Single-top W* analysis using AcerMC

A. Lucotte, A. Lleres

LPSC Grenoble

Selection reminder

- W* signal efficiency
- Main backgrounds

Comparisons TopRex vs AcerMC

- W* signal
- Wg channel
- Wt channel
- Wbb
- Ttbar

Conclusion

Selection of W* events : reminder

Selection Criteria

$p_T^{lep} \geq$ 25 GeV/c , $mE_T \geq$ 25 GeV/c

2^{nd} lep veto

$2 \leq N(jet) \leq 3$ with $p_T^{jet} \geq$ 30 GeV/c

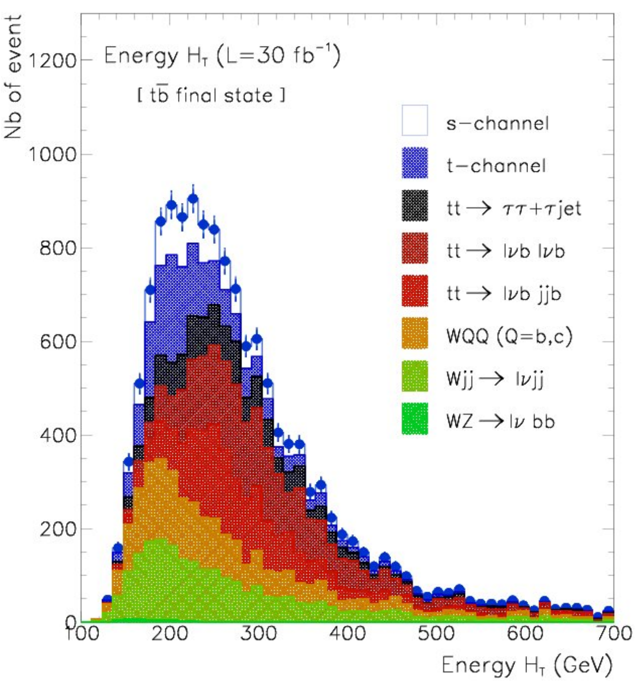
N(b jet) = 2 with $p_T^{jet} \geq$ 35 GeV/c

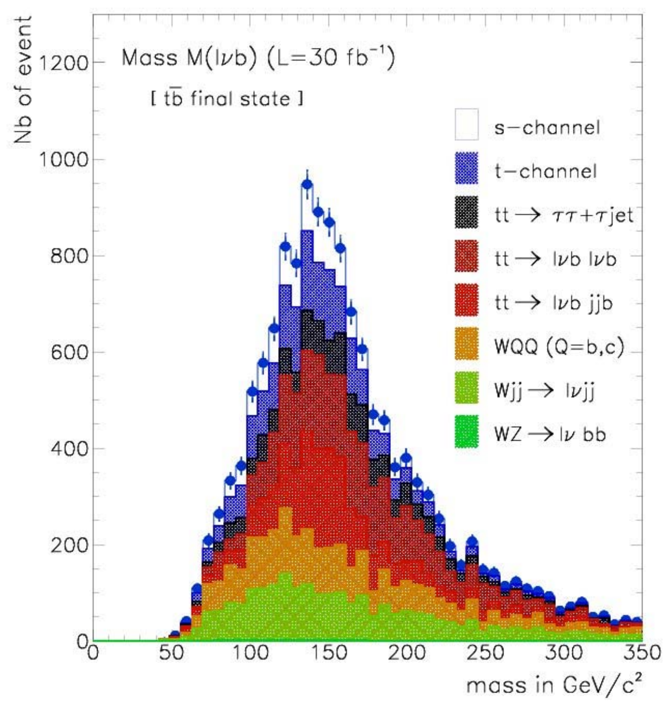
→ Window on H_T and on $M_{l\nu b}$

Ajust S/B & to reduce W+jets,tt

Performance

Signal efficiency ~1-2% & S/B ~ 10-15%





Dominated by systematics:

$$\Delta\sigma/\sigma = 9\%_{stat} \pm 10\%_{exp} \pm 8\%_{bckgd} \pm 5\%_{lumi}$$

ISR/FSR
b-tag
JES

Uncertainty in bckgd:
ttbar, W+jets,Wg

Selection of W* events : reminder

Selection Criteria

$p_T^{lep} \geq$ 25 GeV/c , $mE_T \geq$ 25 GeV/c

2^{nd} lep veto

$2 \leq N(jet) \leq 3$ with $p_T^{jet} \geq$ 30 GeV/c

N(b jet) = 2 with $p_T^{jet} \geq$ 35 GeV/c

→ Window on H_T and on $M_{l\nu b}$

Ajust S/B & to reduce W+jets,tt

Performance

Signal efficiency ~1-2% & S/B ~ 10-15%

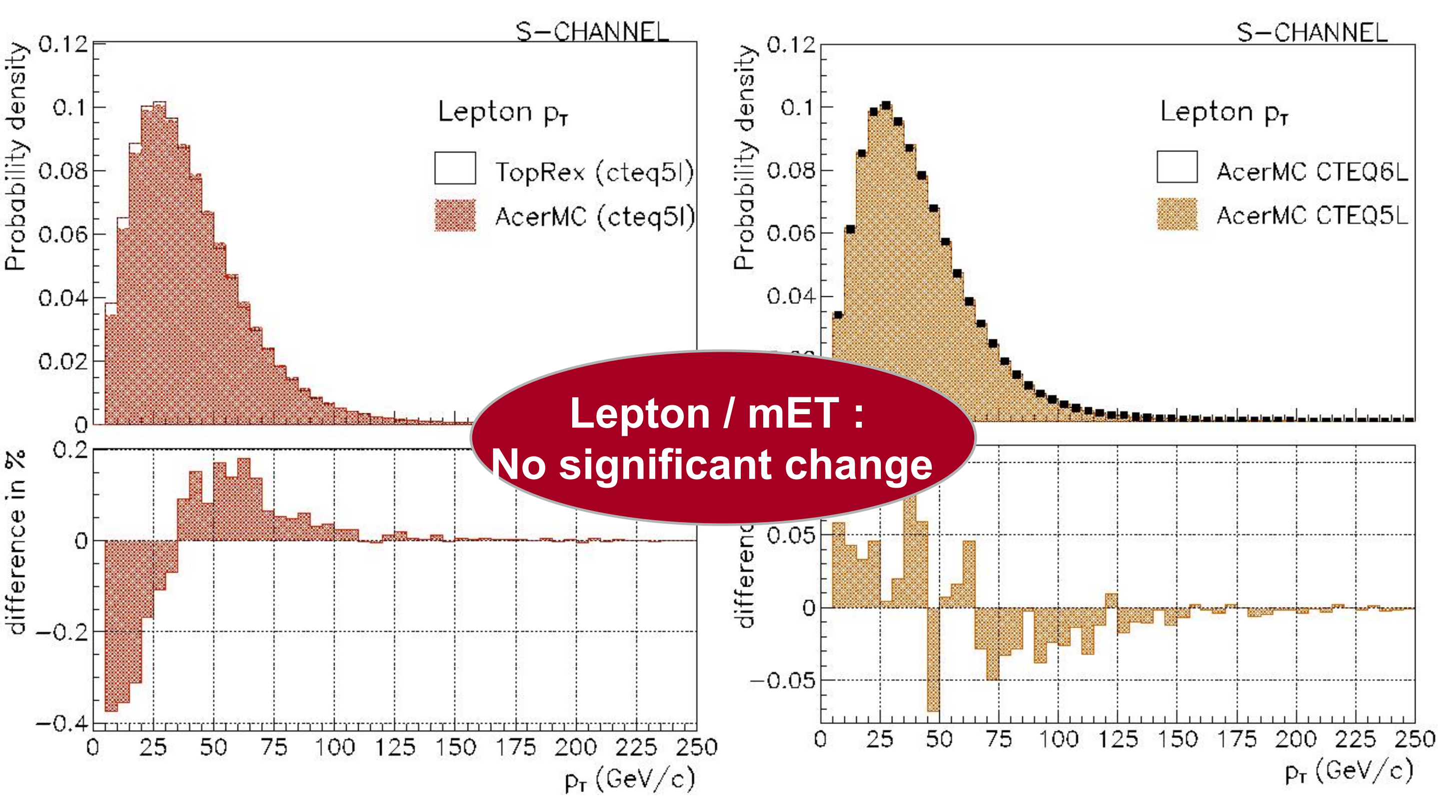
Number of events :

