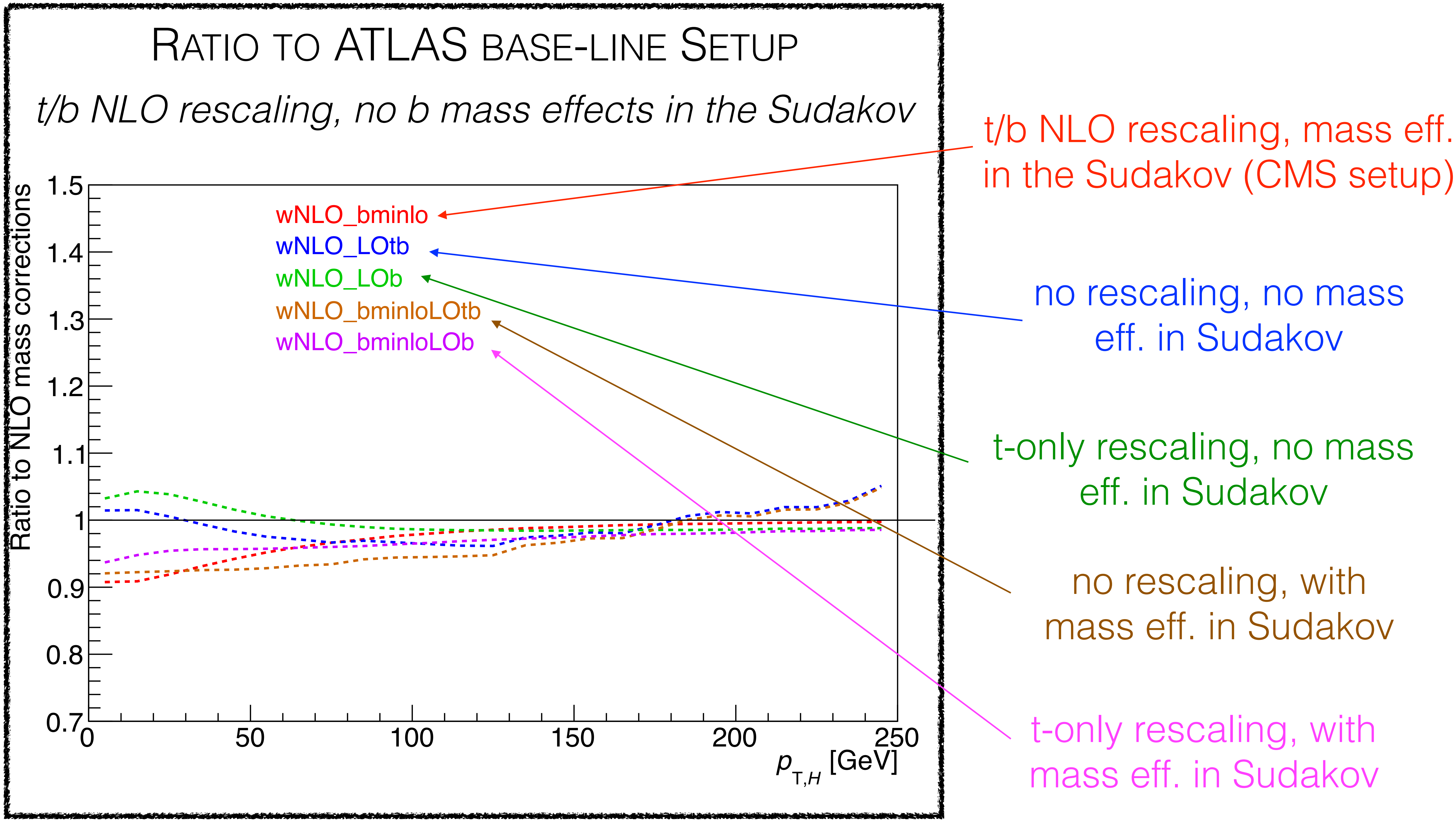
For details see
http://home.thep.lu.se/~torbjorn/pythia81html/POWHEGMerging.html

CMS tune (default)

```
processParameters = cms.vstring('POWHEG:nFinal = 2'),
    pythia8CUEP8M1Settings = cms.vstring('Tune:pp 14',
        'Tune:ee 7',
        'MultipartonInteractions:pT0Ref=2.4024',
        'MultipartonInteractions:ecmPow=0.25208',
        'MultipartonInteractions:expPow=1.6'),
    pythia8CommonSettings = cms.vstring('Tune:preferLHAPDF = 2',
        'Main:timesAllowErrors = 10000',
        'Check:epTolErr = 0.01',
        'Beams:setProductionScalesFromLHEF = off',
        'SLHA:keepSM = on',
        'SLHA:minMassSM = 1000.',
        'ParticleDecays:limitTau0 = on',
        'ParticleDecays:tau0Max = 10',
        'ParticleDecays:allowPhotonRadiation = on'),
  pythia8PowhegEmissionVetoSettings = cms.vstring('POWHEG:veto = 1',
        'POWHEG:pTdef = 1',
        'POWHEG:emitted = 0',
        'POWHEG:pTemt = 0',
        'POWHEG:pThard = 0',
        'POWHEG:vetoCount = 100',
        'SpaceShower:pTmaxMatch = 2',
        'TimeShower:pTmaxMatch = 2')
  )
```

