

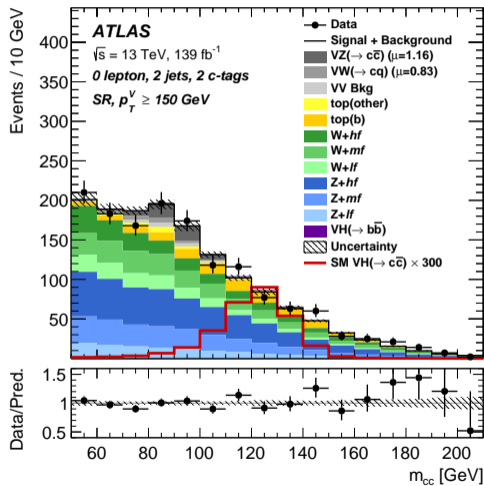
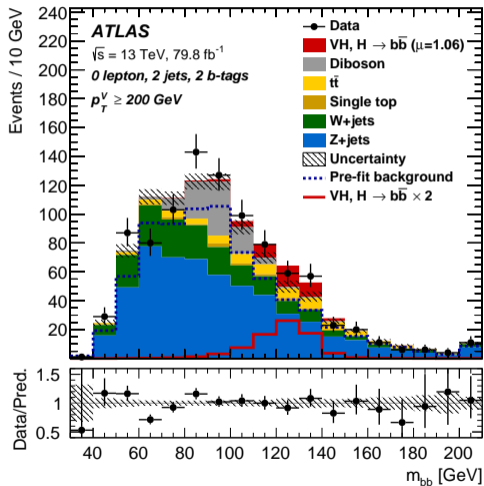
# Heavy-flavoured quark production in association with vector bosons at the LHC

CERN Collider Cross Talk

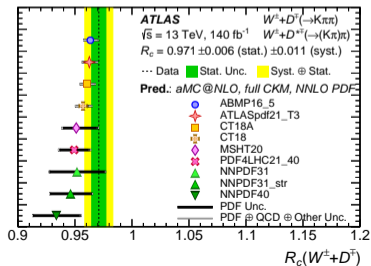
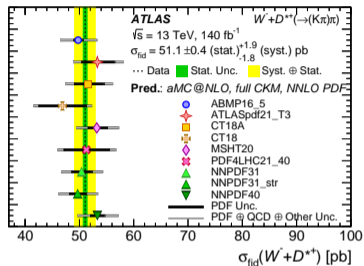
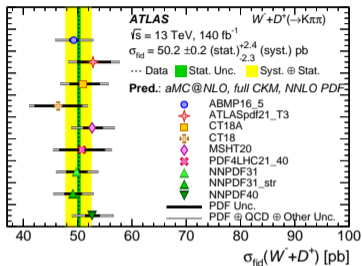
S. Caletti, M. Muskinja

July 11, 2024

# V+HF as a limiting factor



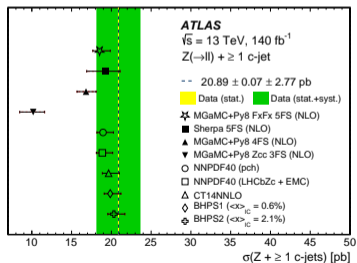
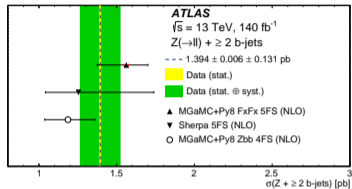
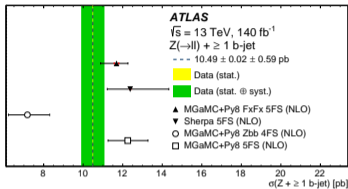
# ATLAS $W+D^{\pm(*)}$ measurement



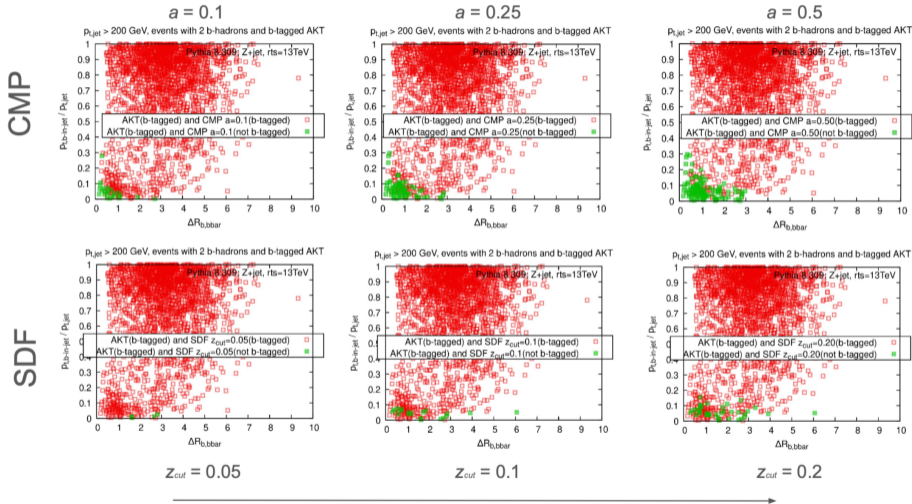
# CMS $W+c$ -jet measurement

Source	SL	SL	SV	SV
	$W \rightarrow e\nu$	$W \rightarrow \mu\nu$	$W \rightarrow e\nu$	$W \rightarrow \mu\nu$
	Uncertainty [%]			
Isolated lepton identification	1.6	0.9	1.6	0.9
Jet energy scale and resolution	2.0	2.0	1.0	1.0
Muon in jet identification	3.0	3.0	—	—
SV reconstruction	—	—	3.7	3.7
Charm fragmentation and decay	2.6	2.6	2.4	2.4
PDF in MC samples	1.0	1.0	1.0	1.0
Stat. uncert. selection efficiency	0.9	1.2	0.9	0.8
Background contributions	0.6	0.9	1.3	1.3
Integrated luminosity	1.6	1.6	1.6	1.6
Total	5.2	5.1	5.4	5.2

