Higgs Production via VBF: Comparison Between Generators

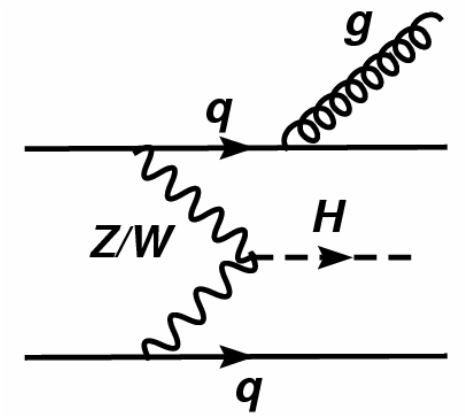
B.Mellado

On behalf of S.Asai, Y.Fang, W.Quayle, M.Schumacher, J.Tanaka, G.Unal and Sau Lan Wu (from ATLAS HWG)

Special thanks to J.Campbell and T.Sjostrand

MC4LHC Workshop 18/07/06

- We were working with Torbjorn to evaluate the performance of the parton shower within the new 6.3 releases
- We are evaluating the performance of various settings within the context of VBF

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C...IMODEL = 1 : New UE model, pT-ordered showers.
C...             Small FSR radiation scale, smooth turnoff ISR.
C...             NB: Must be run with Pythia 6.312+higher using PYEVNW.
C...IMODEL = 2 : New UE model, pT-ordered showers.
C...             Large FSR radiation scale, smooth turnoff ISR.
C...             NB: Must be run with Pythia 6.312+higher using PYEVNW.
C...IMODEL = 3 : New UE model, pT-ordered showers.
C...             Large FSR radiation scale, sharp cutoff ISR.
C...             NB: Must be run with Pythia 6.312+higher using PYEVNW.
C...IMODEL = 4 : New UE model, no interleaving, Q2-ordered showers.
C...             "Rap tune".
C...             NB: Must be run with Pythia 6.312+higher using PYEVNT.
C...IMODEL = 5 : Old (6.2-type) UE model, Q2-ordered showers.
C                "Tune A".
C...             NB: Can be run with Pythia 6.2 or 6.312+higher
C...             using PYEVNT.
C - Models for investigating energy rescaling dependence (eg for LHC).
C...IMODEL = 6 : New UE model, pT-ordered showers.
C...             Energy rescaling pace slower than for Tune A.
C...             NB: Must be run with Pythia 6.312+higher using PYEVNW.
C...IMODEL = 7 : Old (6.2-type) UE model, Q2-ordered showers.
C                "Tune A", but with slower energy rescaling pace.
C...             NB: Can be run with Pythia 6.2 or 6.312+higher using
C...             PYEVNT.
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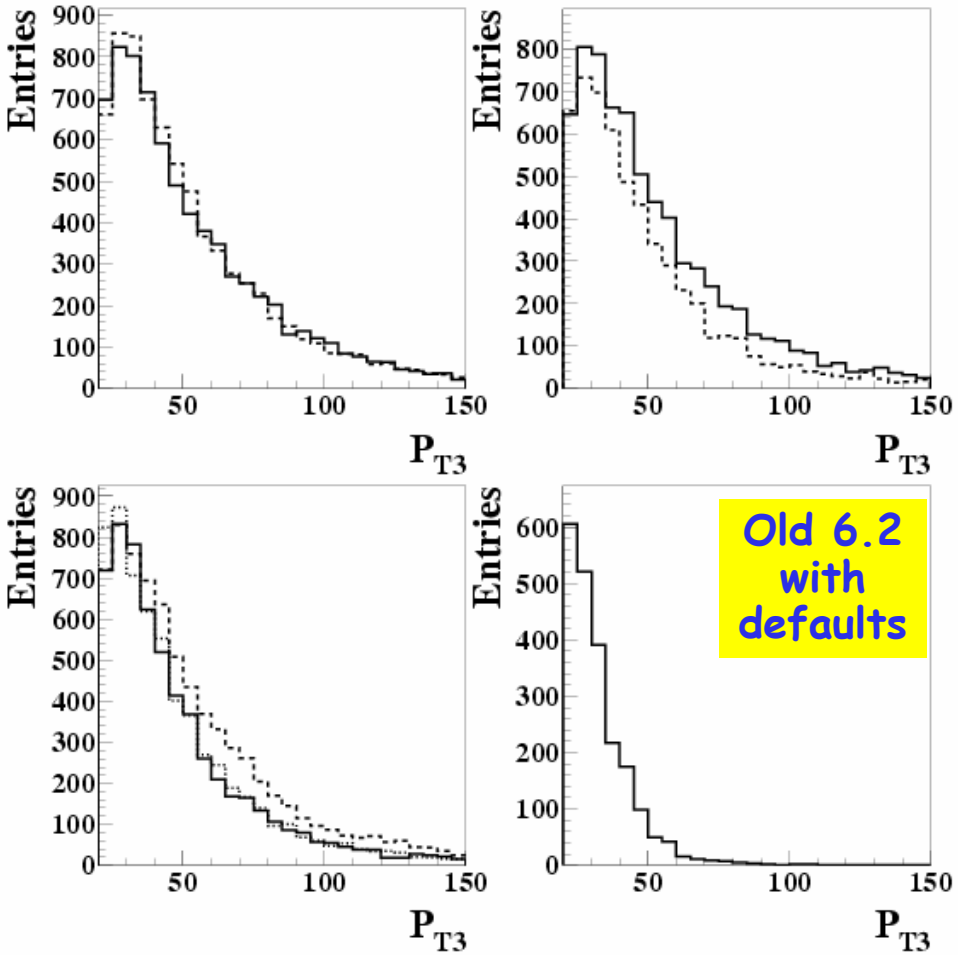
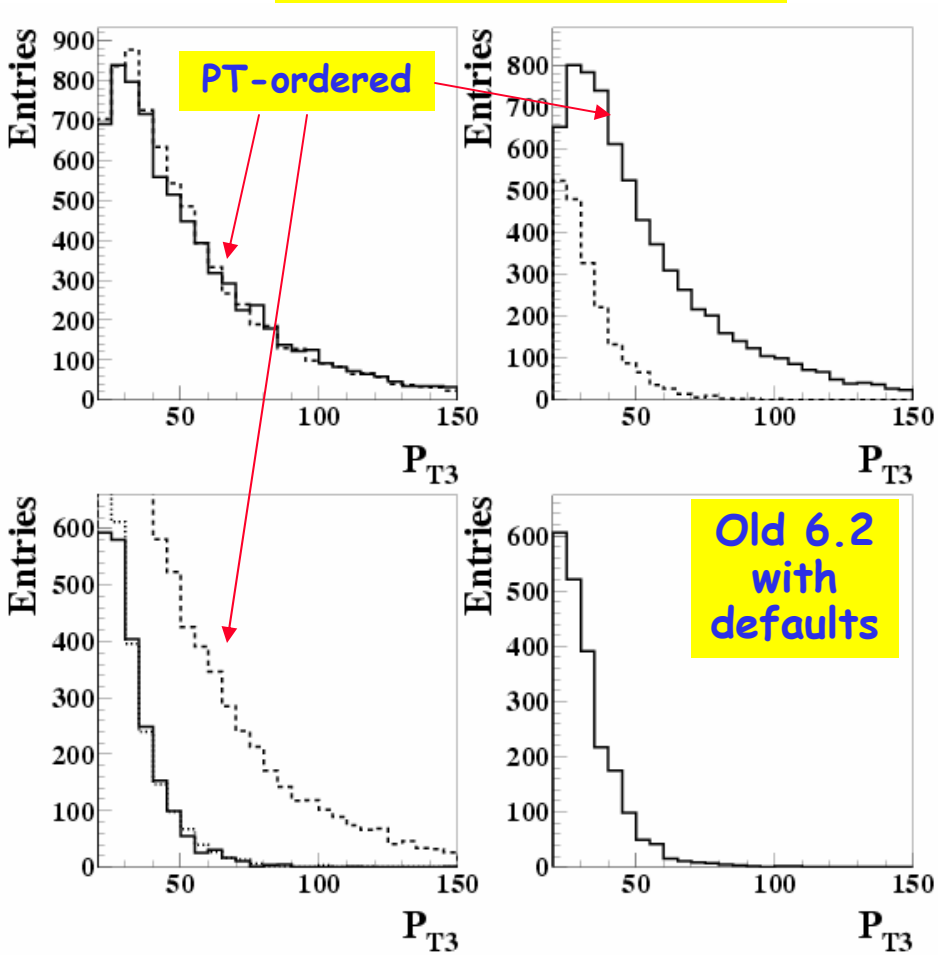
- First seven curves correspond to the settings specified in page 2