$L=30\ fb^{-1}$	tbar b	t bbar
W*	1,200	840
Wg	1,860	1,120
W+t	< 8	< 6
tt→dilepton	2,790	2,790
tt→l+jets	2,220	2,220
tt→tau+jets	420	420
Wbb	2,250	1,410
WZ	90	60
W+jets	1,710	1,260

Re-estimated using AcerMC: W*, Wg, Wt and Wbb

W* channel : lepton+mET

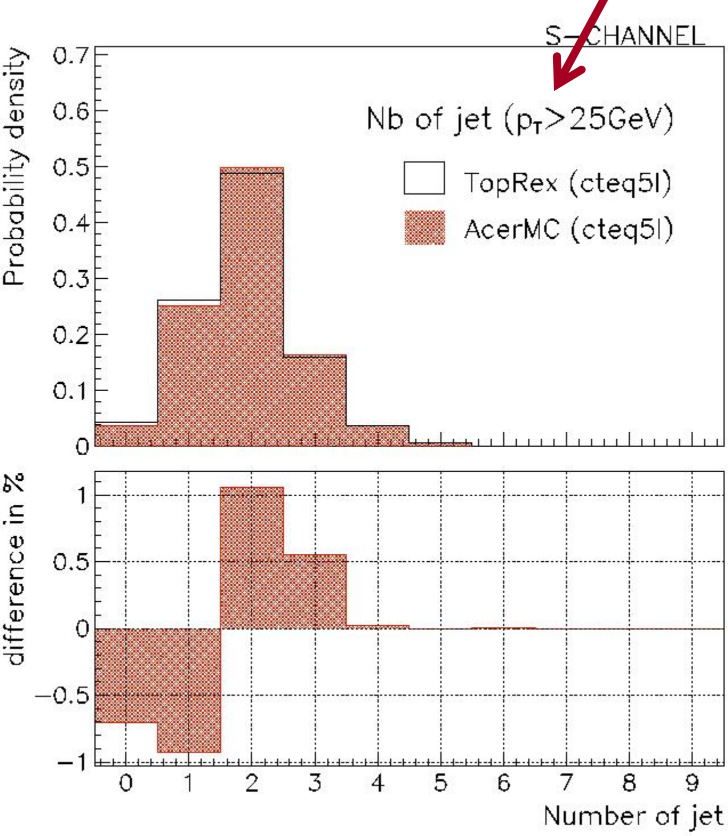
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
N_{lep}	75.26 ± 0.05%	75.41 ± 0.06%	75.40 ± 0.06%
P_T^{lep}	53.37 ± 0.05%	53.43 ± 0.06%	53.60 ± 0.08%
lep. veto	52.65 ± 0.05%	52.68 ± 0.06%	52.85 ± 0.08%
mE_T	42.93 ± 0.05%	43.00 ± 0.06%	43.23 ± 0.08%
N(jet)=2	21.18 ± 0.04%	21.67 ± 0.05%	20.40 ± 0.06%
N(b-jet)=2	4.51 ± 0.02%	4.65 ± 0.03%	4.22 ± 0.03%
H_T	**2.96 ± 0.02%**	**2.98 ± 0.02%**	**2.77 ± 0.03%**
M_{lvb}	**1.38 ± 0.01%**	**1.27 ± 0.01%**	**1.16 ± 0.02%**