# ATLAS $Z+HF$ measurement



# Flavour algorithm: comparison

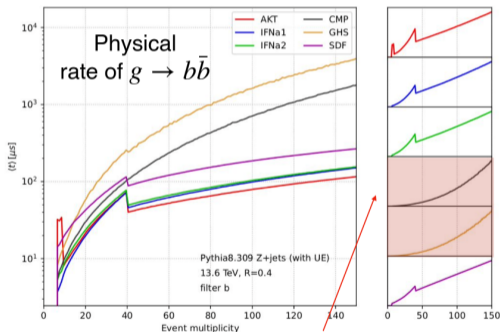


(Thanks to Ludovic/Gavin for the plots. Stolen from Giovanni's presentation in Durham.)

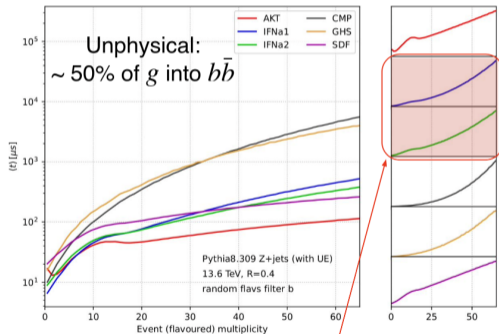
# Flavour algorithm: current performances

## Performance studies of current FastJet implementations

### Clustering time of $Z$ +jet Pythia8 events



Current implementations of  
GHS/CMP scale like  $N^2$



Also IFN scaling is worsening  
with many flavoured particles

# $W+c\text{-jet}$ @ NNLO partonic channel breakdown

$W^-+c\text{-jet}$	OS LO	OS NLO	SS NLO	OS NNLO	SS NNLO
$c(\bar{c})s(\bar{s})$	0.0	-0.1225(3)	0.4852(2)	-0.05(2)	0.842(3)
$c(\bar{c})c(\bar{c})$	0.0	0.2158(1)	0.2062(2)	0.360(2)	0.351(1)
$c(\bar{c})q(\bar{q})$	0.0	1.2392(3)	1.3132(4)	1.958(4)	2.088(4)
$s(\bar{s})q(\bar{q})$	0.0	-0.651(3)	0.03134(1)	-1.1(2)	0.0537(2)
$s(\bar{s})s(\bar{s})$	0.0	-0.2549(3)	0.0	-0.42(3)	0.0
$q(\bar{q})q(\bar{q})$	0.0	1.0314(7)	0.9838(4)	1.73(2)	1.676(6)
$gq(\bar{q})$	8.9255(6)	12.700(1)	0.0	12.7(2)	0.405(3)
$gs(\bar{s})$	86.857(4)	123.002(8)	0.0	128.9(3)	-0.0353(6)
$gc(\bar{c})$	0.0	0.0	0.0	-0.14(2)	-0.057(2)
$gg$	0.0	-6.355(3)	0.0	-8.31(1)	0.0
<b>Total</b>	<b>95.782(5)</b>	<b>130.806(1)</b>	<b>3.020(1)</b>	<b>135.6(5)</b>	<b>5.324 (9)</b>
$W^++c\text{-jet}$	OS LO	OS NLO	SS NLO	OS NNLO	SS NNLO
$c(\bar{c})s(\bar{s})$	0.0	-0.1191(9)	0.4752(4)	-0.13(2)	0.838(1)
$c(\bar{c})c(\bar{c})$	0.0	0.2151(3)	0.2047(3)	0.3316(5)	0.3246(6)
$c(\bar{c})q(\bar{q})$	0.0	1.948(3)	1.988(4)	2.945(6)	3.038(6)
$s(\bar{s})q(\bar{q})$	0.0	-0.649(9)	0.0673(1)	-1.9(3)	0.1157(3)
$s(\bar{s})s(\bar{s})$	0.0	-0.258(1)	0.0	-0.55(5)	0.0
$q(\bar{q})q(\bar{q})$	0.0	1.431(2)	1.409(2)	2.35(2)	2.423(6)
$gq(\bar{q})$	5.8299(7)	8.257(2)	0.0	10.1(4)	0.508(4)
$gs(\bar{s})$	85.51(1)	121.04(3)	0.0	126.3(6)	-0.0430(4)
$gc(\bar{c})$	0.0	0.0	0.0	0.02(2)	-0.0293(7)
$gg$	0.0	-6.34(1)	0.0	-13.62(6)	0.0
<b>Total</b>	<b>91.34(1)</b>	<b>125.51(4)</b>	<b>4.146(4)</b>	<b>125.9(7)</b>	<b>7.17(1)</b>



# $W+D^\pm$ @ NLO