POWHEG definition of pT

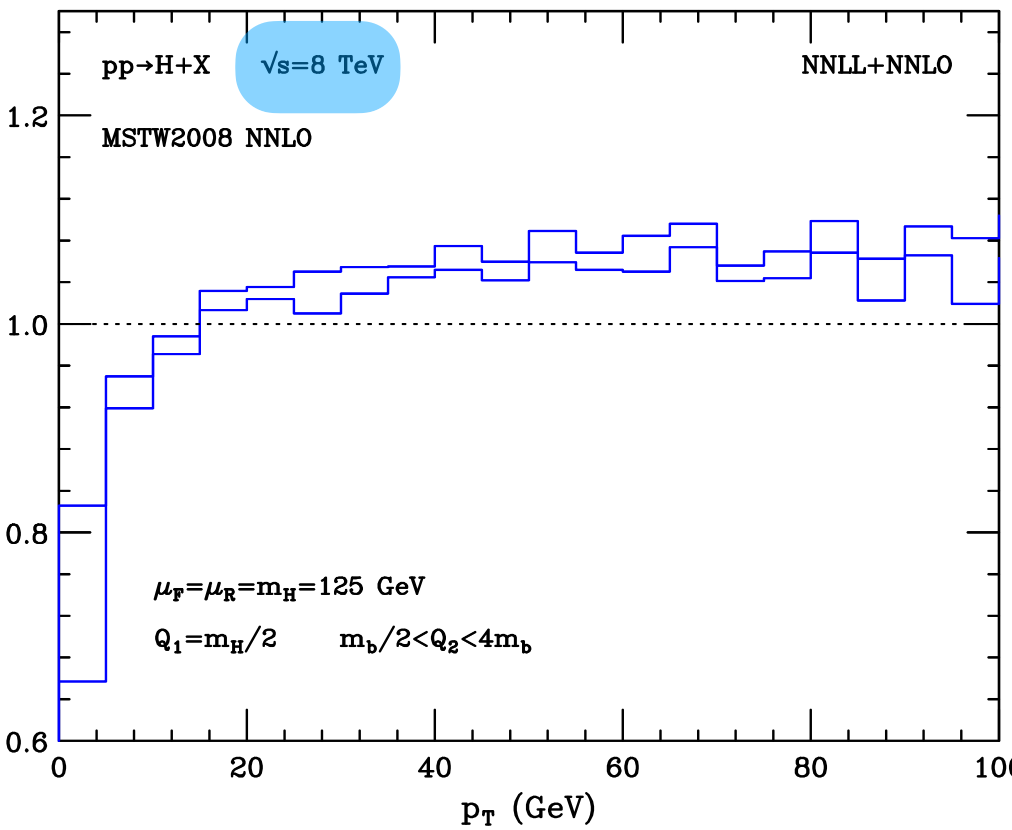
Example: mass vs effective theory



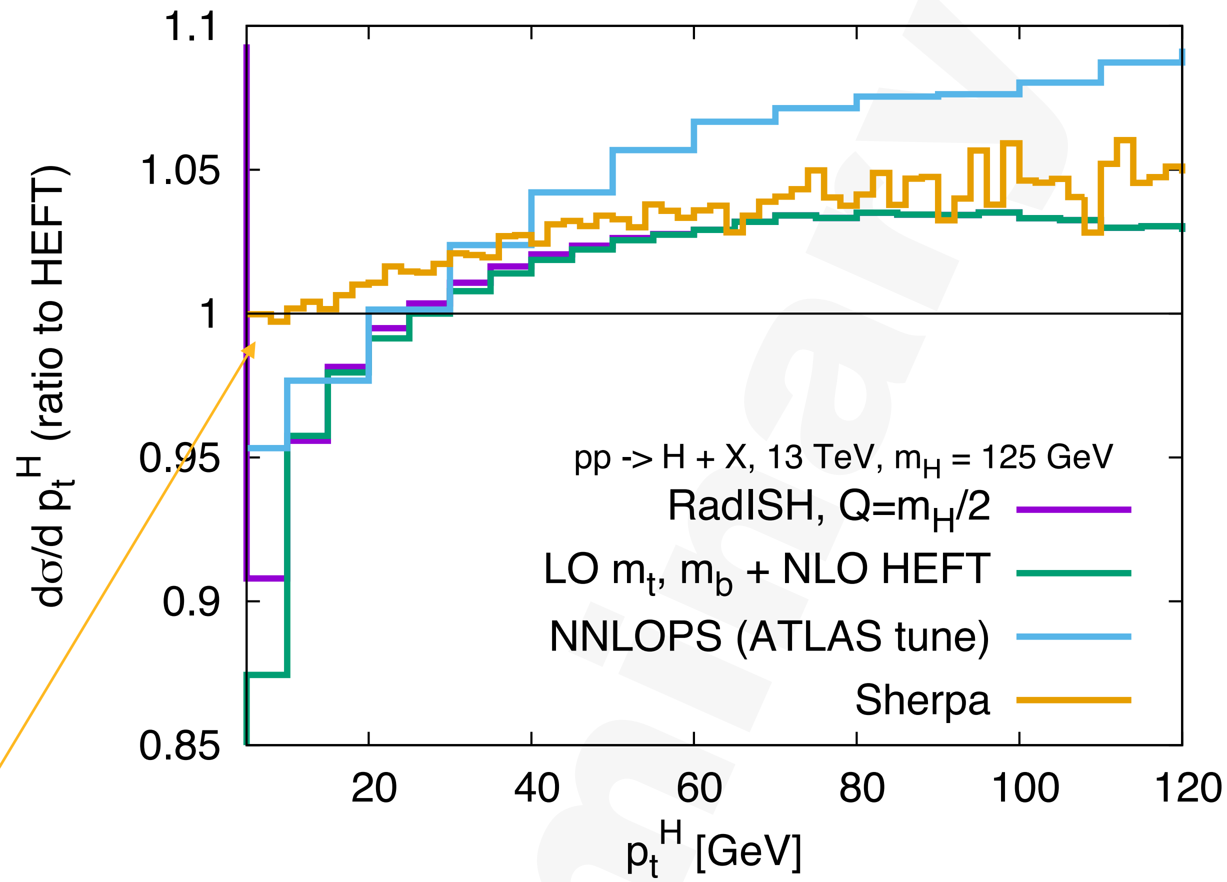
~ 10% spread between different approaches, as large as scale variation

