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aMC@NLO results with FxFx merging

In collaboration with Rikkert Frederix

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Disclaimer

We could not do a proper job, and had to resort on the hard events generated for the merging paper 1209.6215

This implies that, after cuts, the statistics is lousy

However, although what follows will need to be confirmed (or not) by larger-statistics runs, there are some patterns which may be interesting to discuss

FxFx merging (1209.6215)

- The i-parton sample receives contributions from the same matrix elements that enter the i-jet cross section at the NLO
- The i-parton cross section is basically the MC@NLO one, times a suitable combination of damping factors defined with a (smooth) function $D(\mu)$, which allow one to distinguish ME-dominated, MC-dominated, and intermediate regions
- $D(\mu)$ can also be chosen to be sharp, in which case

$$D(\mu) = \Theta\left(\mu_Q - \mu\right)$$

  with μ_Q the merging scale
- The above is further supplemented by a CKKW-like procedure

Merged samples (0-, 1-, and 2-parton) with $\mu_Q = 30$, 50, and 70 GeV

Anti-k_T jets, $R = 0.4$, only those with $|\eta| \leq 5$ considered

- cuts$_1$:
  at least two jets, both with $p_T \geq 25$ GeV

- cuts$_2$:
  $M_{j_1 j_2} \geq 400$ GeV && $|\Delta y_{j_1 j_2}| \geq 2.8$ && cuts$_1$

Rates (pb)

(and fractions of 0-, 1- and 2-parton sample contributions)

	$\mu_Q = 30$	$\mu_Q = 50$	$\mu_Q = 70$
no cuts	13.91 (58.8+29+12.2)%	14.09 (77.5+18.7+3.8)%	14.08 (86.4+12+1.6)%
cuts_1	1.65 (0.2+14.6+85.2)%	1.62 (16.1+51+32.9)%	1.58 (36+49.8+14.2)%
cuts_2	0.125 (0.2+7.5+92.3)%	0.170 (21.8+43.5+34.7)%	0.207 (43.6+43.4+13)%

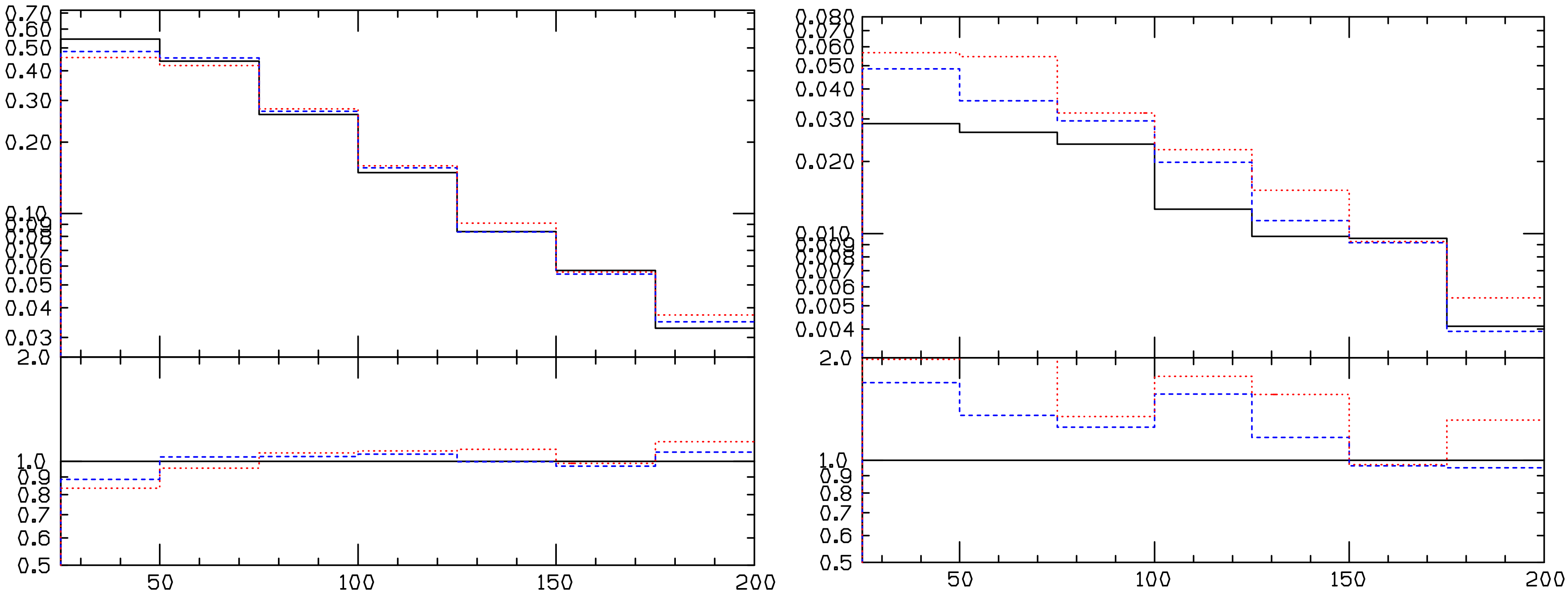
ME $\longleftarrow$ $\longrightarrow$ MC