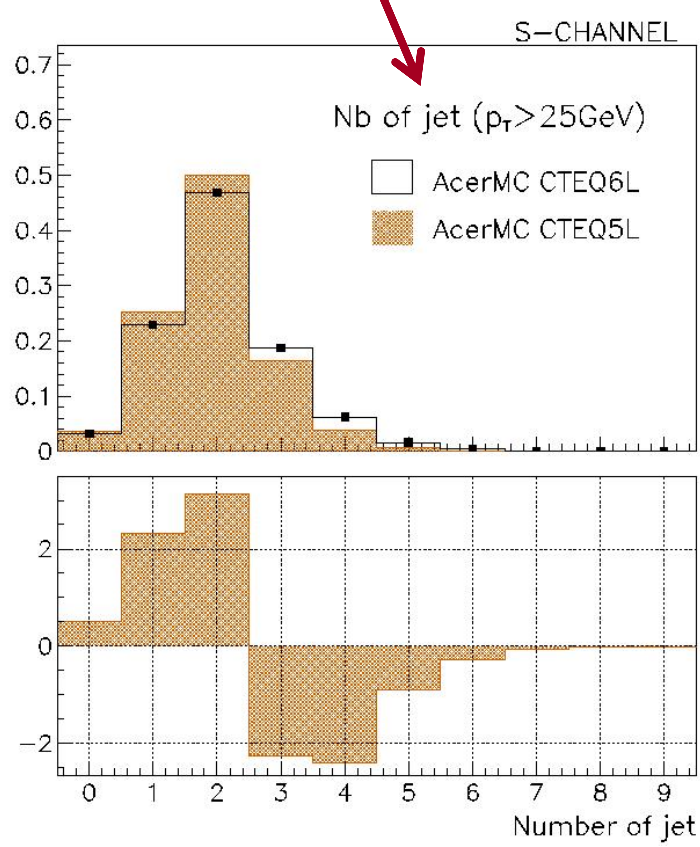


Lepton / mET :
No significant change

W* channel : nb of jets

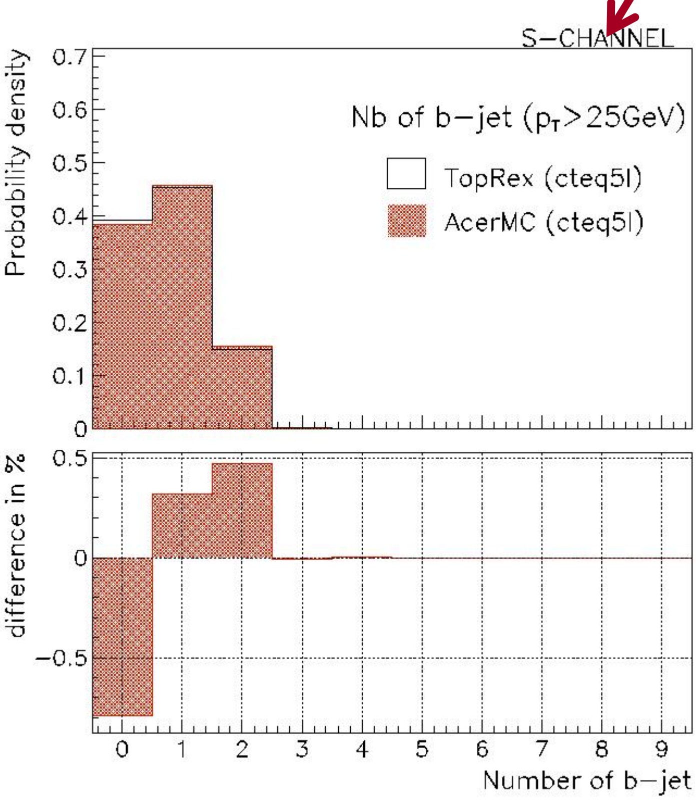
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
N_{lep}	75.26 ± 0.05%	75.41 ± 0.06%	75.40 ± 0.06%
P_T^{lep}	53.37 ± 0.05%	53.43 ± 0.06%	53.60 ± 0.08%
lep. veto	52.65 ± 0.05%	52.68 ± 0.06%	52.85 ± 0.08%
mE_T	42.93 ± 0.05%	43.00 ± 0.06%	43.23 ± 0.08%
N(jet)=2	21.18 ± 0.04%	21.67 ± 0.05%	20.40 ± 0.06%
N(b-jet)=2	4.51 ± 0.02%	4.65 ± 0.03%	4.22 ± 0.03%
H_T	2.96 ± 0.02%	2.98 ± 0.02%	2.77 ± 0.03%
M_{lvb}	1.38 ± 0.01%	1.27 ± 0.01%	1.16 ± 0.02%

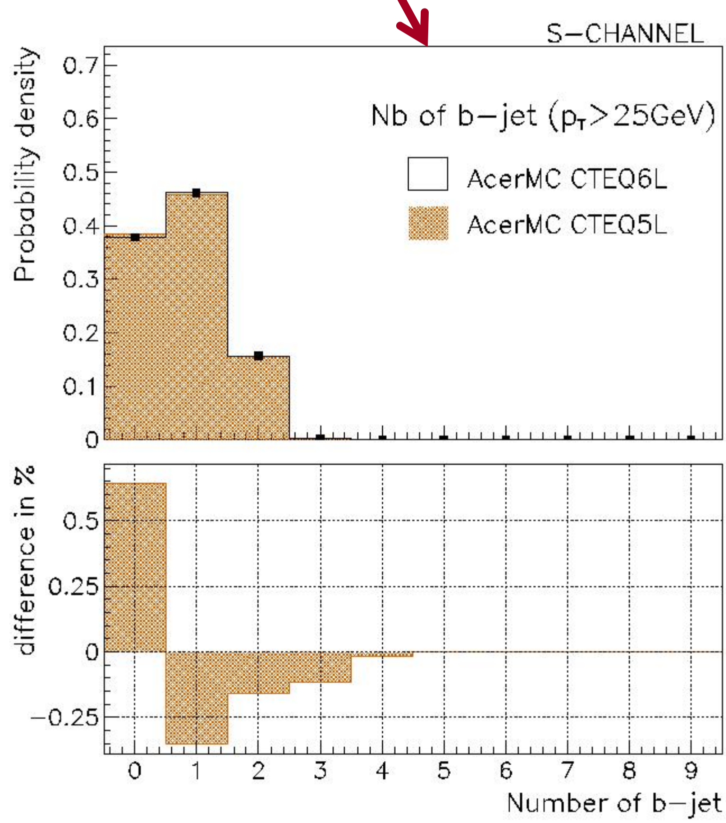




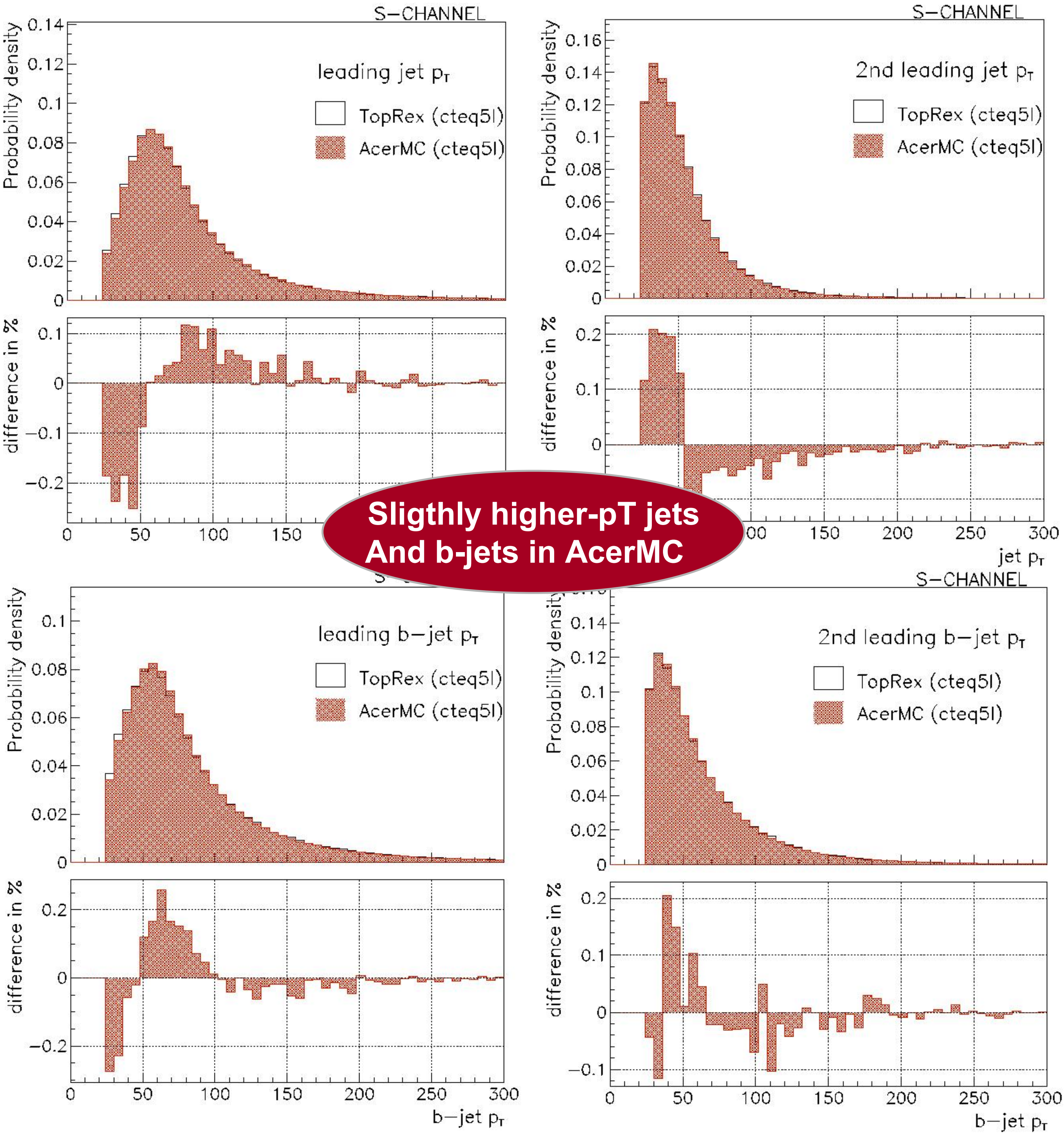
W* channel : nb of b-jets

	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
N_{lep}	75.26 ± 0.05%	75.41 ± 0.06%	75.40 ± 0.06%
P_T^{lep}	53.37 ± 0.05%	53.43 ± 0.06%	53.60 ± 0.08%
lep. veto	52.65 ± 0.05%	52.68 ± 0.06%	52.85 ± 0.08%
mE_T	42.93 ± 0.05%	43.00 ± 0.06%	43.23 ± 0.08%
N(jet)=2	21.18 ± 0.04%	21.67 ± 0.05%	20.40 ± 0.06%
N(b-jet)=2	4.51 ± 0.02%	4.65 ± 0.03%	4.22 ± 0.03%
H_T	2.96 ± 0.02%	2.98 ± 0.02%	2.77 ± 0.03%
$M_{l\nu b}$	1.38 ± 0.01%	1.27 ± 0.01%	1.16 ± 0.02%