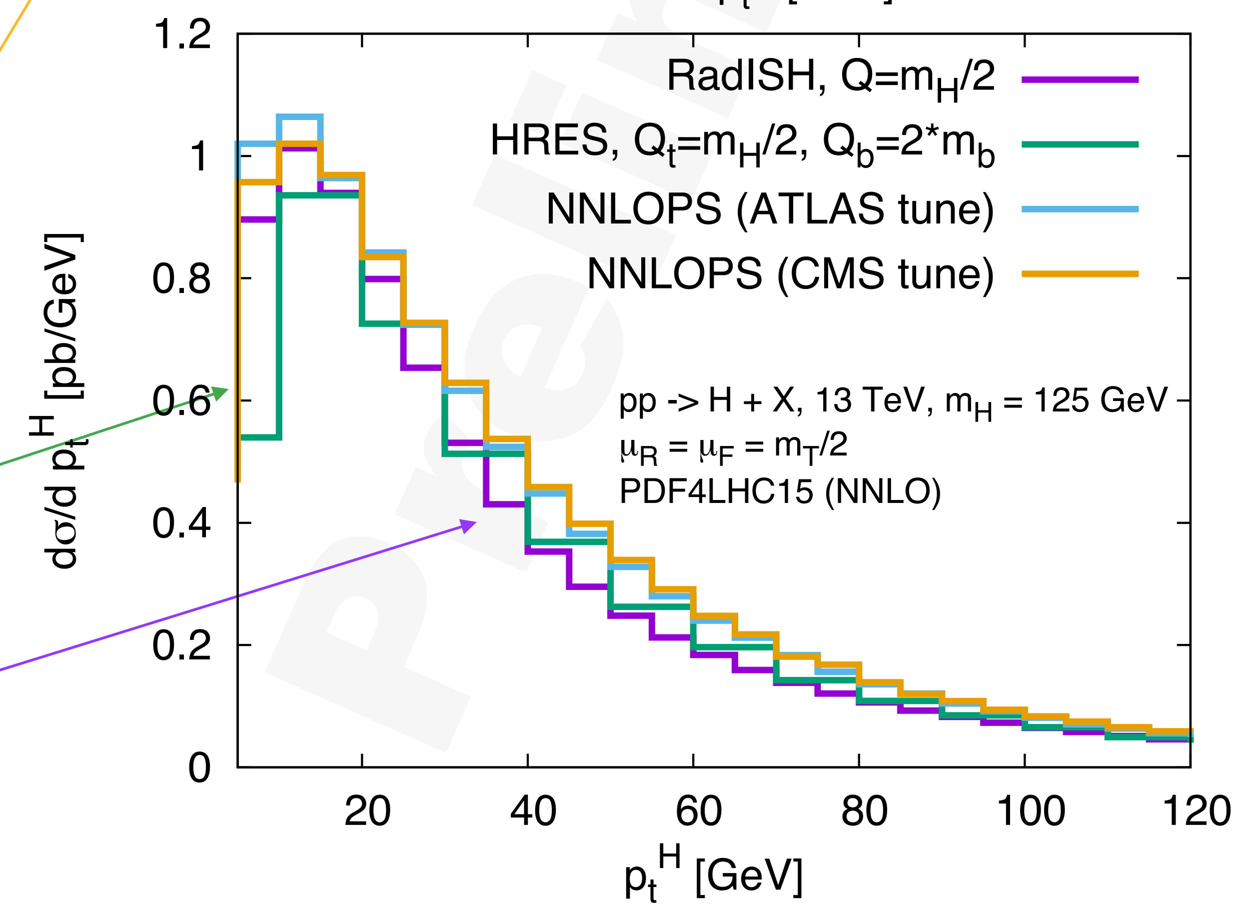
needs to be understood better

Example: mass vs effective theory



[Grazzini, Sargsyan (2013)]





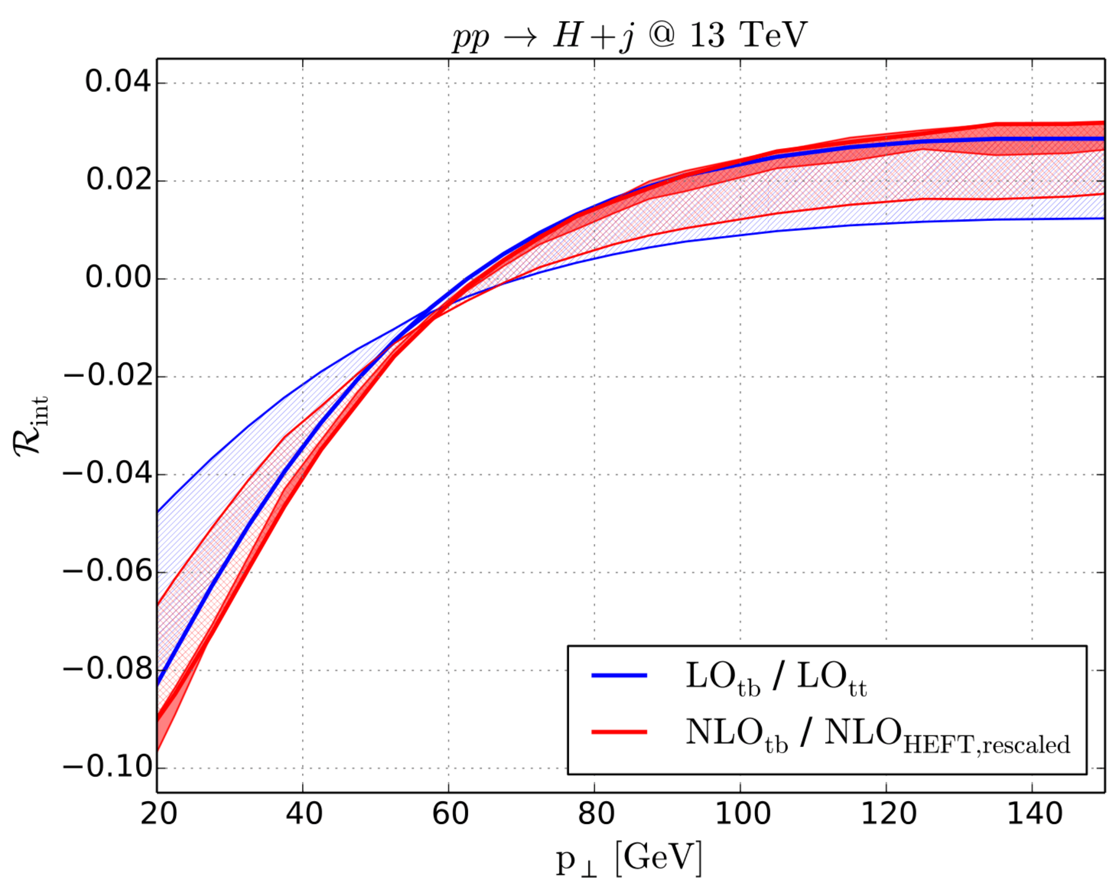
Different generators treat mass effects differently