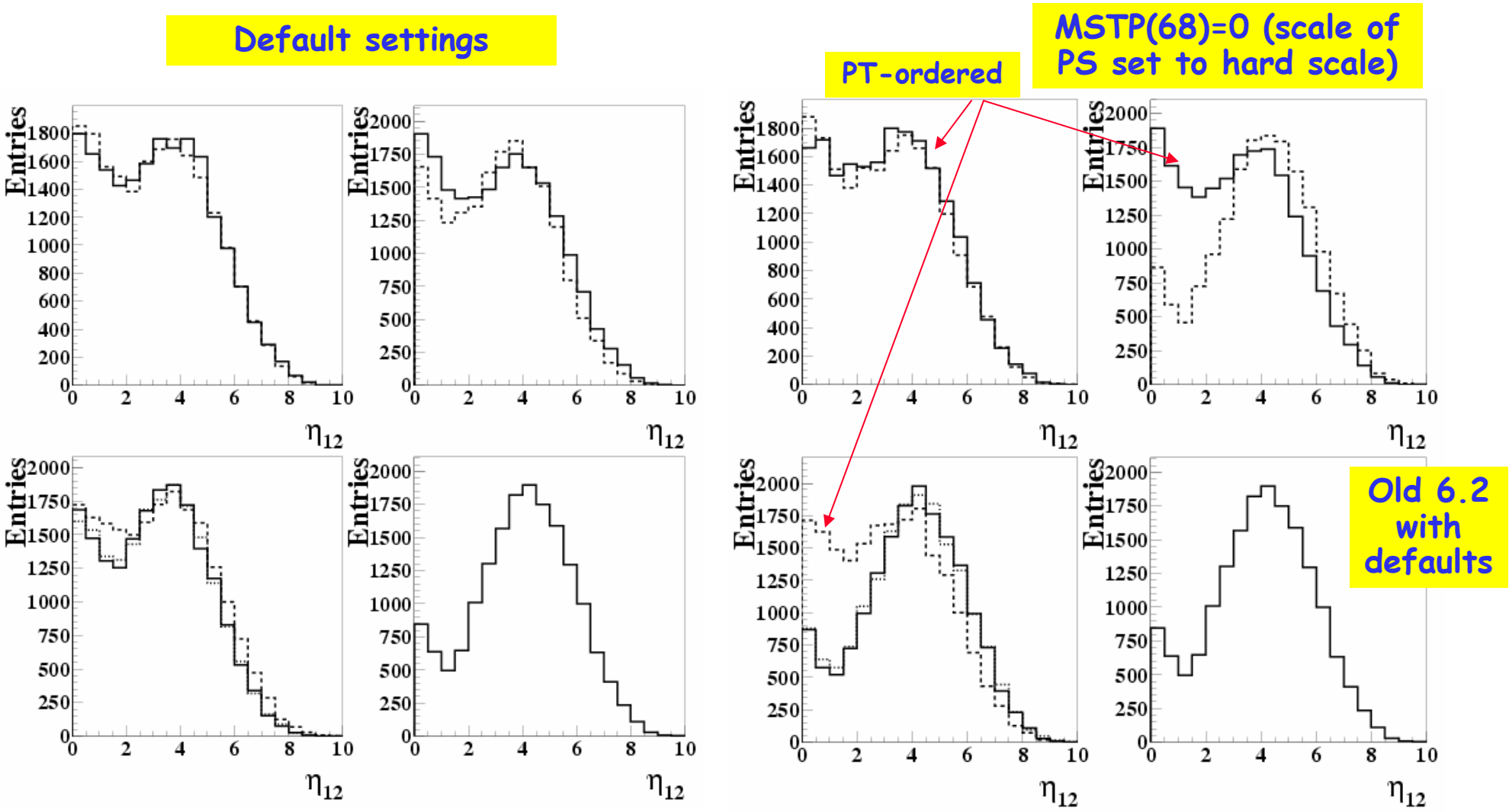
Default settings

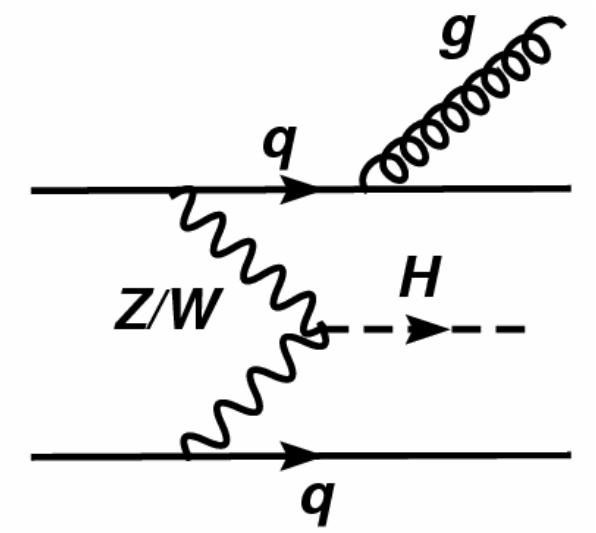


MSTP(68)=0 (scale of PS set to hard scale)

