Heavy flavour cross sections at LHC from NLO + Parton shower

HERA-LHC Workshop
WG3 Heavy quarks (charm & beauty)

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MC@NLO in a Nutshell

- MC@NLO is a standalone ME generator which matched **NLO calculations** of rates for QCD processes with a **PS MC event generator** namely **HERWIG**
- Integration step (the most time consumming step) is **done only once** while event generation can be repeated (several runs)
- Events with **negative weights**
  - their sum si equal to the total rate
  - mainly ($\sim 60\%$) events that radiate a hard gluon are negatively weighted
- ALICE has implemented an interface to process partonic events into its simulation framework

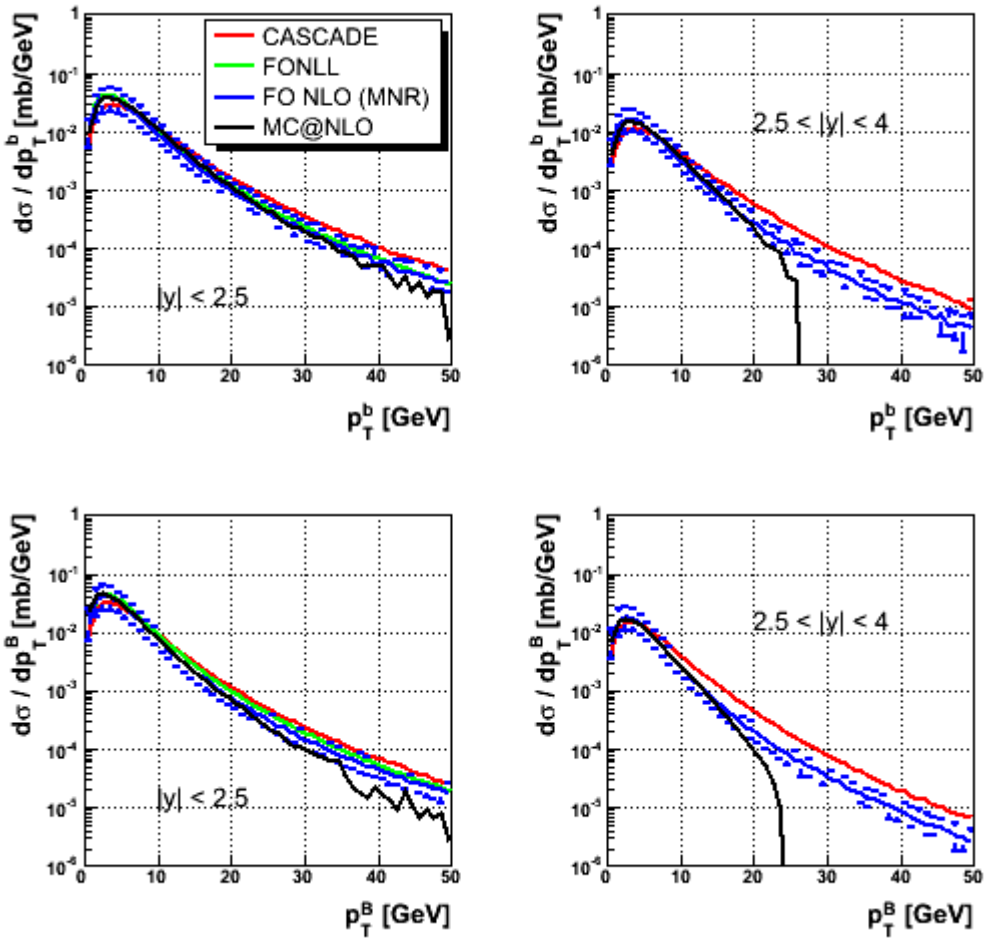
Input parameters & cross-sections

Parameter	central value	range
$\Lambda^{\bar{5}}_{\rm QCD}$	0.226 GeV	fix
PDF	CTEQ6.1	CTEQ6.1 errors
m_c	1.5 GeV	1.3-1.7 GeV
m_b	4.75 GeV	4.5-5.0 GeV
c fragmentation		
FO: Peterson ϵ_c =	0.021	0.002-0.11
NLL: Peterson ϵ_c =	0.0030	0.0023-0.0036
Pythia/Jetset:	Pet. ϵ_c =0.075	Bowler - ϵ_c =0.05
b fragmentation		
FO: Peterson ϵ_b =	0.001	0.0002-0.004
NLL: Peterson ϵ_b =	0.00035	0.00020-0.00055
Pythia/Jetset:	Pet. ϵ_b =0.002	Bowler - ϵ_b =0.005
Herwig: PSPLT(2)=	0.5	0.2 - 1.0