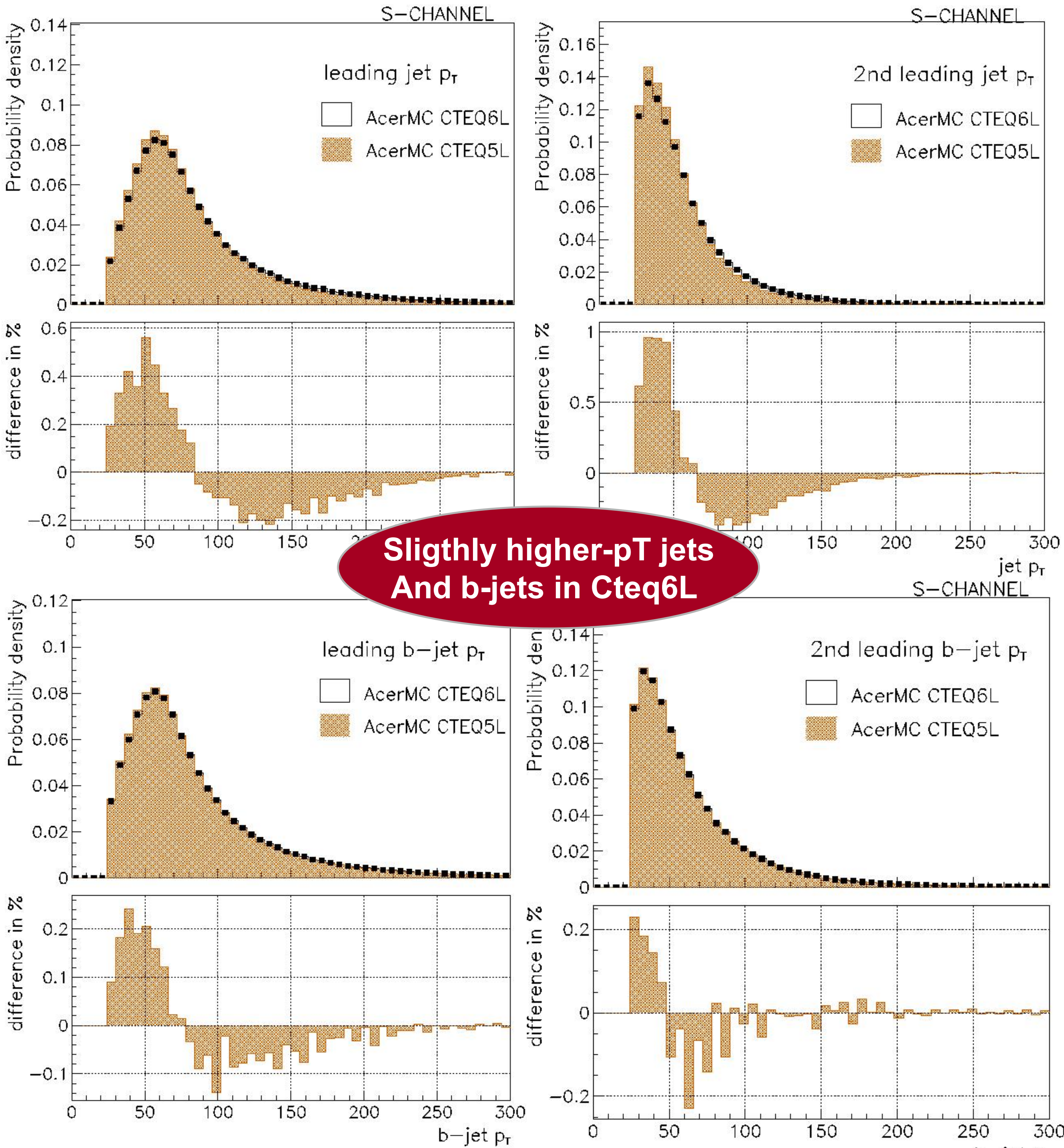


W* channel : leading (b-)jets



Sligthly higher-pT jets And b-jets in AcerMC

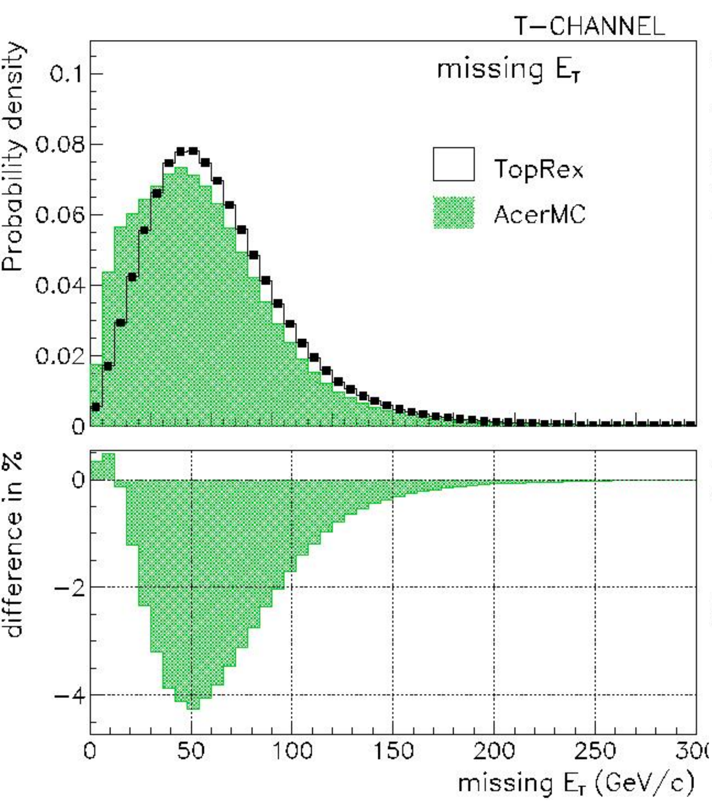
W* channel : leading (b-)jets

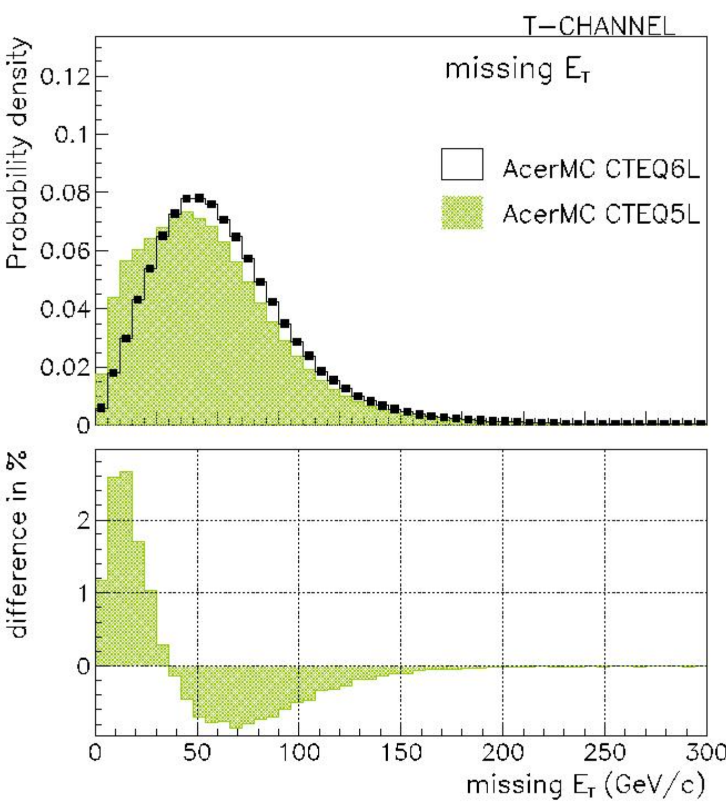


Sligthly higher-pT jets And b-jets in Cteq6L

Wg channel : lepton+mET

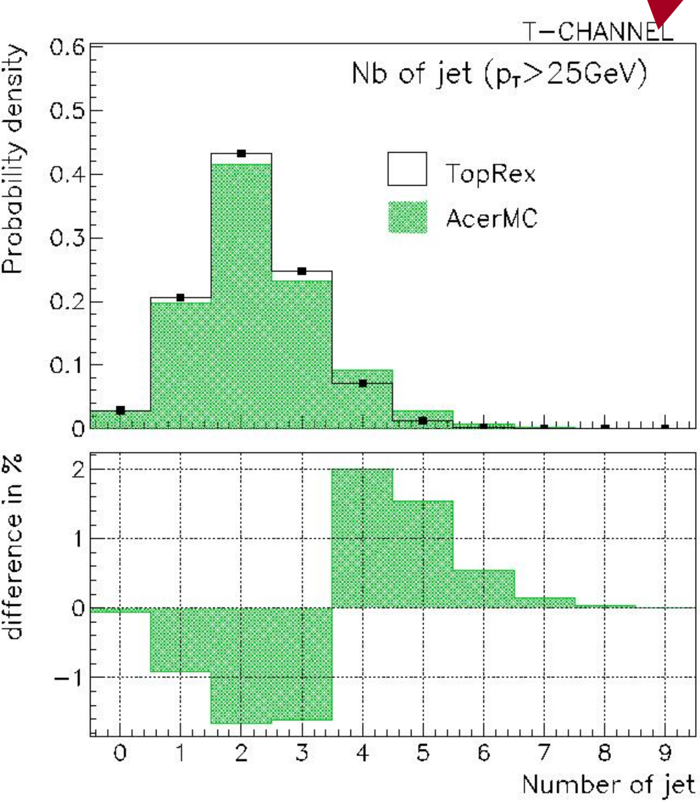
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	46.35 ± 0.06%	45.68 ± 0.1%	46.69 ± 0.1%
N(jet)=2	21.01 ± 0.05%	19.97 ± 0.1%	18.45 ± 0.1%