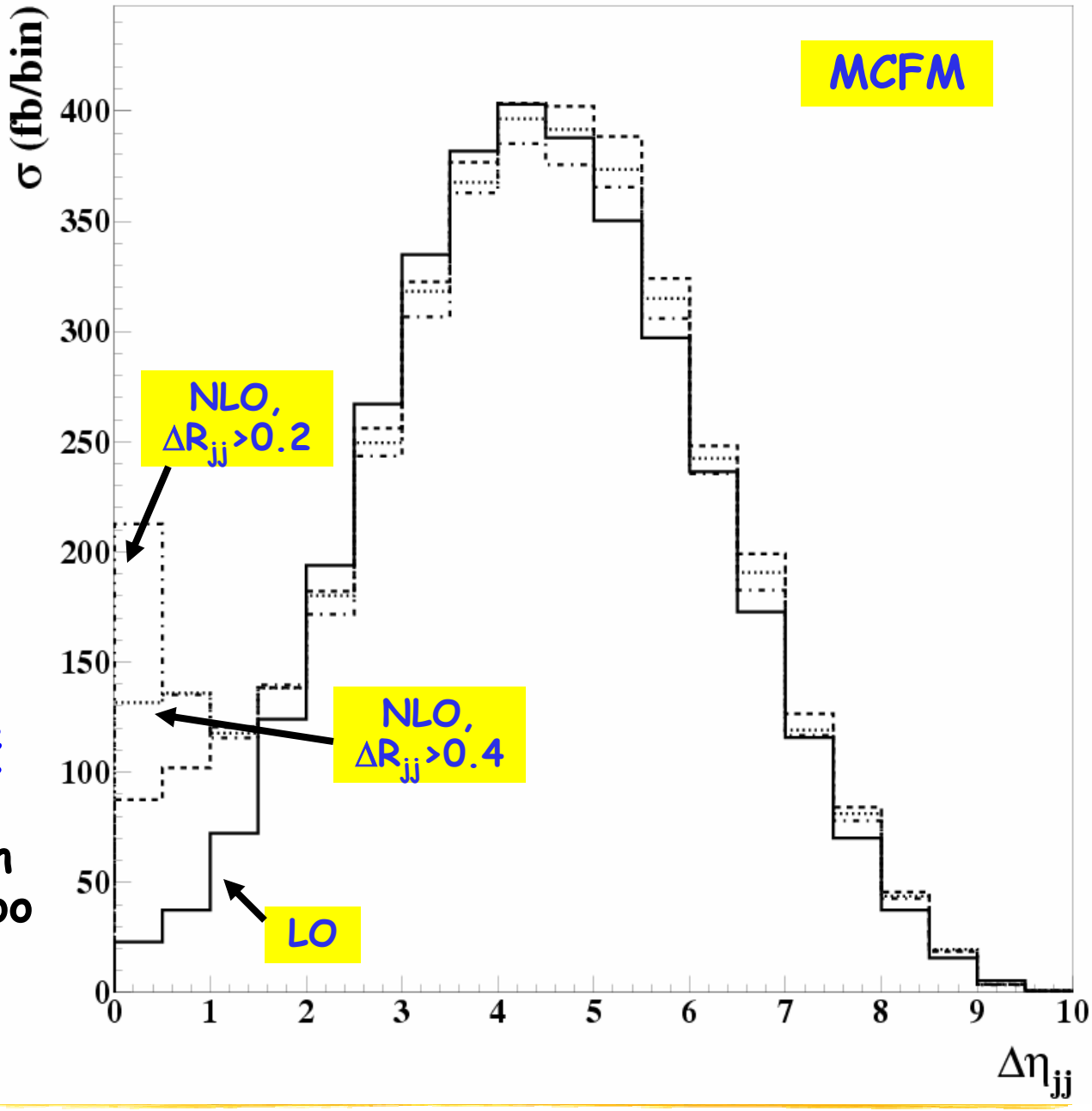


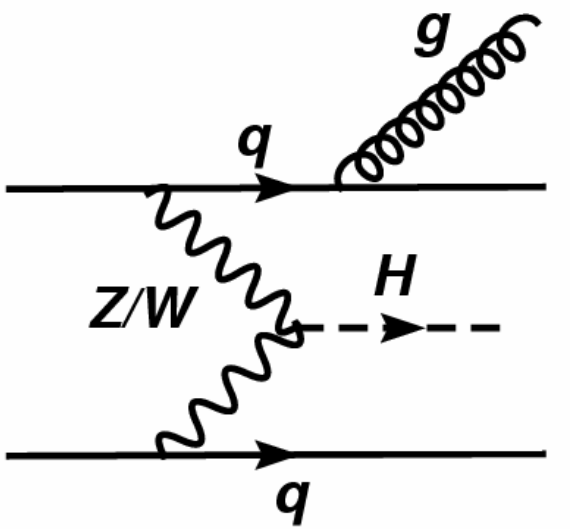
First seven curves correspond to the settings specified in page 3