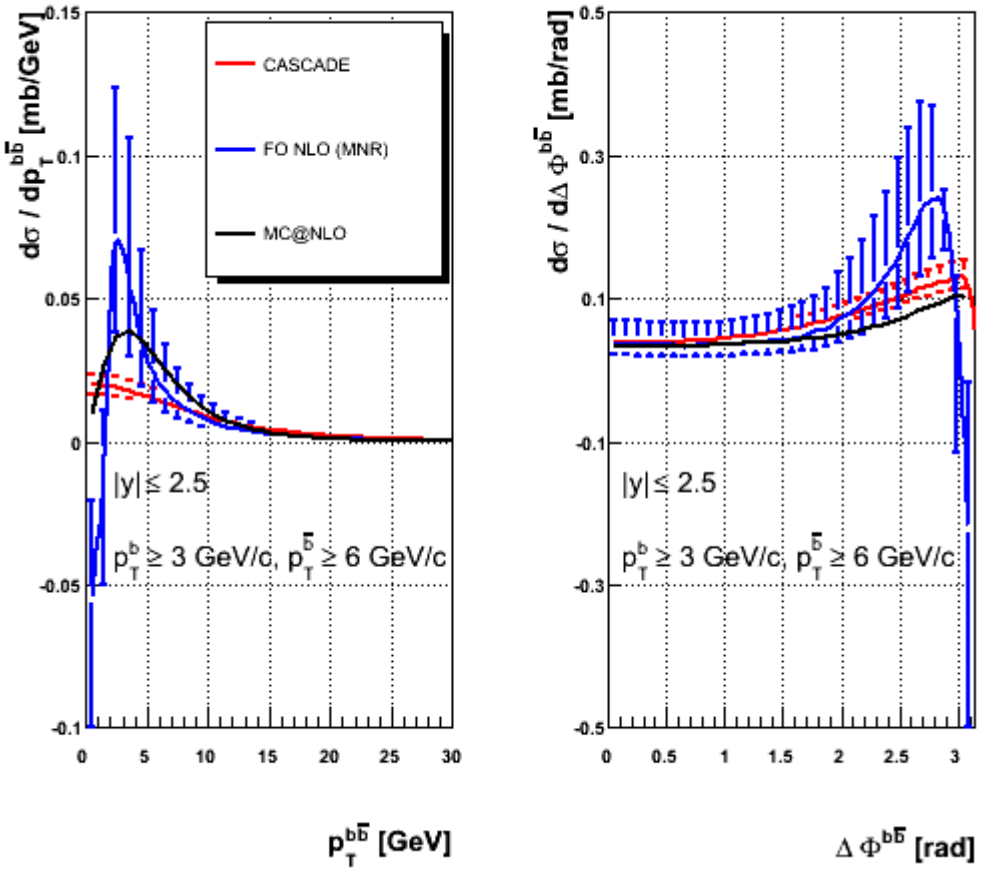
Cross Section	Cuts	Range	Notes
$d\sigma/dp_T^c$	$\|Y^c\| < 2.5$	$0 \to 50$GeV	c quark
$d\sigma/dp_T^c$	$\|Y^c\| < 2.5$	$0 \to 500$GeV	(extended range)
$d\sigma/dp_T^c$	$2.5 < \|Y^c\| < 4$	$0 \to 50$GeV	
$d\sigma/d\Delta\phi^{c\bar{c}}$	$p_T^c > 3, p_T^{\bar{c}} > 6$ GeV, $\|Y^c\| < 2.5, \|Y^{\bar{c}}\| < 2.5$	$0 \to \pi$	$c\bar{c}$ correl.
$d\sigma/dp_T^{c\bar{c}}$	$p_T^c > 3, p_T^{\bar{c}} > 6$ GeV, $\|Y^c\| < 2.5, \|Y^{\bar{c}}\| < 2.5$	$0 \to 50$	p_T of $c\bar{c}$ system
$d\sigma/dp_T^D$	$\|Y^D\| < 2.5$	$0 \to 50$GeV	charmed hadron
$d\sigma/dp_T^D$	$2.5 < \|Y^D\| < 4.5$	$0 \to 50$GeV	
$d\sigma^c/dp_T^\mu$	$\|Y^\mu\| < 2.5$	$0 \to 50$ GeV	any μ from c or $\bar{c}$
$d\sigma^c/dp_T^\mu$	$2.5 < \|Y^\mu\| < 4.5$	$0 \to 50$ GeV	
$d\sigma/dp_T^b$	$\|Y^b\| < 2.5$	$0 \to 50$GeV	b quark
$d\sigma/dp_T^b$	$\|Y^b\| < 2.5$	$0 \to 500$GeV	(extended range)
$d\sigma/dp_T^b$	$2.5 < \|Y^b\| < 4$	$0 \to 50$GeV	
$d\sigma/d\Delta\phi^{b\bar{b}}$	$p_T^b > 3, p_T^{\bar{b}} > 6$ GeV, $\|Y^b\| < 2.5, \|Y^{\bar{b}}\| < 2.5$	$0 \to \pi$	$b\bar{b}$ correl.
$d\sigma/dp_T^{b\bar{b}}$	$p_T^b > 3, p_T^{\bar{b}} > 6$ GeV, $\|Y^b\| < 2.5, \|Y^{\bar{b}}\| < 2.5$	$0 \to 50$	p_T of $c\bar{c}$ system
$d\sigma/dp_T^B$	$\|Y^B\| < 2.5$	$0 \to 50$GeV	B hadron
$d\sigma/dp_T^B$	$2.5 < \|Y^B\| < 4.5$	$0 \to 50$GeV	
$d\sigma^b/dp_T^\mu$	$\|Y^\mu\| < 2.5$	$0 \to 50$ GeV	any μ from b or $\bar{b}$
$d\sigma^b/dp_T^\mu$	$2.5 < \|Y^\mu\| < 4.5$	$0 \to 50$ GeV	

Benchmark cross-section manual, Massimo Corradi

Differential cross-sections



$Q\bar{Q}$ correlations



Program for the workshop

- Assess signal systematics
- Study underlying event
  - We should agree on relevant quantities
- **PO**stive **W**eight **H**ardest **E**mission **G**enerator
  - Both charm & bottom
  - No negative weights