Distributions

- Left plots: cuts_1; right plots: cuts_2
- Black solid: $\mu_Q = 30$ GeV; blue dashed: $\mu_Q = 50$ GeV; red dotted: $\mu_Q = 70$ GeV
- Lower insets: ratios $(\mu_Q = 50)/(\mu_Q = 30)$ and $(\mu_Q = 70)/(\mu_Q = 30)$

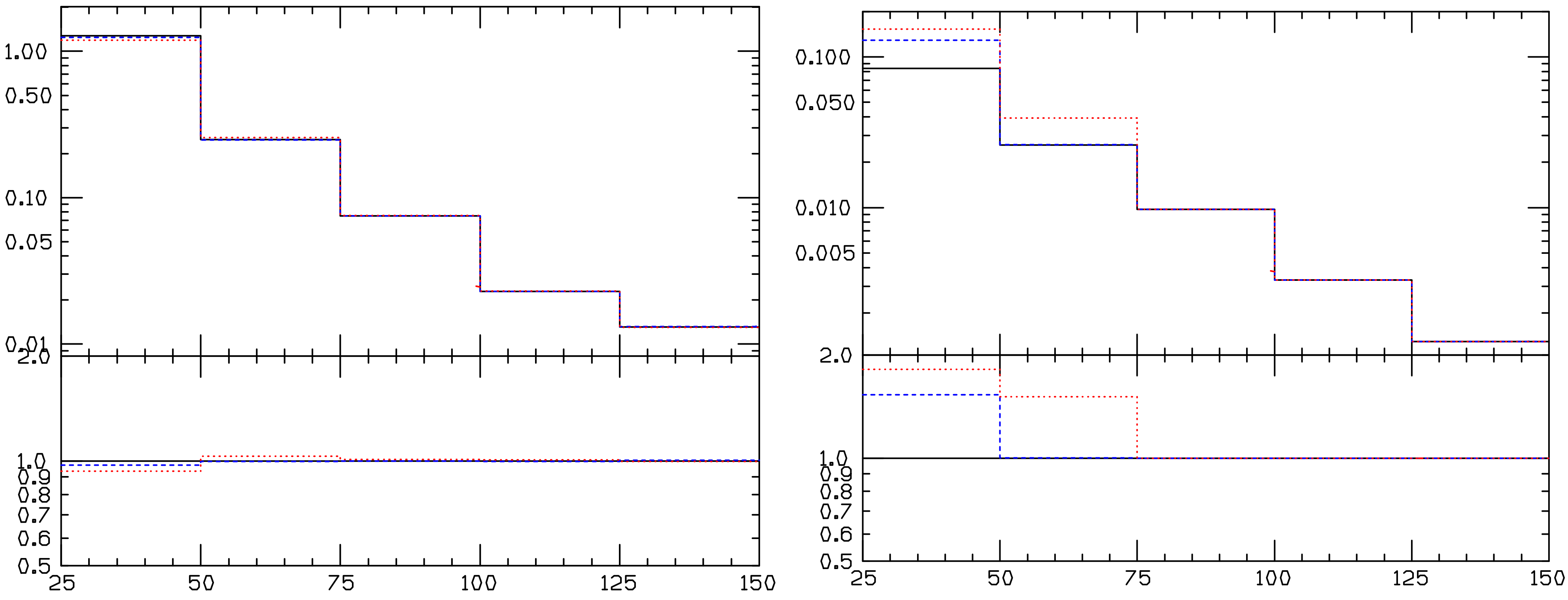
Note: this does not imply that $\mu_Q = 30$ GeV is our overall best choice. In 1209.6215 we actually argue for a slight preference for $\mu_Q = 50$ GeV. However, we did not specifically target 2-jet observables there