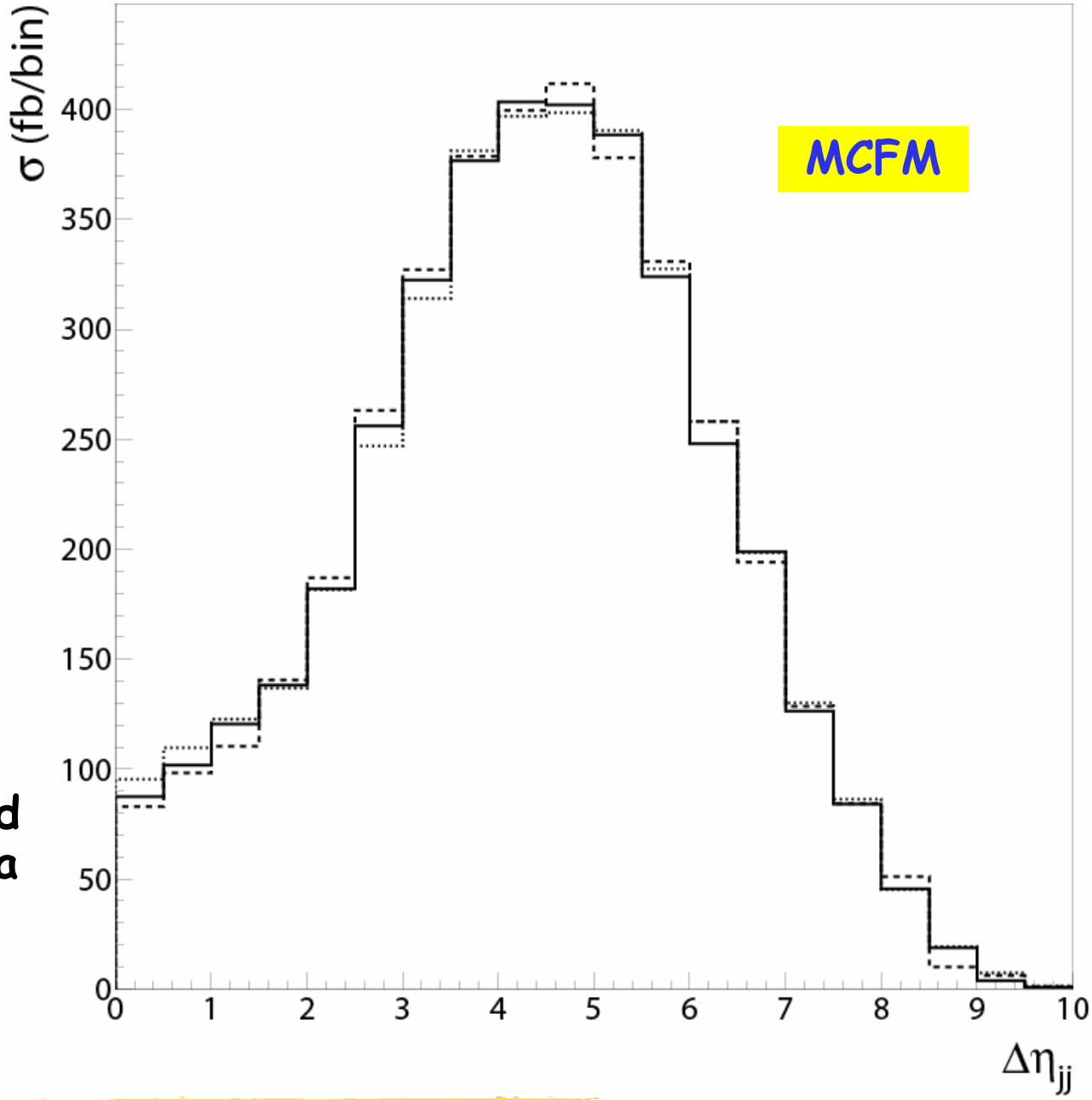


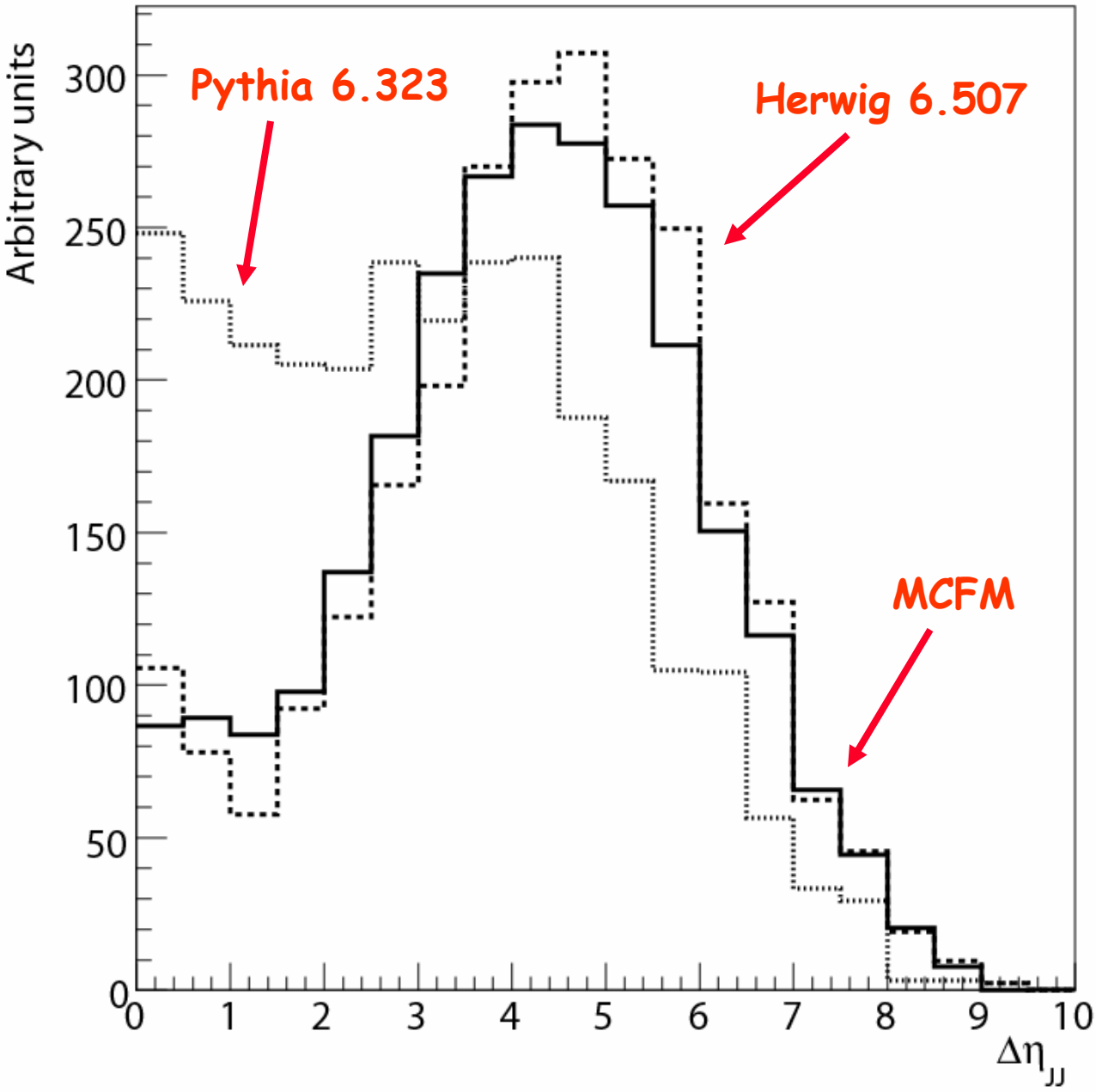
- Parton Shower is supposed to absorb the collinear divergence one observes using NLO ME
  - It seems like the PS in PYTHIA is radiating too many collinear jets





- **Scale dependence of distribution is very small according to MCFM**
  - Vary renormalization and factorization scales by a factor of 2 and 1/2




Pythia 6.323
Herwig 6.507
MCFM
Arbitrary units
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
$\Delta\eta_{JJ}$