N(b-jet)=2	0.58 ± 0.01%	1.46 ± 0.03%	0.39 ± 0.02%
H_T	0.40 ± 0.01%	0.96 ± 0.02%	0.30 ± 0.02%
M_{lvb}	0.18 ± 0.01%	0.38 ± 0.02%	0.11 ± 0.01%

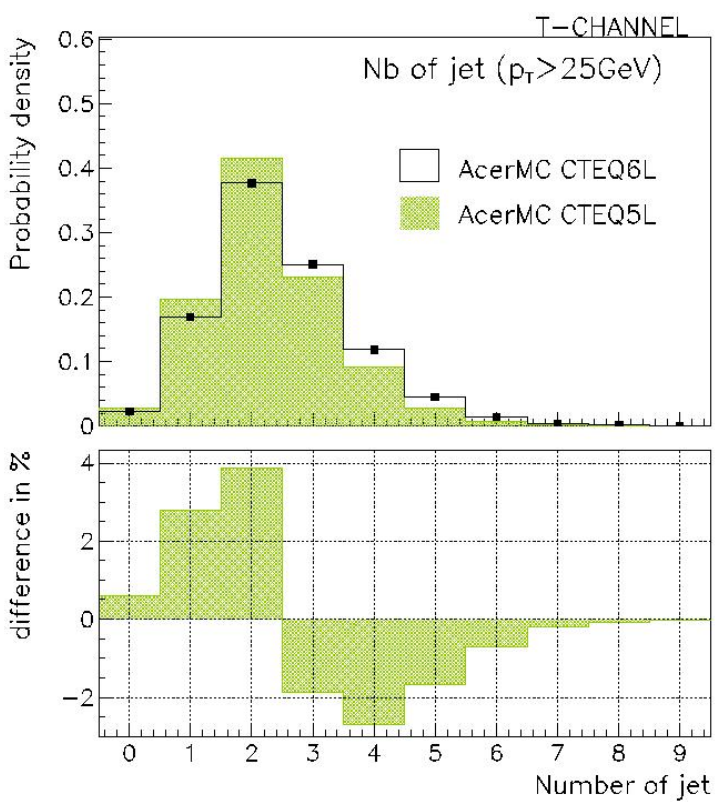




Wg channel : nb of jets

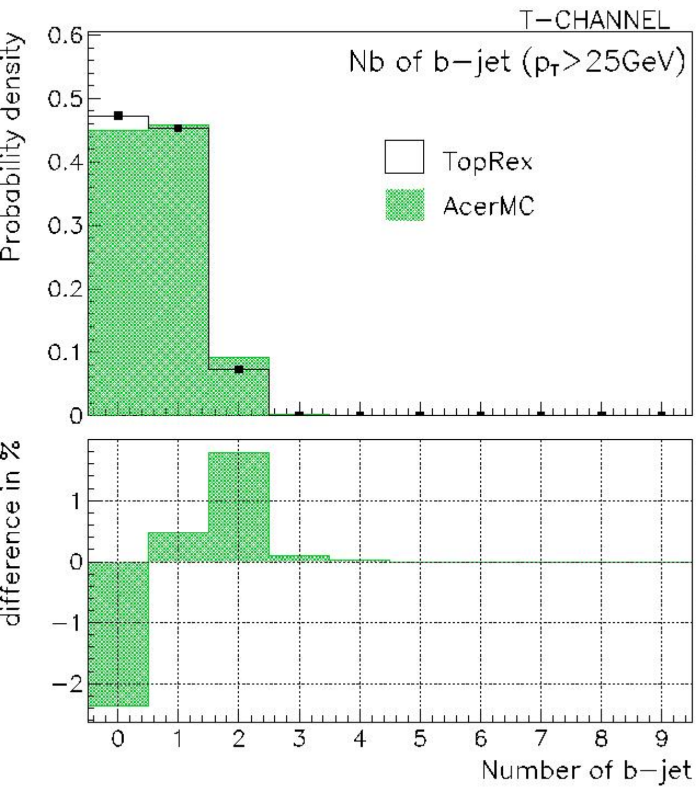
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	46.35 ± 0.06%	45.68 ± 0.1%	46.69 ± 0.1%
N(jet)=2	21.01 ± 0.05%	19.97 ± 0.1%	18.45 ± 0.1%
N(b-jet)=2	0.58 ± 0.01%	1.46 ± 0.03%	0.39 ± 0.02%
H_T	0.40 ± 0.01%	0.96 ± 0.02%	0.30 ± 0.02%
M_{lvb}	0.18 ± 0.01%	0.38 ± 0.02%	0.11 ± 0.01%