$p_T(j_1)$



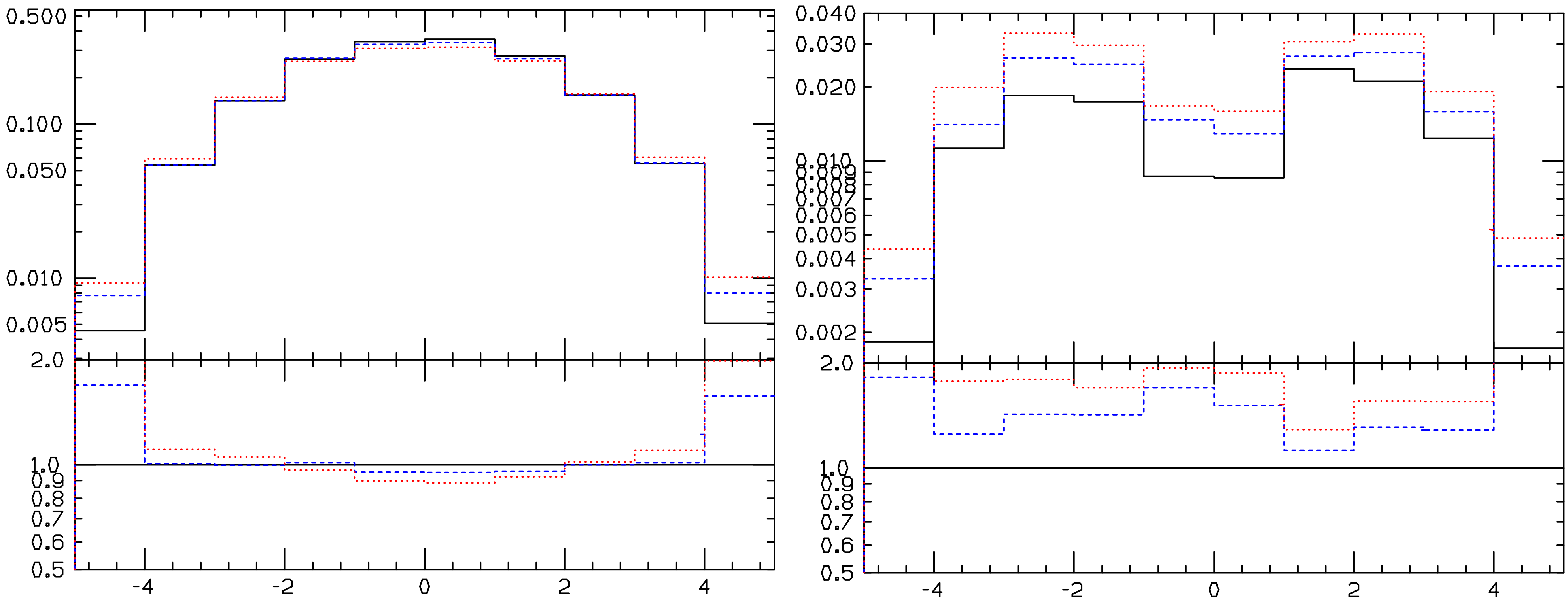
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
2.0
1.0
0.9
0.8
0.7
0.6
0.5
50
100
150
200
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.009
0.008
0.007
0.006
0.005
0.004
2.0
1.0
0.9
0.8
0.7
0.6
0.5
50
100
150
200