Sherpa: MC@NLO_top + CKKW_b (as in YR4)

HRES: $Q_t=m_H/2$, $Q_b=2\ m_b$

RadISH: $Q_b=Q_t=m_H/2$

- Ongoing work on comparisons/understanding
  - Grazzini, Sargsyan (HRES)
  - Kuttimalai, Schoenherr, Winter (Sherpa)
  - Bagnaschi, Vicini (POWHEG)
  - NNLOPS
  - aMC@NLO [tbc]
  - …

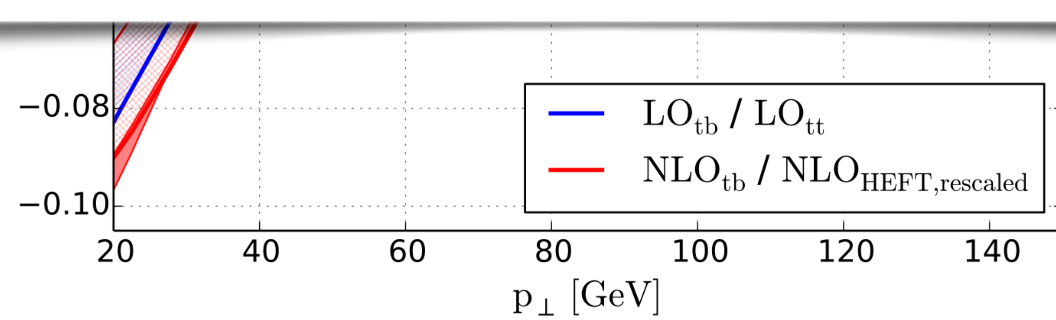


[Lindert, Melnikov, Tancredi, Wever]

- Full NLO available. Detailed pheno studies in progress with the authors

- Ongoing work on comparisons/understanding
  - Grazzini, Sargsyan (HRES)
  - Kuttimalai, Schoenherr, Winter (Sherpa)
  - Bagnaschi, Vicini (POWHEG)

Meeting to be called as soon as preliminary results are ready



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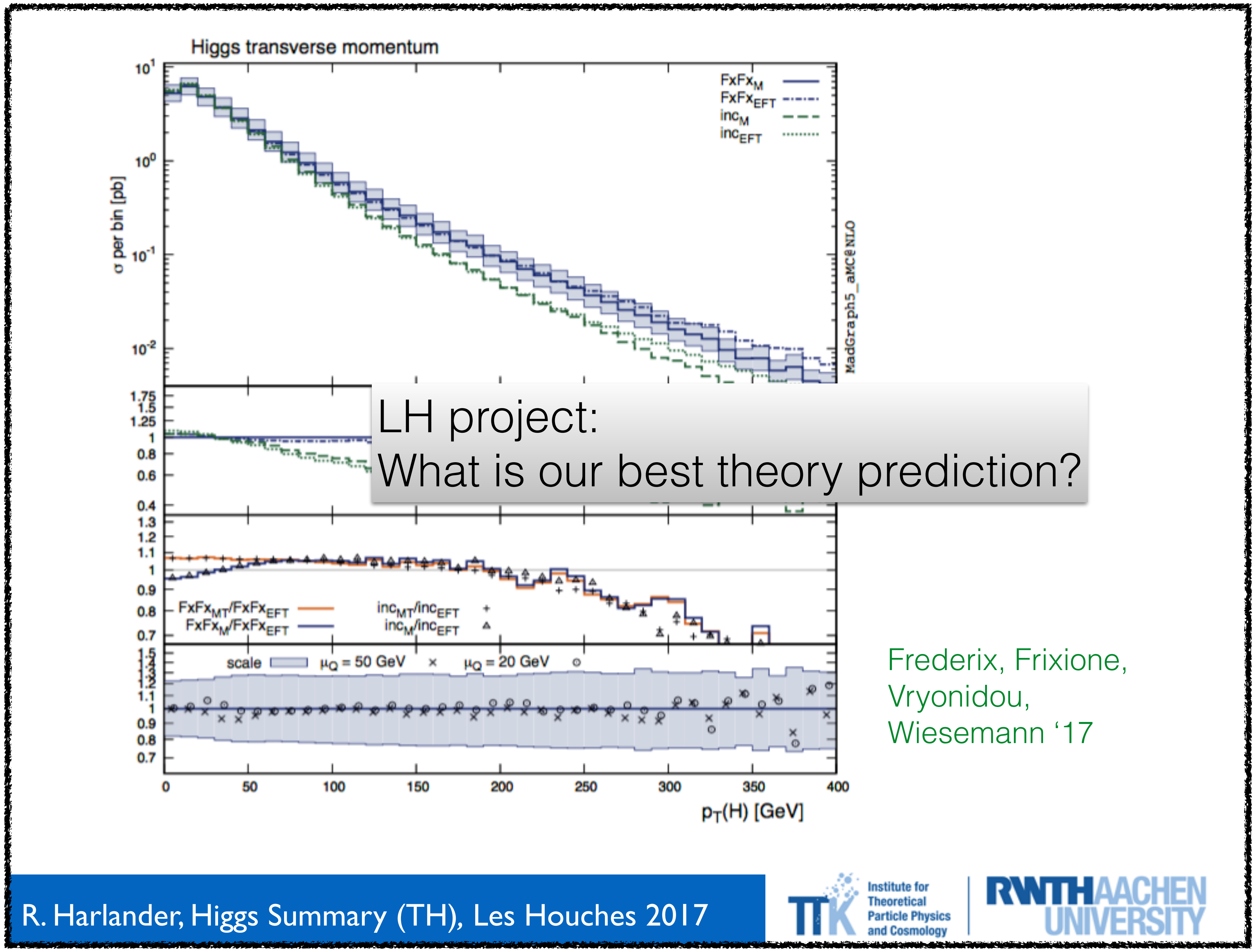
Other issues with modeling: boosted H



[R. Harlander, LH SM Higgs summary talk]

ONGOING LH EFFORT *(merged samples vs. approx LO vs. resummation)* [J. Bendavid et al]