MC event samples and selection

- PYTHIA 6.2 / Rome M_H=115 GeV
- PYTHIA 6.3 / CSC M_H=120 GeV
- HERWIG / CSC M_H=120 GeV
- VBFNLO M_H=120 GeV

  (V. Hankle, B. Jäger, D. Zeppenfeld et al.)

  calculates NLO distributions , no MC event generator

selection: at least 2 jets with pt>15 GeV

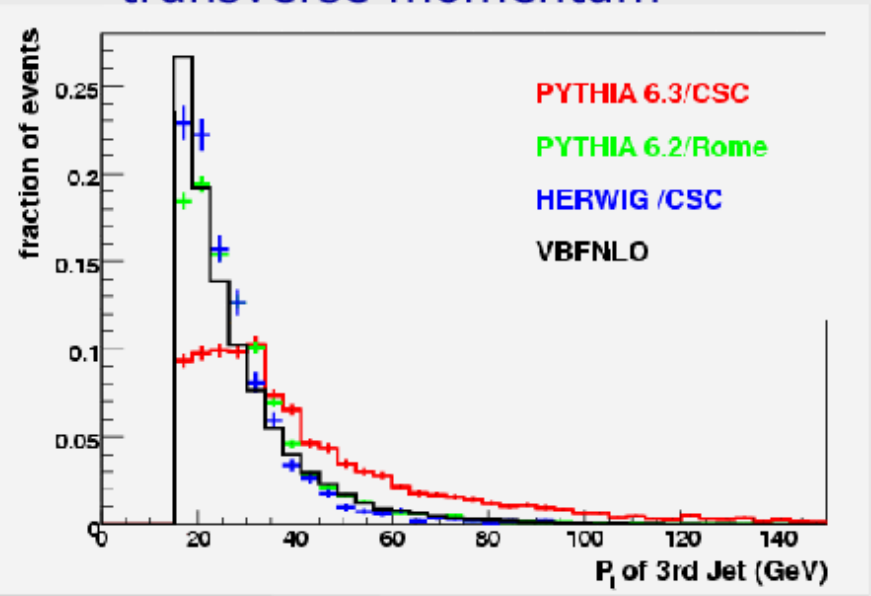
PYTHIA/HERWIG: ATLFAST jets / cone 0.4 including PS and UE

VBFNLO : truth jets on parton level / (naive) cone 0.4

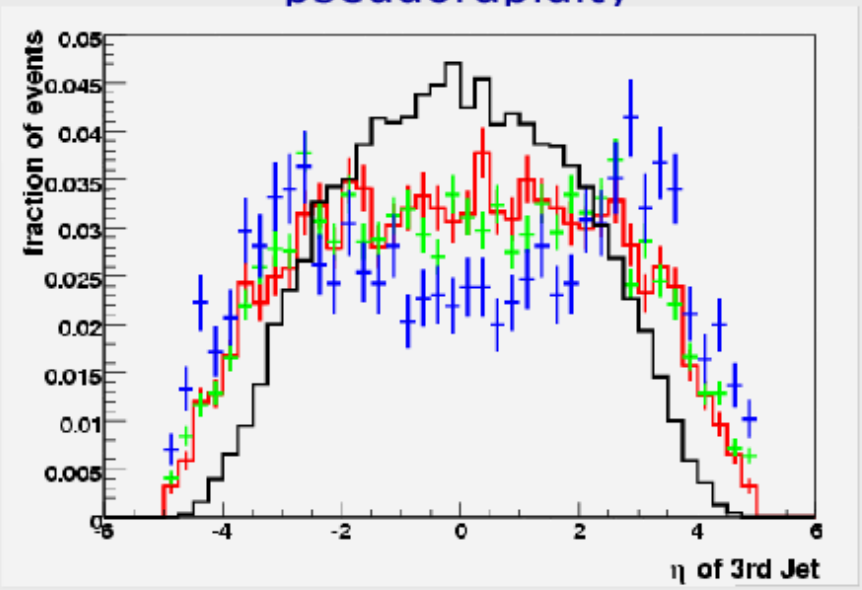
all figures normalised to unity → only comparison of shapes