$p_T(j_2)$

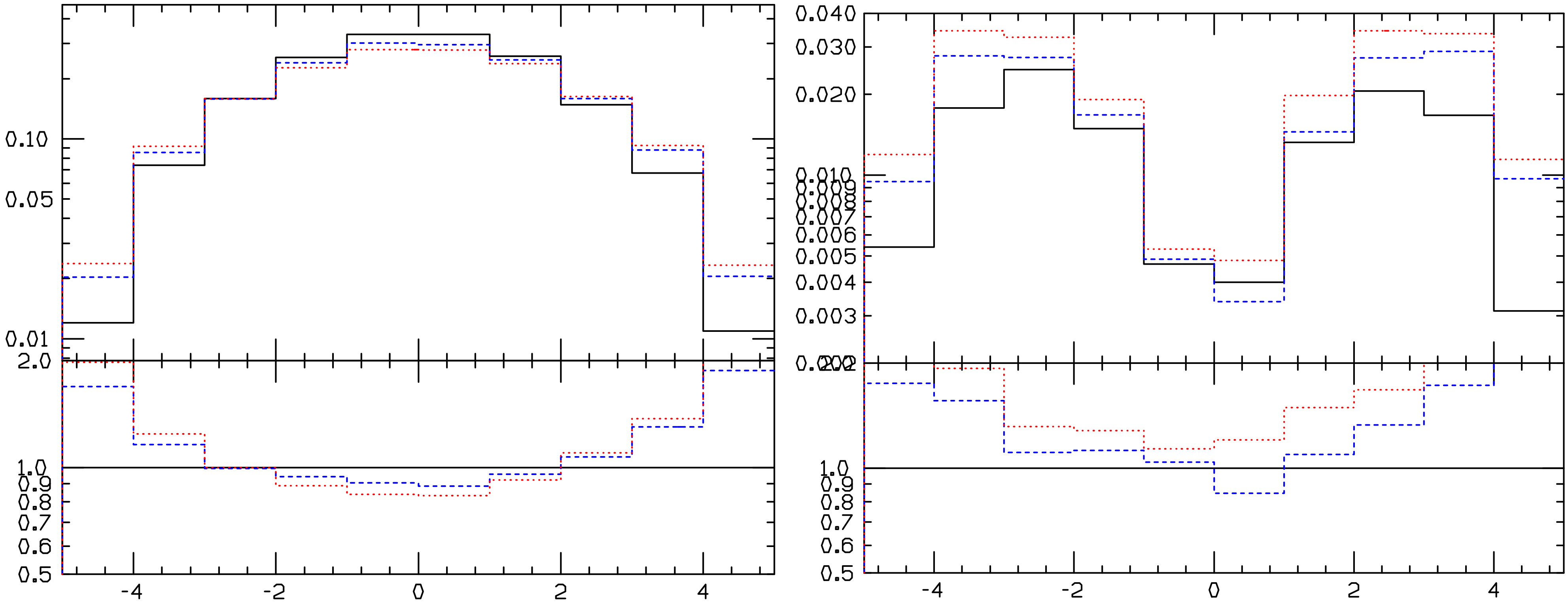


1.00
0.50
0.10
0.05
0.01
2.0
1.0
0.9
0.8
0.7
0.6
0.5
25
50
75
100
125
150
0.100
0.050
0.010
0.005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
25
50
75
100
125
150