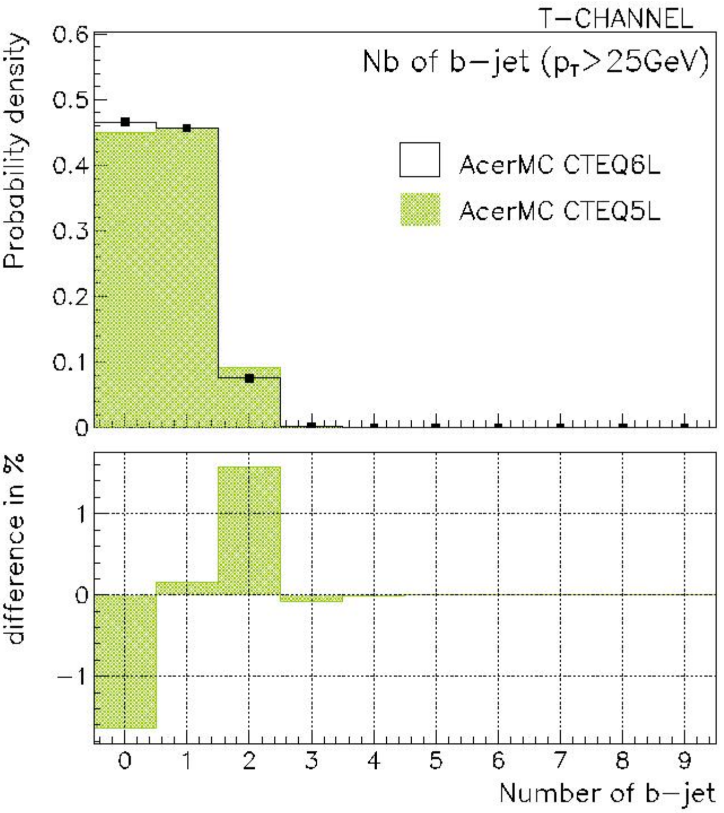




Wg channel : nb of b-jet

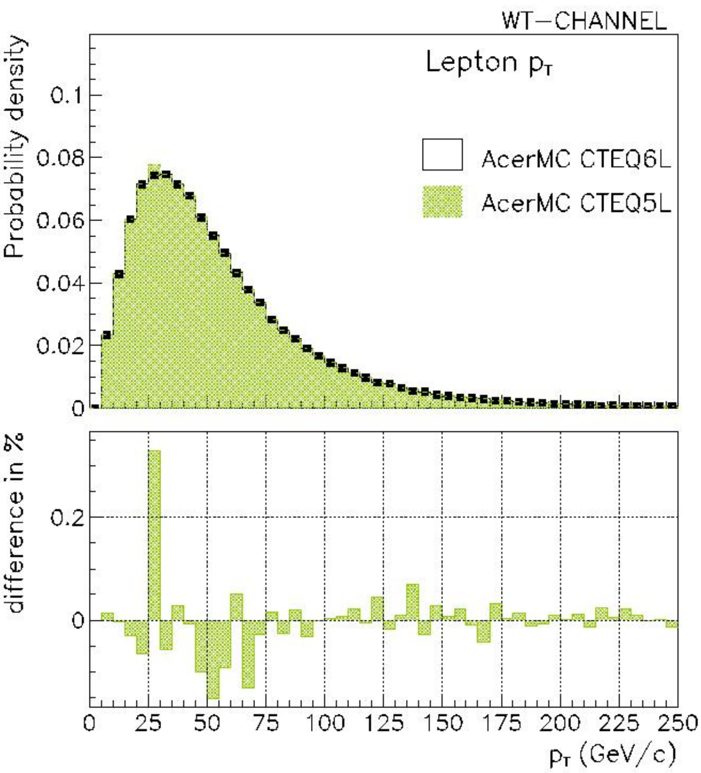
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	46.35 ± 0.06%	45.68 ± 0.1%	46.69 ± 0.1%
N(jet)=2	21.01 ± 0.05%	19.97 ± 0.1%	18.45 ± 0.1%
N(b-jet)=2	0.58 ± 0.01%	1.46 ± 0.03%	0.39 ± 0.02%
H_T	0.40 ± 0.01%	0.96 ± 0.02%	0.30 ± 0.02%
$M_{l\nu b}$	0.18 ± 0.01%	0.38 ± 0.02%	0.11 ± 0.01%