Third jet, rapidity gap and „Zeppenfeld" variable

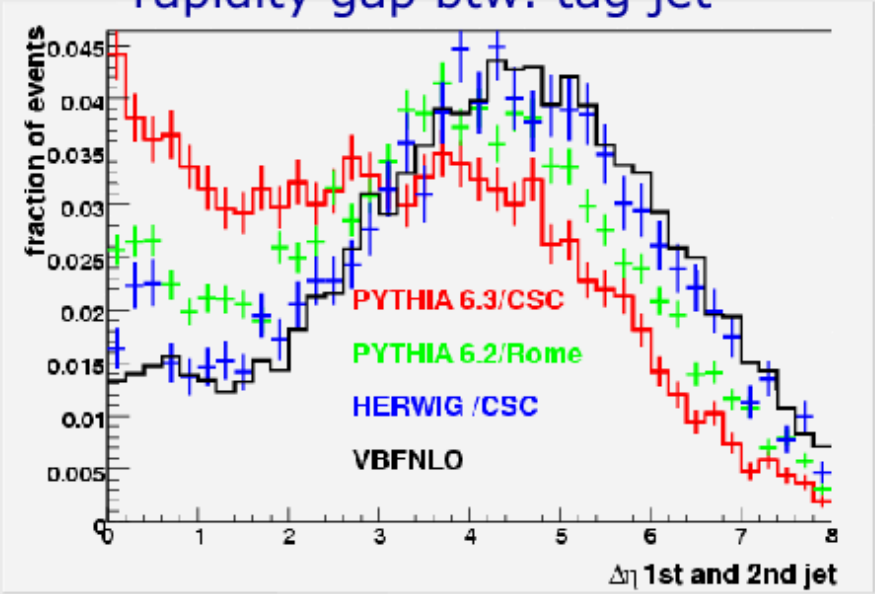
transverse momentum



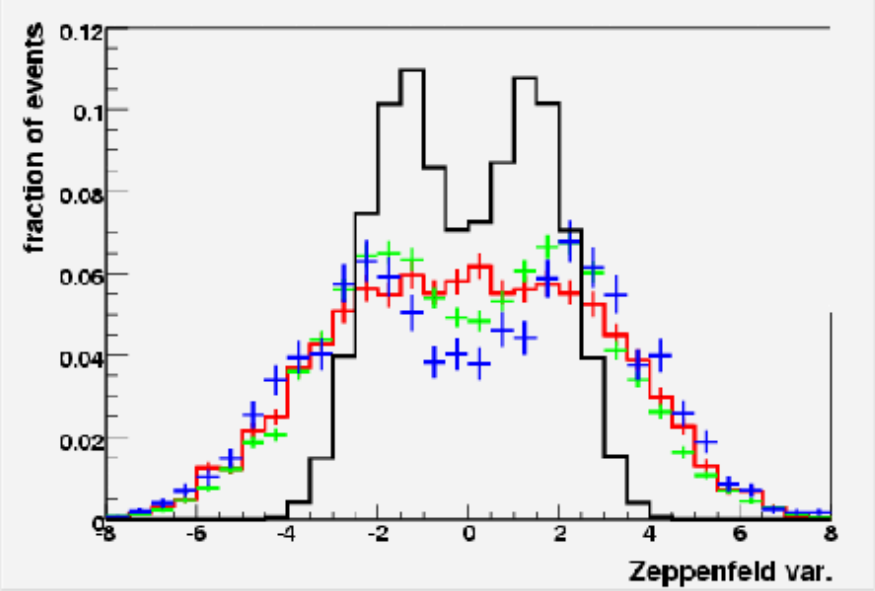
pseudorapidity



rapidity gap btw. tag jet

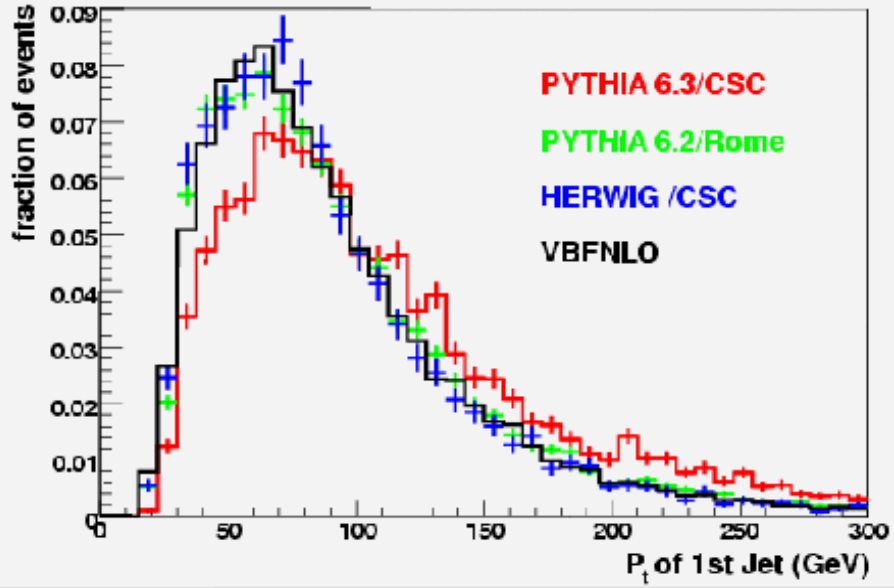


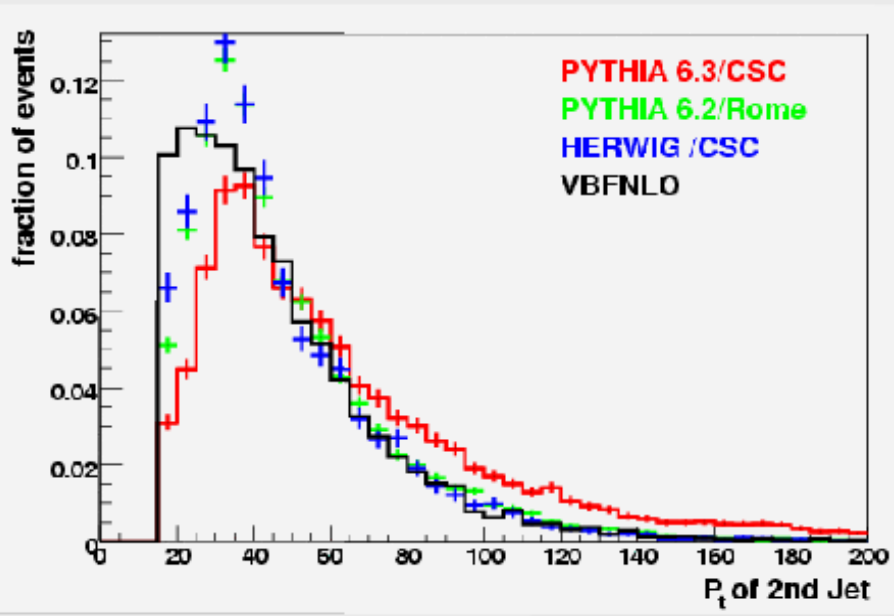
„Zeppenfeld" variable



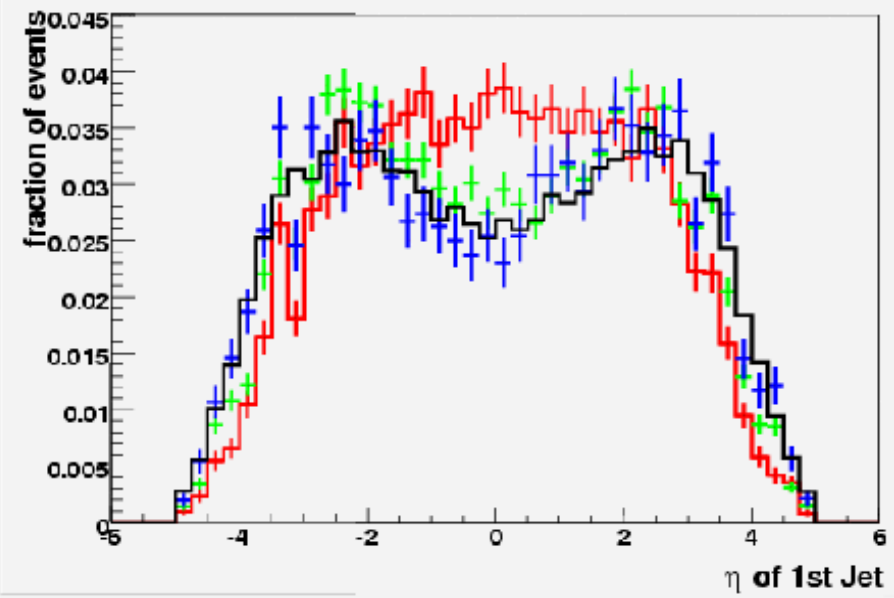
Tagging jets (two highest pt jets)