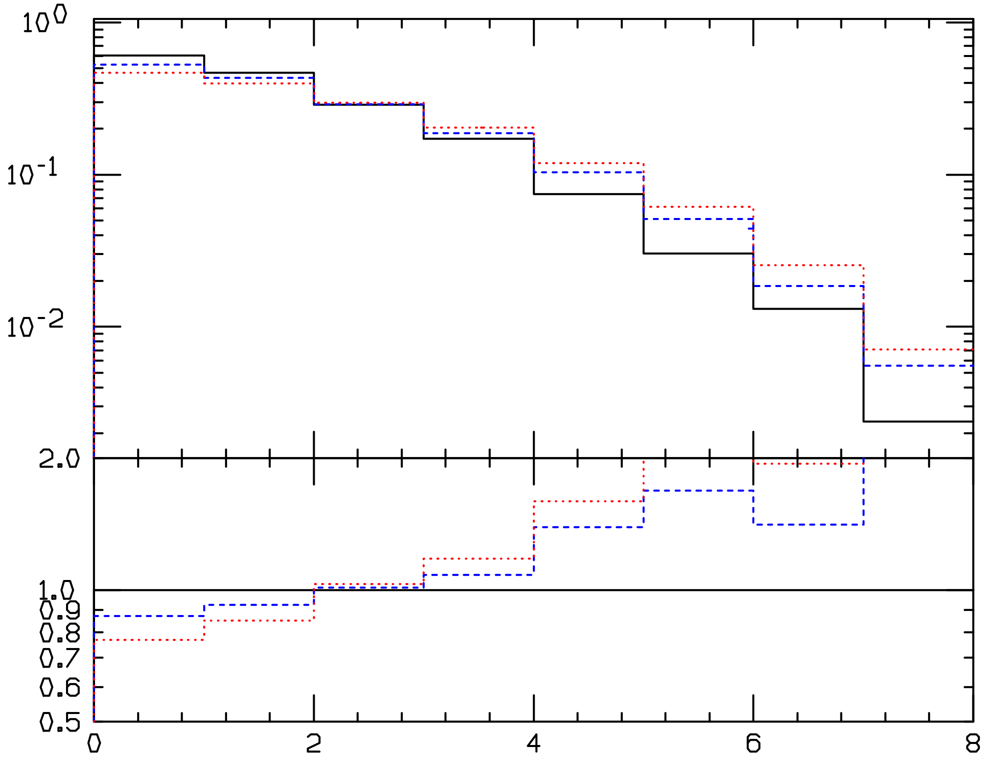
$y(j_1)$


0.500
0.100
0.050
0.010
0.005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4
0.040
0.030
0.020
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4

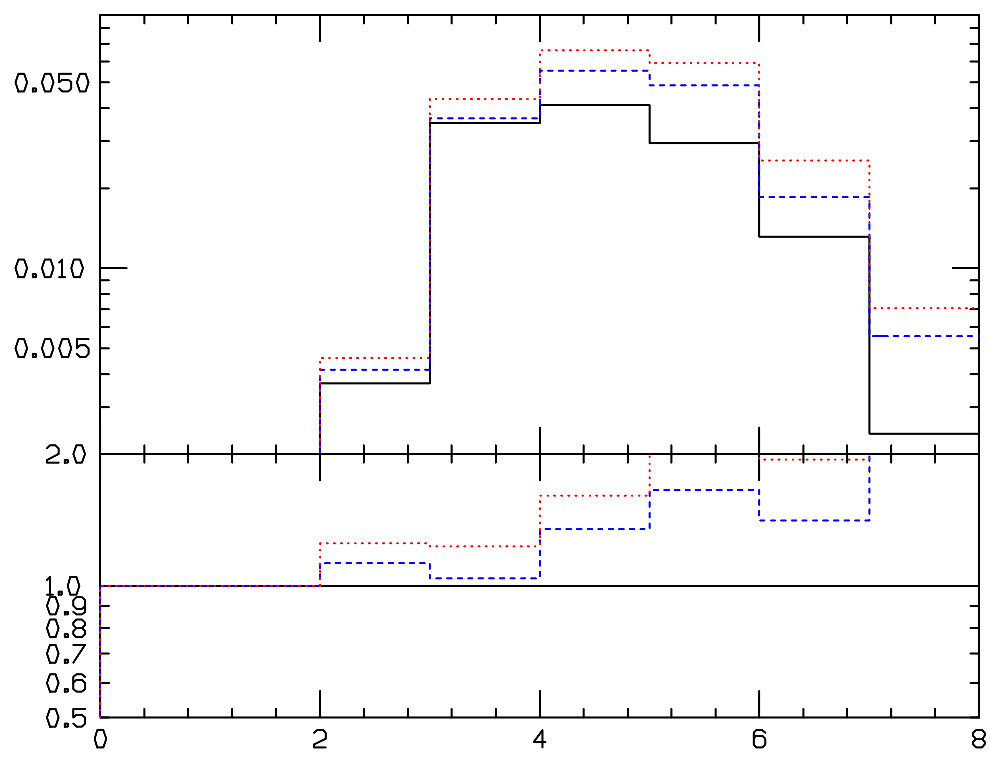
$y(j_2)$


0.10
0.05
0.01
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4
0.040
0.030
0.020
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4