TO BE COORDINATED WITH THE GGF WG

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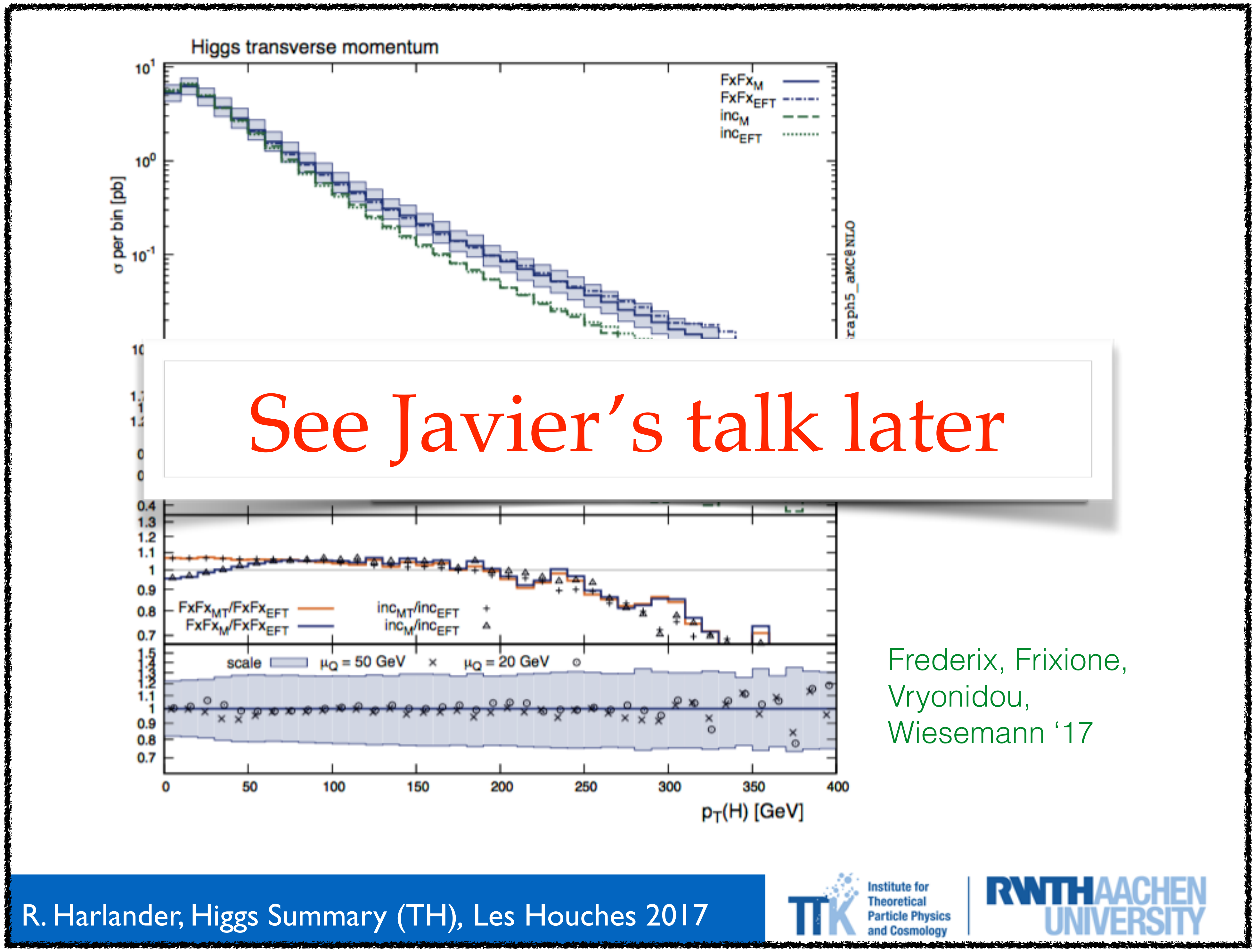

Frederix, Frixione, Vryonidou, Wiesemann '17

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Theory outlook

- Moving to differential distributions: Higgs p_T studies under way
  - Tune differences
  - Mass effects for $p_T \lesssim m_H$
  - Boosted region → LH
- First results are coming soon → meeting will follow shortly
- To be considered in the future:
  - Comparisons and assessment of different matching / resummation uncertainties in the small p_T region
  - More differential observables
  - ggF contamination in VBF (Hjjj@NLO studies…)
  - …

WG1 ggF activities

- Post YR4, focus of group has been to settle on recommendations for ggF perturbative uncertainties used by ATLAS and CMS Higgs measurements, e.g.
  - Higgs coupling, Simplified template cross sections
- Procedure

Interim 2017 uncertainty scheme

Documentation in preparation: LHCHXSWG-2017-001

9 independent sources of uncertainties

1. QCD scale variation
2. Resummation scale variation
3. 0 □ 1 jet migration
4. 1 □ 2 jets migration
5. VBF phase space
6. VBF phase space with 3rd jet veto
7. Higgs p_T 0-60/60-∞ GeV
8. Higgs p_T 60-120/120-∞ GeV
9. Finite top mass dependence: $p_T > m_t$

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9. Finite top mass dependence: $p_T > m_t$

Uncertainty on finite top mass effects.
Taken from difference between LO and NLO rescaling.

Jet bins: four sources
Taken from YR4, Tackmann et al.
Cross checked with JVE @N3LO

VBF topology uncertainties
Found consistent central values and uncertainties using Run-1 style, YR3 uncertainties (from MCFM + ST), and using GoSam+Sherpa HJJJ @ NLO

Uncertainties on the Higgs pT shape within a fixed jet multiplicity bin. Taken from QCD scale variations of Powheg NNLOPS