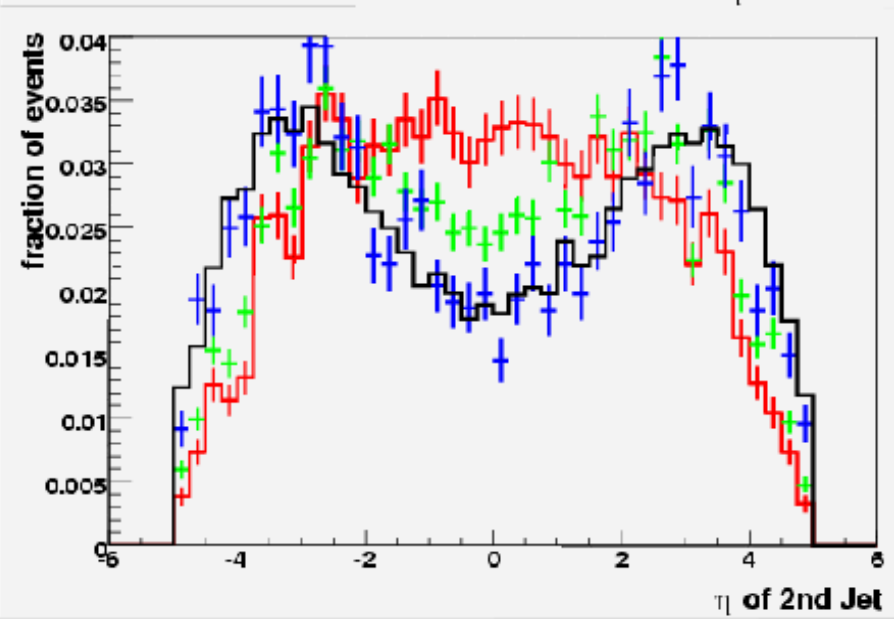
transverse momentum

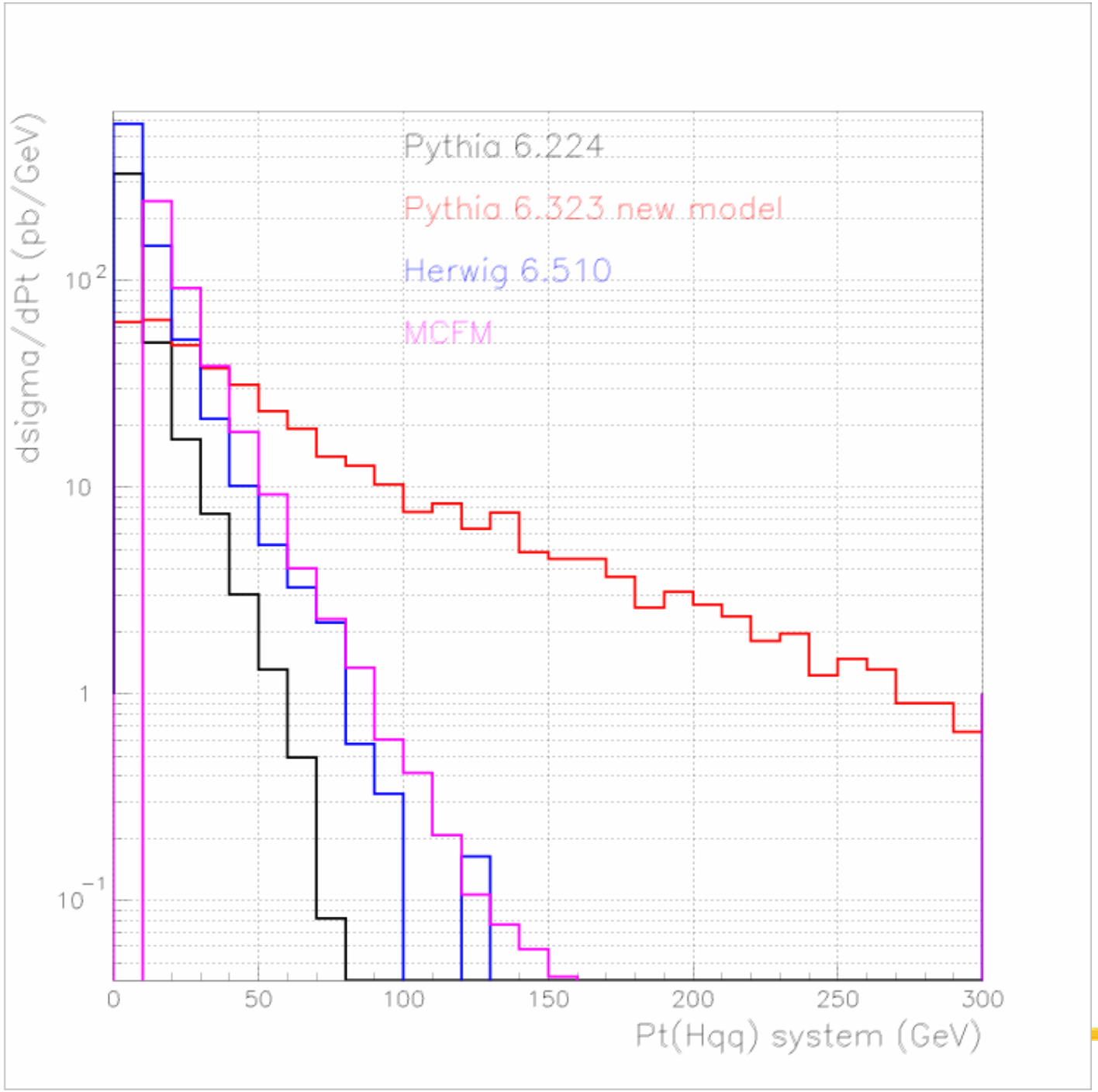




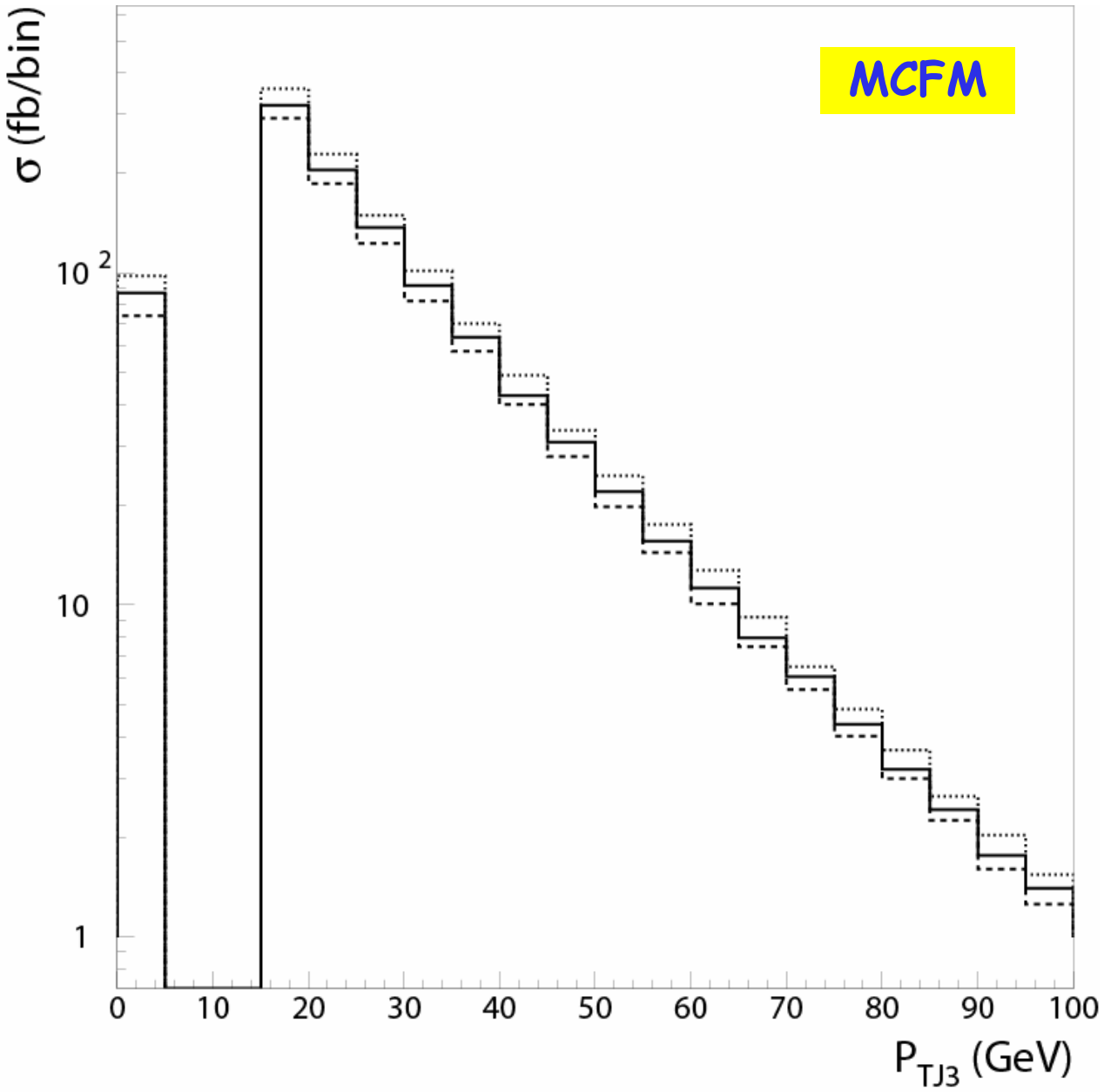
pseudorapidity





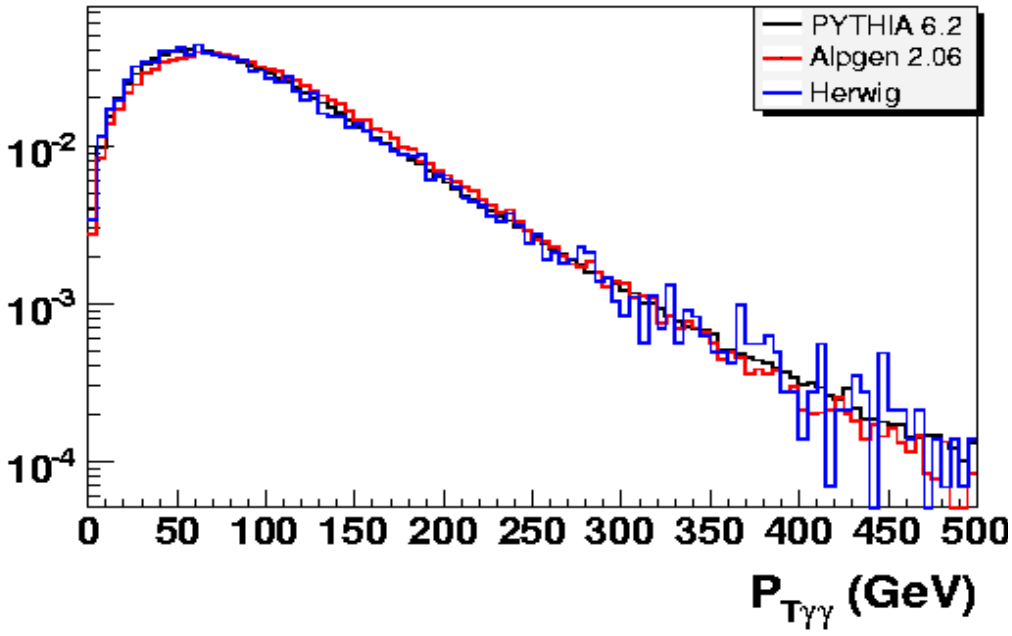

Pythia 6.224
Pythia 6.323 new model
Herwig 6.510
MCFM
dsigma/dPt (pb/GeV)
10^2
10
1
10^{-1}
0
50
100
150
200
250
300
Pt(Hqq) system (GeV)