$|\Delta y_{j_1 j_2}|$

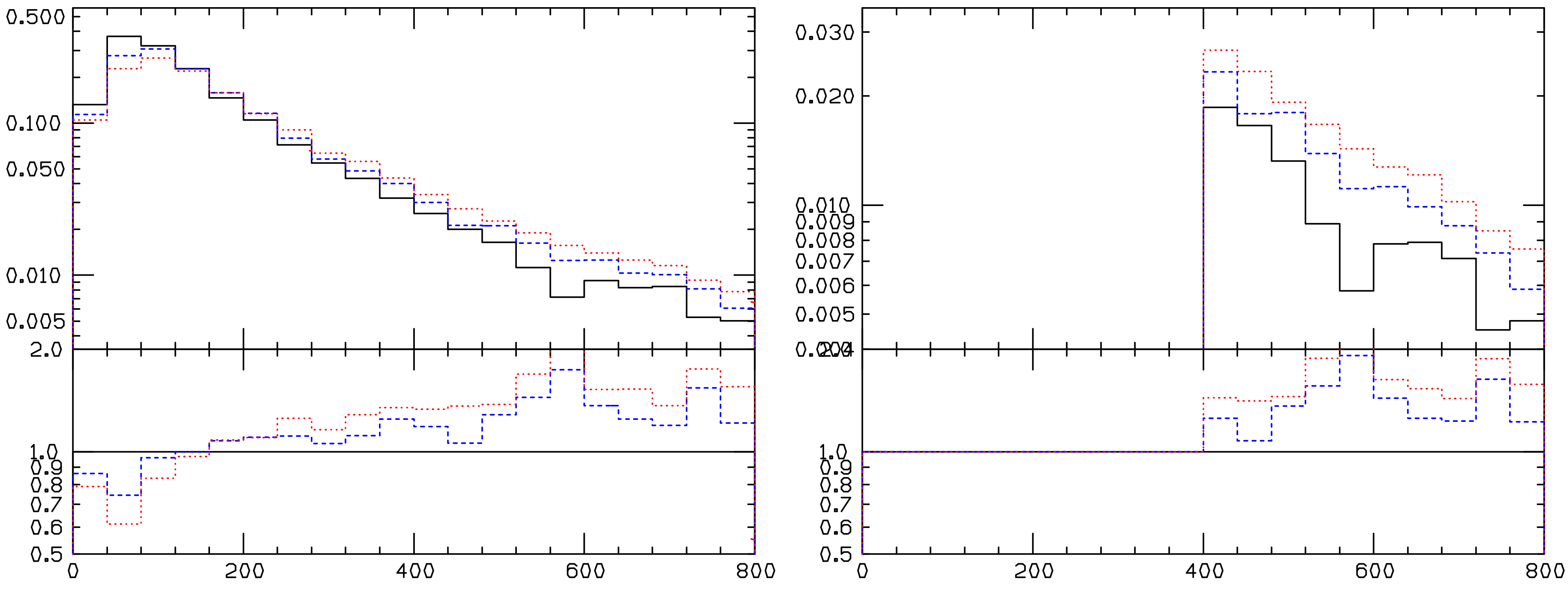


10^0
10^-1
10^-2
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0
2
4
6
8



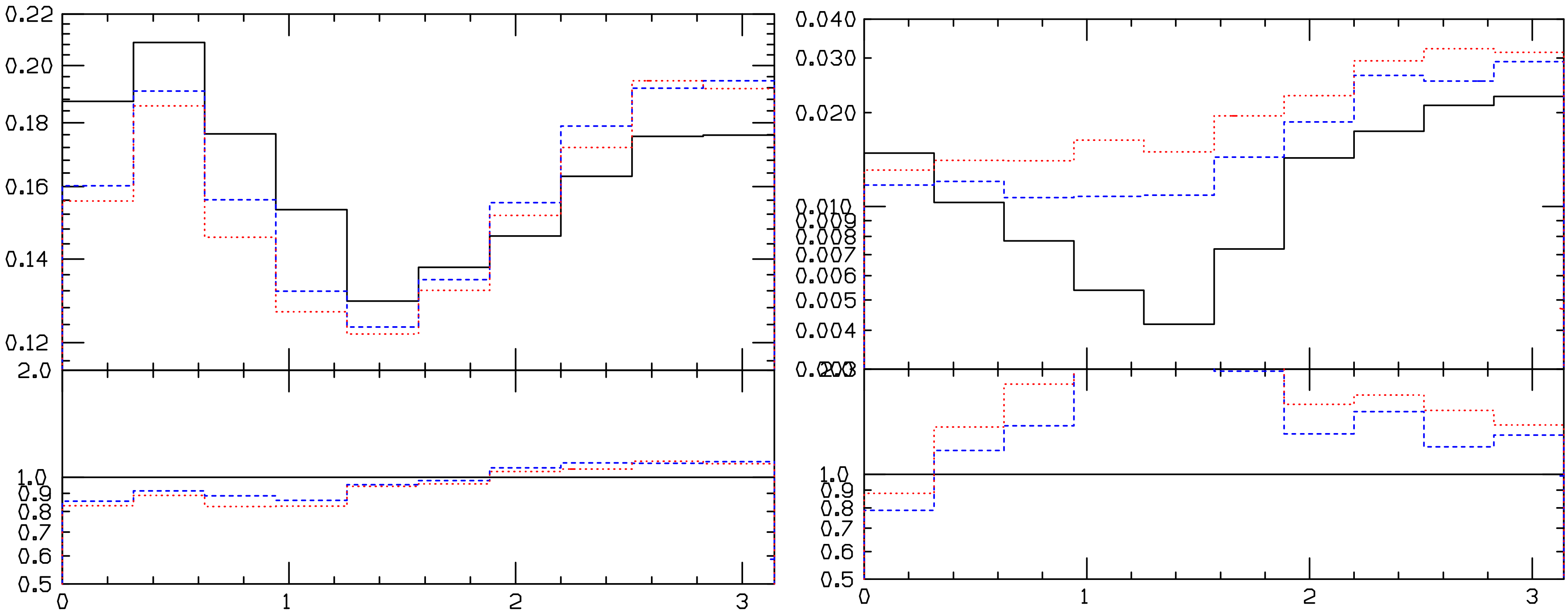
0.050
0.010
0.005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0
2
4
6
8