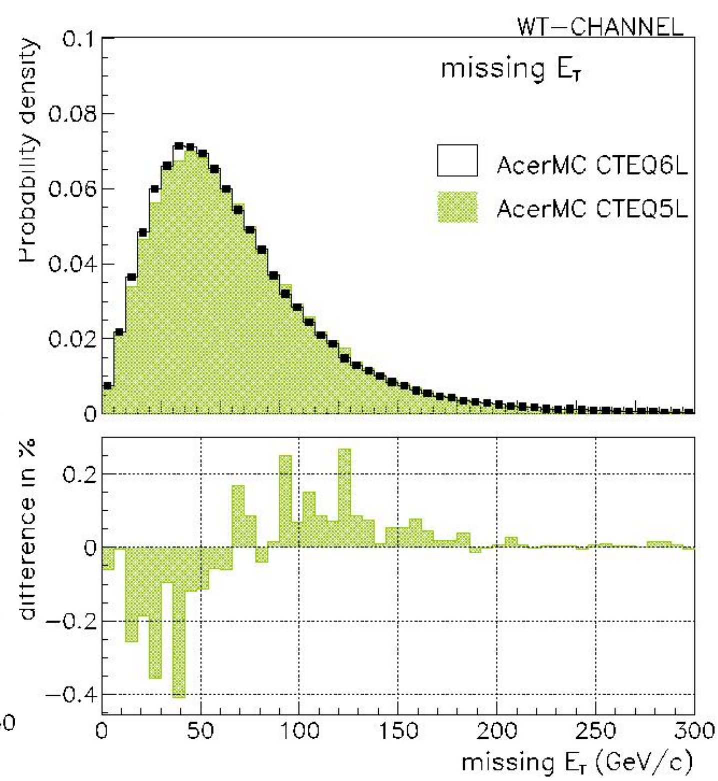




Wt channel : lepton + mET

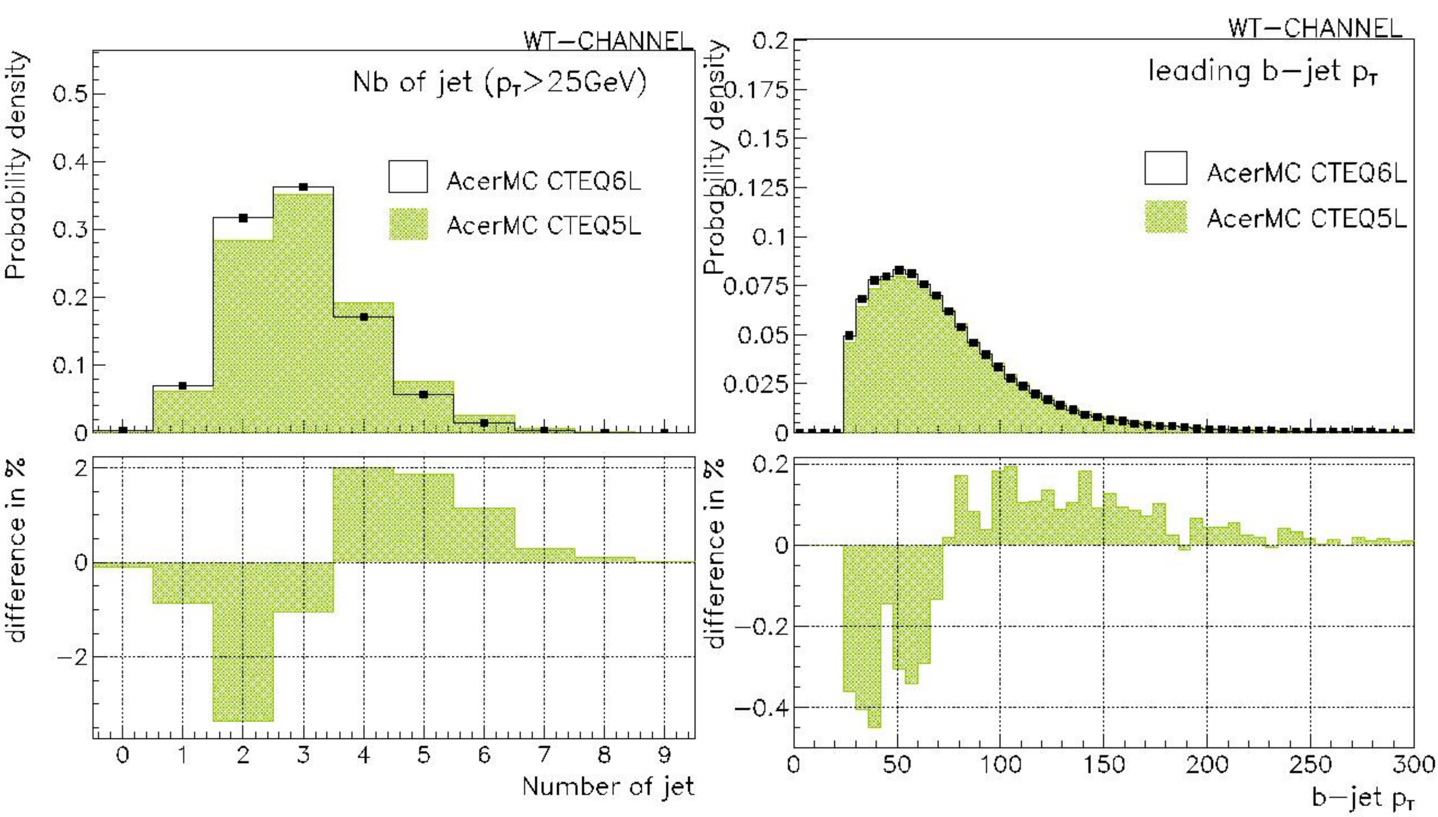
	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	51.84 ± 0.05%	53.23 ± 0.2%	53.72 ± 0.3%
N(jet)=2	22.48 ± 0.04%	18.27 ± 0.2%	16.46 ± 0.2%
N(b-jet)=2	0.031 ± 0.02%	0.051 ± 0.01%	0.040 ± 0.01%
H_T	0.02 ± 0.002%	0.03 ± 0.02%	0.019 ± 0.02%
M_{lvb}	0.01 ± 0.001%	0.012 ± 0.02%	0.008 ± 0.01%





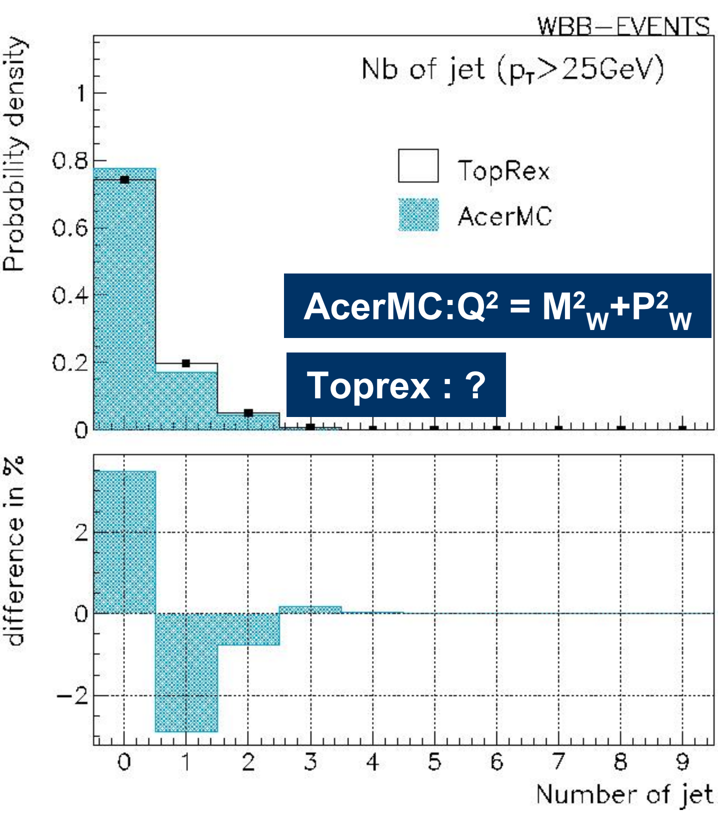
Wt channel : nb of jet

	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	51.84 ± 0.05%	53.23 ± 0.2%	53.72 ± 0.3%
N(jet)=2	22.48 ± 0.04%	18.27 ± 0.2%	16.46 ± 0.2%
N(b-jet)=2	0.031 ± 0.02%	0.051 ± 0.01%	0.040 ± 0.01%
H_T	0.02 ± 0.002%	0.03 ± 0.02%	0.019 ± 0.02%
M_{lvb}	0.01 ± 0.001%	0.012 ± 0.02%	0.008 ± 0.01%