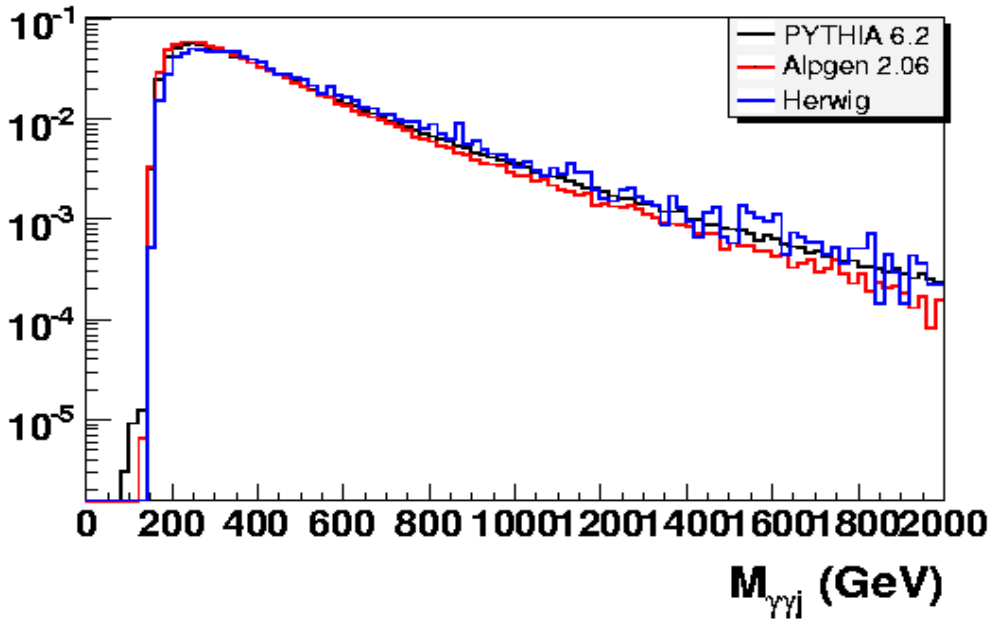
- **Scale dependence with MCFM**
  - Vary renormalization and factorization scales by a factor of 2 and 1/2



Comparison with ALPGEN

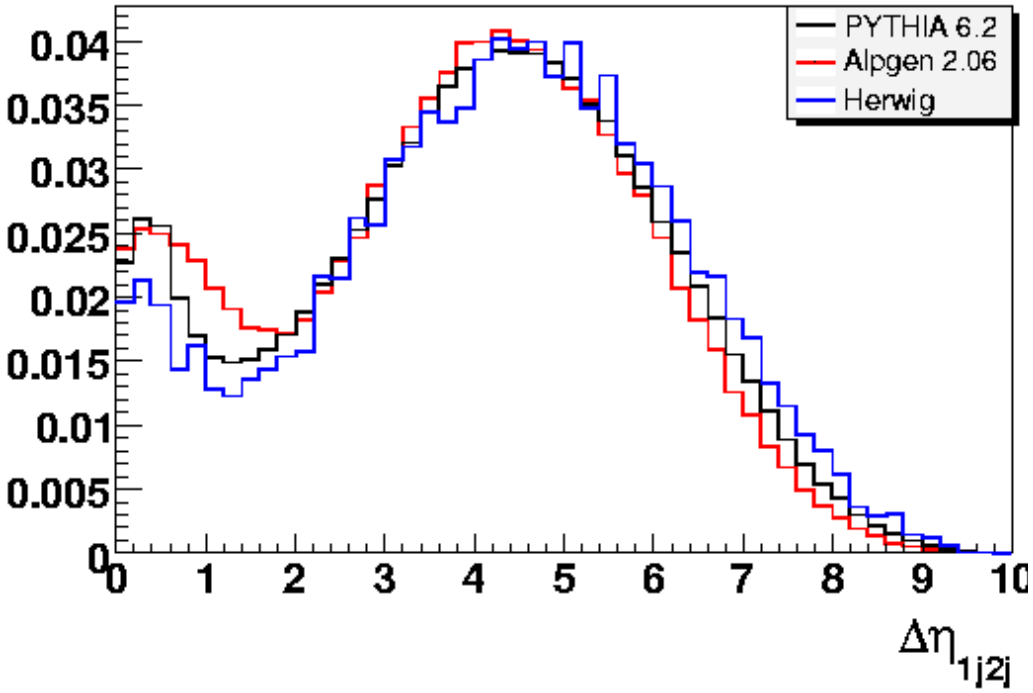
Preselection cuts: $P_{T\gamma 1,T\gamma 2}$>20 GeV $P_{TJ1,J2}$>20GeV

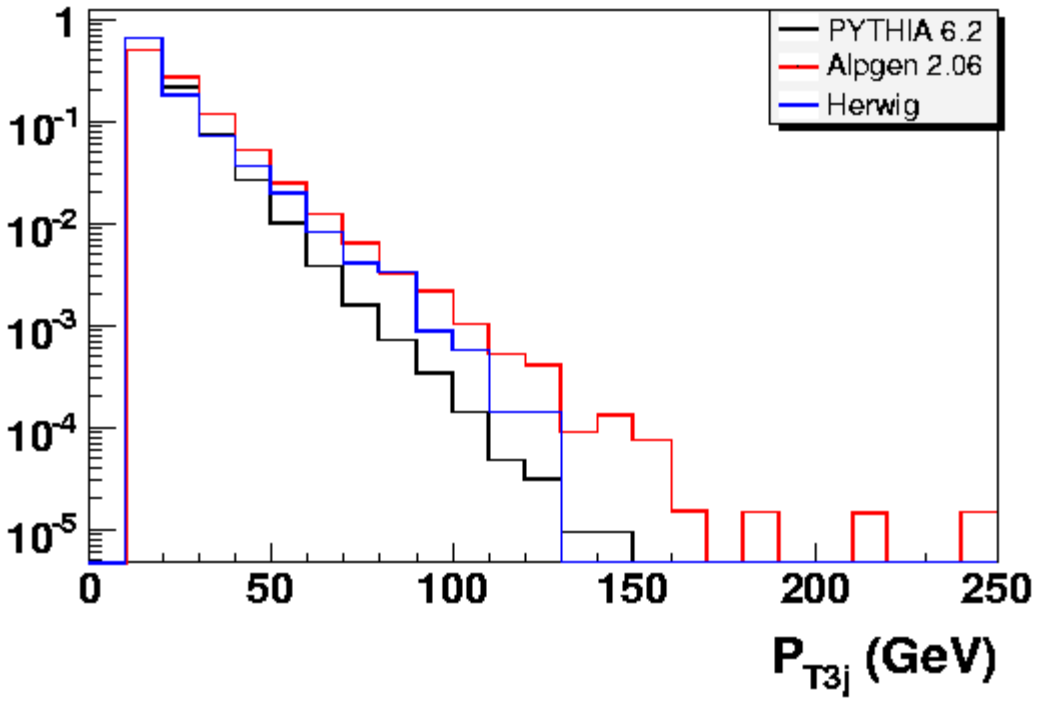




Comparison with ALPGEN (cont)

Preselection cuts: $P_{T\gamma 1,T\gamma 2}$>20 GeV $P_{TJ1,J2}$>20GeV





Cut flow in H+2jet Analysis

a	$P_{T\gamma 1}$>57 GeV, $P_{T\gamma 2}$>34 GeV, $\Delta\eta_{\gamma\gamma}$<1.58
b	$\eta_{J1} \bullet \eta_{J2}$<0, P_{TJ1}>40 GeV, P_{TJ2}>30 GeV, $\Delta\eta_{JJ}$>3.9
c	Photons in between tagging jets
d	M_{JJ}>610 GeV
e	Central jet veto (P_{TJ}>20 GeV $\|\eta\|$<3.2)
f	Mass window (±2 GeV)

VBF	a	b	c	d	e	f	Overall eff.
Pythia (6.2)	0.738	0.416	0.967	0.806	0.749	0.904	0.162
Herwig	0.720	0.449	0.978	0.826	0.605	0.904	0.142
Alpgen H+2j(exclu)	*0.735*	*0.487*	*0.970*	*0.810*	*0.905*	*0.900*	
Alpgen H+3j(inclu)	*0.744*	*0.289*	*0.966*	*0.796*	*0.264*	*0.895*	
Alpgen all	0.737	0.442	0.969	0.812	0.810	0.901	0.187