The inputs

Inputs from YR4 calculations

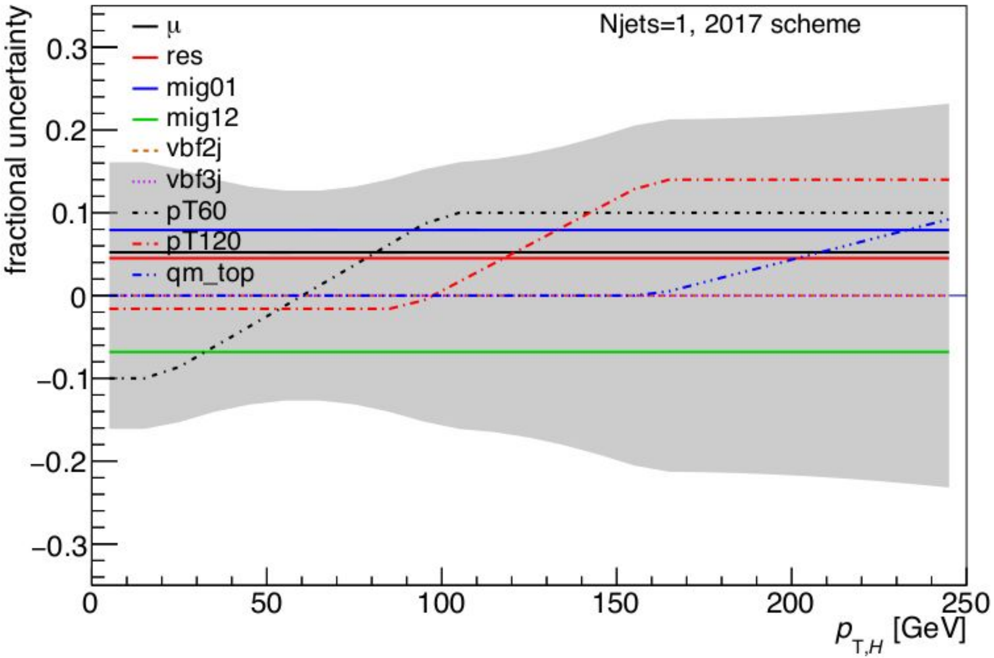
Table 20: Predictions for the 0/1/2-jet bins for $p_T^{cut} = 25$ GeV (top) and $p_T^{cut} = 30$ GeV (bottom).

$p_T^{cut} = 25$ GeV	σ/pb	Δ_μ	Δ_φ	$\Delta_{cut}^{0/1}$	$\Delta_{cut}^{1/2}$	total pert. unc.
$\sigma_{\geq 0}$	47.41±2.40	4.6%	2.0%	-	-	5.1%
σ_0	26.25±1.97	4.7%	0.6%	5.8%	-	7.5%
$\sigma_{\geq 1}$	21.16±1.96	4.5%	3.8%	7.1%	-	9.3%
σ_1	13.28±1.76	4.2%	3.3%	9.8%	7.2%	13.3%
$\sigma_{\geq 2}$	7.88±1.12	5.1%	4.6%	2.7%	12.2%	14.3%
$p_T^{cut} = 30$ GeV	σ/pb	Δ_μ	Δ_φ	$\Delta_{cut}^{0/1}$	$\Delta_{cut}^{1/2}$	total pert. unc.
$\sigma_{\geq 0}$	47.41±2.40	4.6%	2.0%	-	-	5.1%
σ_0	29.51±1.65	3.8%	0.1%	4.1%	-	5.6%
$\sigma_{\geq 1}$	17.90±1.88	6.0%	5.2%	6.8%	-	10.5%
σ_1	11.94±1.58	5.5%	4.8%	8.4%	7.2%	13.2%
$\sigma_{\geq 2}$	5.96±1.05	7.1%	6.1%	3.6%	14.5%	17.6%

Higgs p_T uncertainty from scale variation in Higgs p_T bins

Technical implementation: https://indico.cern.ch/event/618048/attachments/1430472/2204126/ggF_qcd_uncertainty_2017.cxx

The effects in specific phase spaces



Example of the different source of uncertainties on the Higg p_T in the 1 jet phase space

The effects in interesting regions

Different uncertainties

Different phase spaces

Cross sections and fractional uncertainties

STXS	sig	stat	mu	res	mig01	mig12	VBF2j	VBF3j	pT60	pT120	qm_top	Tot
Incl	48.52 +/-	0.00	+4.6%	+2.1%	-0.0%	-0.0%	+0.3%	-0.0%	+0.0%	+0.2%	+0.2%	+5.1%
FWDH	4.27 +/-	0.01	+4.5%	+1.9%	-0.5%	-0.2%	+0.0%	+0.0%	-0.3%	-0.1%	+0.0%	+4.9%
VBF_J3V	0.27 +/-	0.00	+0.0%	+0.0%	+0.0%	+0.0%	+20.0%	-32.0%	-1.6%	+1.1%	+0.1%	+37.8%
VBF_J3	0.36 +/-	0.00	+0.0%	+0.0%	+0.0%	+0.0%	+20.0%	+23.5%	-0.2%	+2.5%	+0.2%	+31.0%
=0J	27.25 +/-	0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+5.6%
=1J_0-60	6.49 +/-	0.01	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	-4.8%	-1.6%	+0.0%	+13.5%
=1J_60-120	4.50 +/-	0.01	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	+4.8%	-0.9%	+0.0%	+13.4%
=1J_120-200	0.74 +/-	0.00	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	+10.0%	+10.1%	+0.5%	+18.9%
=1J_200->	0.15 +/-	0.00	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	+10.0%	+14.0%	+10.5%	+23.7%
>=2J_0-60	1.22 +/-	0.01	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.0%	-5.9%	-1.6%	+0.0%	+23.3%
>=2J_60-120	1.86 +/-	0.01	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.0%	-0.2%	-0.2%	+0.0%	+22.5%
>=2J_120-200	0.99 +/-	0.00	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.0%	+6.6%	+10.6%	+0.6%	+25.8%
>=2J_200->	0.42 +/-	0.00	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.0%	+10.0%	+14.0%	+11.8%	+30.7%
=0J	30.12 +/-	0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+5.6%
=1J	12.92 +/-	0.02	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	-0.1%	-0.4%	+0.2%	+12.5%
>=2J	5.47 +/-	0.01	+7.8%	+7.8%	+3.9%	+16.1%	+2.3%	-0.0%	+0.4%	+2.9%	+1.1%	+20.3%
>=1J 60-200	9.09 +/-	0.01	+6.2%	+5.8%	+6.4%	+1.9%	+0.9%	+0.1%	+4.2%	+1.7%	+0.1%	+11.8%
>=1J 120-200	1.96 +/-	0.01	+6.8%	+6.5%	+5.5%	+6.9%	+1.5%	+0.4%	+8.0%	+10.4%	+0.6%	+18.5%
>=1J >200	0.58 +/-	0.00	+7.9%	+7.7%	+5.4%	+11.6%	+0.0%	+0.0%	+10.0%	+14.0%	+11.4%	+26.7%
>=1J >60	9.68 +/-	0.01	+6.3%	+5.9%	+6.3%	+2.5%	+0.8%	+0.1%	+4.6%	+2.5%	+0.8%	+12.2%
>=1J >120	2.54 +/-	0.01	+7.0%	+6.8%	+5.5%	+8.0%	+1.2%	+0.3%	+8.4%	+11.2%	+3.0%	+19.9%
>=1	18.40 +/-	0.02	+6.0%	+5.5%	+6.7%	-0.0%	+0.7%	-0.0%	+0.0%	+0.5%	+0.4%	+10.6%