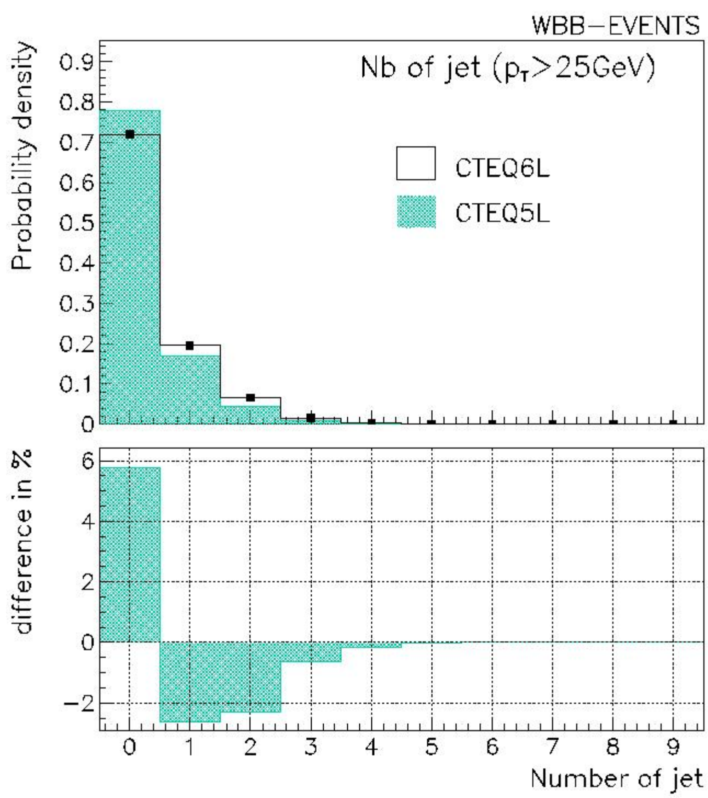
Wbb channel : nb of jets

	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	35.50 ± 0.04%	41.0 ± 0.3%	41.65 ± 0.3%
N(jet)=2	1.84 ± 0.01%	1.80 ± 0.1%	2.68 ± 0.1%
N(b-jet)=2	0.28 ± 0.01%	0.23 ± 0.04%	0.27 ± 0.04%
H_T	0.148 ± 0.01%	0.124 ± 0.02%	0.139 ± 0.022%
M_{lvb}	0.039 ± 0.002%	0.029 ± 0.02%	0.017 ± 0.012%



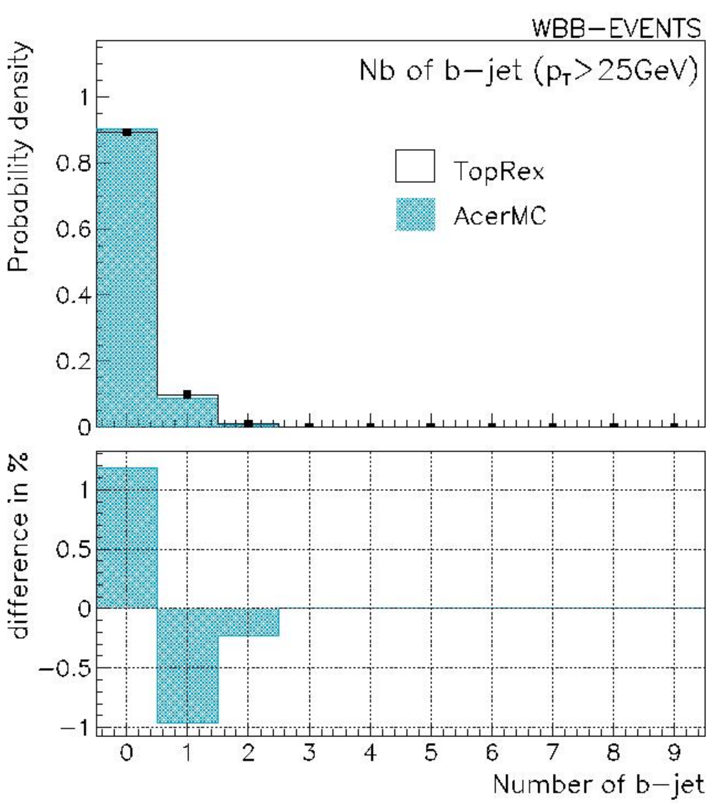
$AcerMC: Q^2 = M^2_W + P^2_W$

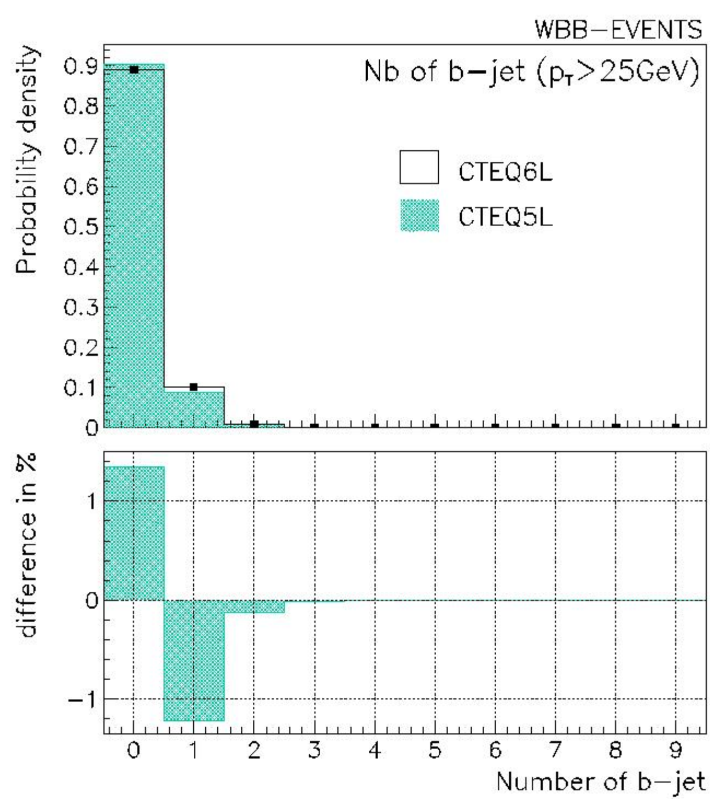
Toprex : ?



Wbb channel : nb of b-jets

	TopReX CTEQ5L	AcerMC CTEQ5L	AcerMC CTEQ6L
mE_T	35.50 ± 0.04%	41.0 ± 0.3%	41.65 ± 0.3%
N(jet)=2	1.84 ± 0.01%	1.80 ± 0.1%	2.68 ± 0.1%
N(b-jet)=2	0.28 ± 0.01%	0.23 ± 0.04%	0.27 ± 0.04%
H_T	0.148 ± 0.01%	0.124 ± 0.02%	0.139 ± 0.022%
$M_{l\nu b}$	0.039 ± 0.002%	0.029 ± 0.02%	0.017 ± 0.012%





Conclusion : AcerMC vs Toprex

Comparison TopReX vs AcerMC

From Toprex CTEQ5L to AcerMC CTEQ5L

- W* : stable / slight increase of ~few %
- Wg : increases by ~40%-50% !!
- Wt : increases by 20%-30%
- Wbb : decreases by ~20% at the preselection
  decrease of 30% after topological cuts

From Toprex CTEQ5L to AcerMC CTEQ6L

- W* : loss of 6 to 15%
- Wg : decreases by ~25-30%
- Wt : decreases by 10-20%
- Wbb : almost no change at the preselection
  decrease of 25% after topological cuts

Overall : CTEQ6L is now the reference for LO

- Signal decreases by ~6-15%
- Main backgrounds (Wg, Wbb) also decrease :
  ➔ S/B is improved

Plans

Most significant background is top pair

➔ Use of AcerMC and comparison w/ MC@NLO

➔ Full Sim MC production of AcerMC available for tests …

NB : MC production using AcerMC

MC Production

Production performed at the CC / IN2P3 :

- Official jobOptions (B. Kersevan→ I. Hinchliffe)
- Against release 11.0.41
  - → 30k events of AOD and ESD's
  - (100 evts x 300 files)

Available samples [responsible] :

[Wt] : bg→W t → jj e/$\mu\nu$ b (10k) [Lleres]

[W*] : W*→tb → Wb b → e/$\mu\nu$b b (10k) [Lucotte]

[Wg]: qg (qb) → tbq (tq)→ e/$\mu\nu$b bq (e/$\mu\nu$b q) [Lucotte]