The effects in interesting regions (example)

Different uncertainties

Different phase spaces

Cross sections and fractional uncertainties

STXS	sig	stat	mu	res	mig01	mig12	VBF2j	VBF3j	pT60	pT120	qm_top	Tot
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FWDH	4.27	+/- 0.01	+4.5%	+1.9%	-0.5%	-0.2%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
VBF_J3V	0.27	+/- 0.00	+0.0%	+0.0%	+0.0%	+0.0%	+20.0%	-32.	[illegible]	[illegible]	[illegible]	[illegible]
VBF_J3	0.36	+/- 0.00	+0.0%	+0.0%	+0.0%	+0.0%	+20.0%	+23.	[illegible]	[illegible]	[illegible]	[illegible]
=0J	27.25	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
=1J_0-60	6.49	+/- 0.01	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
=1J_60-120	4.50	+/- 0.01	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
=1J_120-200	0.74	+/- 0.00	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
=1J_200->	0.15	+/- 0.00	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
>=2J_0-60	1.22	+/- 0.01	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
>=2J_60-120	1.86	+/- 0.01	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
>=2J_120-200	0.99	+/- 0.00	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
>=2J_200->	0.42	+/- 0.00	+8.9%	+8.9%	+4.4%	+18.2%	+0.0%	+0.	[illegible]	[illegible]	[illegible]	[illegible]
=0J	30.12	+/- 0.03	+3.8%	+0.1%	-4.1%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+0.0%	+5.6%
=1J	12.92	+/- 0.02	+5.2%	+4.5%	+7.9%	-6.8%	+0.0%	+0.0%	-0.1%	-0.4%	+0.2%	+12.5%
>=2J	5.47	+/- 0.01	+7.8%	+7.8%	+3.9%	+16.1%	+2.3%	-0.0%	+0.4%	+2.9%	+1.1%	+20.3%
>=1J 60-200	9.09	+/- 0.01	+6.2%	+5.8%	+6.4%	+1.9%	+0.9%	+0.1%	+4.2%	+1.7%	+0.1%	+11.8%
>=1J 120-200	1.96	+/- 0.01	+6.8%	+6.5%	+5.5%	+6.9%	+1.5%	+0.4%	+8.0%	+10.4%	+0.6%	+18.5%
>=1J >200	0.58	+/- 0.00	+7.9%	+7.7%	+5.4%	+11.6%	+0.0%	+0.0%	+10.0%	+14.0%	+11.4%	+26.7%
>=1J >60	9.68	+/- 0.01	+6.3%	+5.9%	+6.3%	+2.5%	+0.8%	+0.1%	+4.6%	+2.5%	+0.8%	+12.2%
>=1J >120	2.54	+/- 0.01	+7.0%	+6.8%	+5.5%	+8.0%	+1.2%	+0.3%	+8.4%	+11.2%	+3.0%	+19.9%
>=1	18.40	+/- 0.02	+6.0%	+5.5%	+6.7%	-0.0%	+0.7%	-0.0%	+0.0%	+0.5%	+0.4%	+10.6%

0 □ 1 jet migration uncertainty will migrate events from 0 and 1 jet bin

Summary

Documentation in preparation with the prescription and the validation

LHCHXSWG-2017-001

- Samples to match NNLOPS to apply the prescription
- Validation of the prescription working for the STXS binning
  - If new variables are used, careful check of the uncertainties: validation with most accurate prediction
- We are using the most up-do-date uncertainties, and associating to NNLOPS
  - Be careful

Backup

Old slide

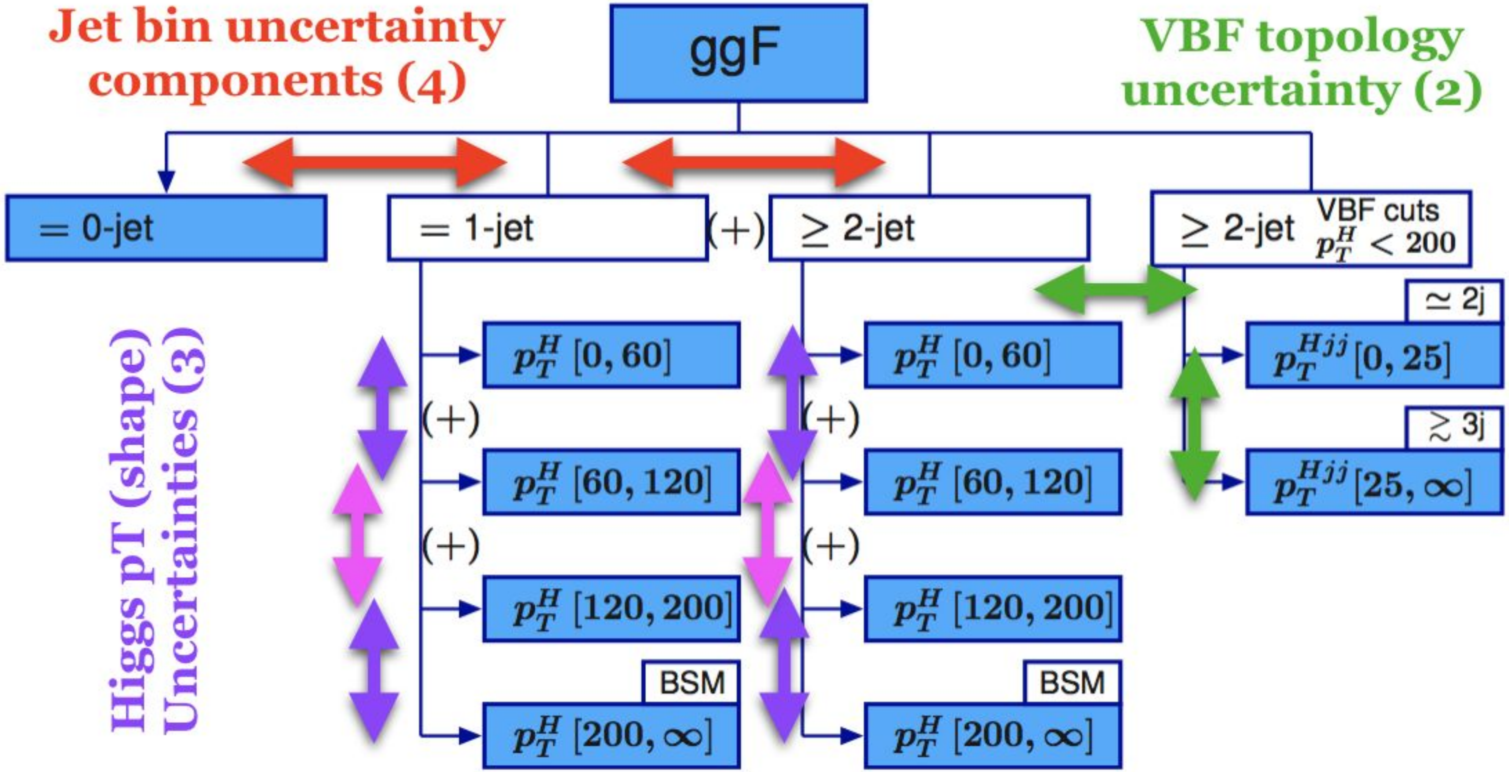
- Here extending the proposed scheme presented in last WG1 meeting in November
- Jet bin uncertainties evaluated according to the BLPTW scheme of YR4:

$p_T^{\rm cut} = 30$ GeV	σ/pb	Δ_μ	Δ_φ	$\Delta_{\rm cut}^{0/1}$	$\Delta_{\rm cut}^{1/2}$	total pert. unc.
$\sigma_{\geq 0}$	47.41±2.40	4.6%	2.0%	-	-	5.1%
σ_0	29.51±1.65	3.8%	0.1%	4.1%	-	5.6%
$\sigma_{\geq 1}$	17.90±1.88	6.0%	5.2%	6.8%	-	10.5%
σ_1	11.94±1.58	5.5%	4.8%	8.4%	7.2%	13.2%
$\sigma_{\geq 2}$	5.96±1.05	7.1%	6.1%	3.6%	14.5%	17.6%

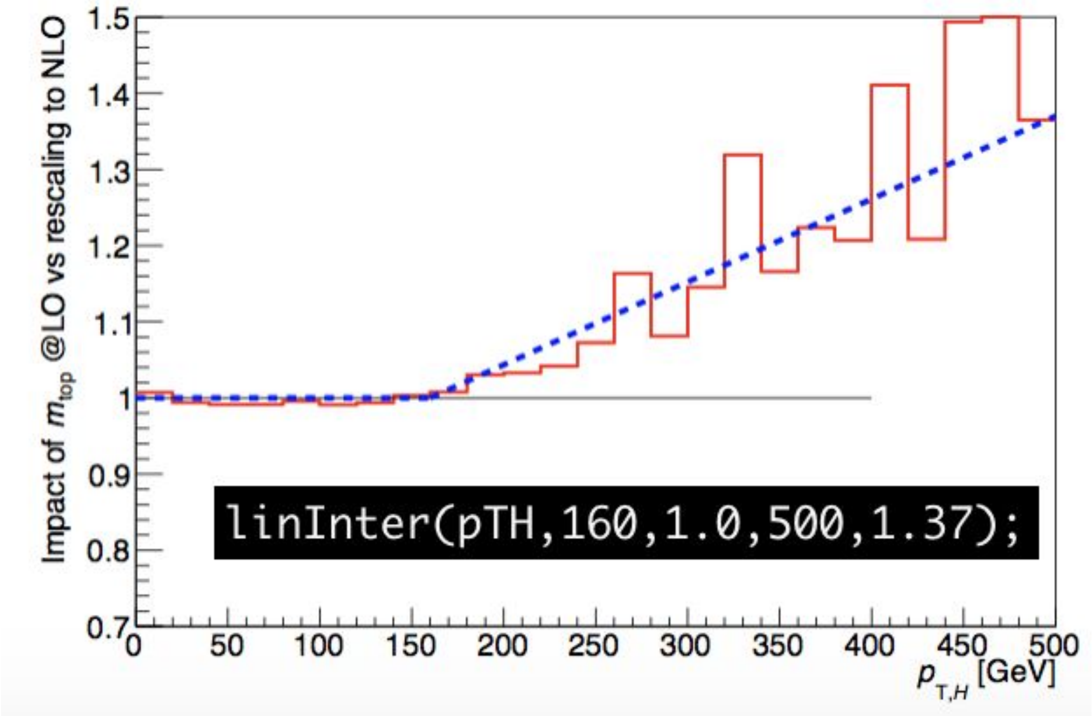
QCD uncertainty split into 4 independent sources
normalization
resummation
0⟷1 jet migration
1⟷2 jet migration

  - Accounts for uncertainties and migrations between the =0, =1 and >=2 jet bins
- Uncertainties also needed for:
  - Higgs p_T spectrum within a given jet bin
  - Quark mass treatment in ggF loop, if significant wrt QCD scale uncertainties
  - VBF region

Old slide 2


Jet bin uncertainty components (4)
ggF
VBF topology uncertainty (2)
= 0-jet
= 1-jet
(+)
≥ 2-jet
≥ 2-jet
VBF cuts
$p_T^H < 200$
≃ 2j
≳ 3j
Higgs pT (shape) Uncertainties (3)
p_T^H [0, 60]
p_T^H [60, 120]
p_T^H [120, 200]
BSM
p_T^H [200, ∞]
p_T^{Hjj} [0, 25]
p_T^{Hjj} [25, ∞]

NP number 9 ...



Impact of m_{top} @LO vs rescaling to NLO
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0
50
100
150
200
250
300
350
400
450
500
$p_{T,H}$ [GeV]
linInter(pTH,160,1.0,500,1.37);