$M_{j_1 j_2}$

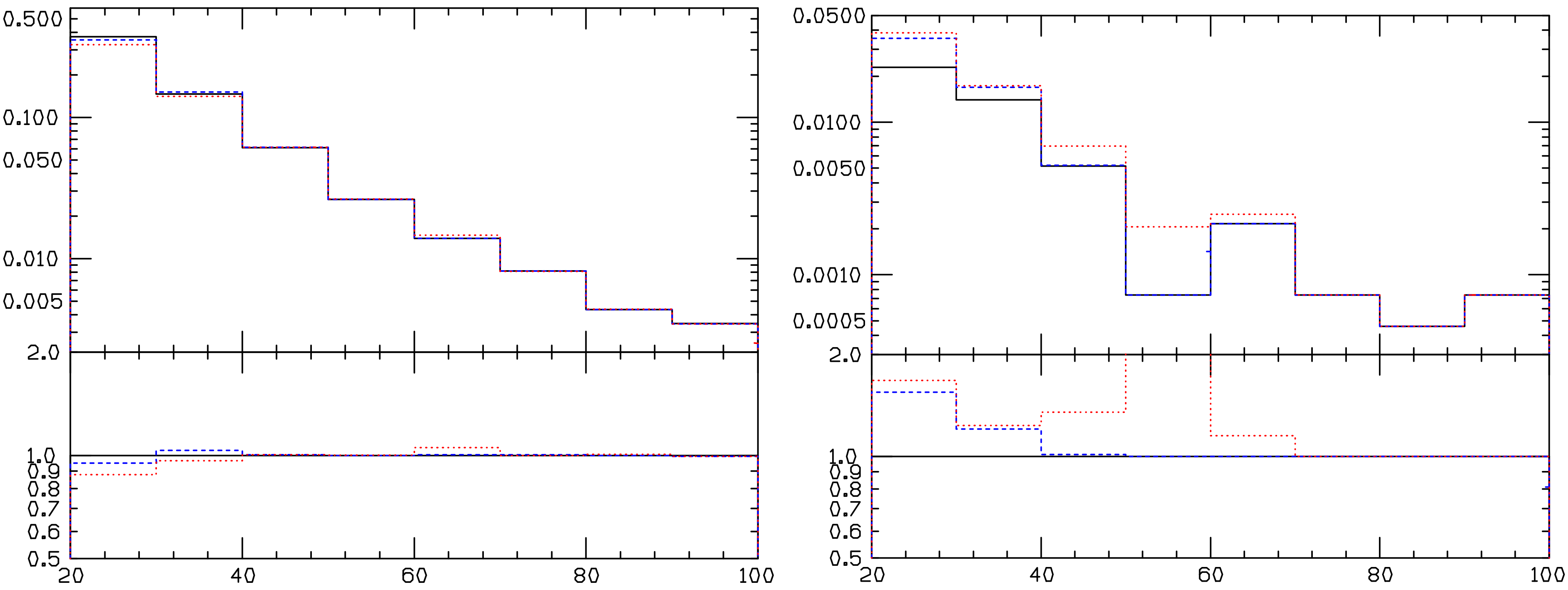


0.500
0.100
0.050
0.010
0.005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0
200
400
600
800
0.030
0.020
0.010
0.009
0.008
0.007
0.006
0.005
1.0
0.9
0.8
0.7
0.6
0.5
0
200
400
600
800

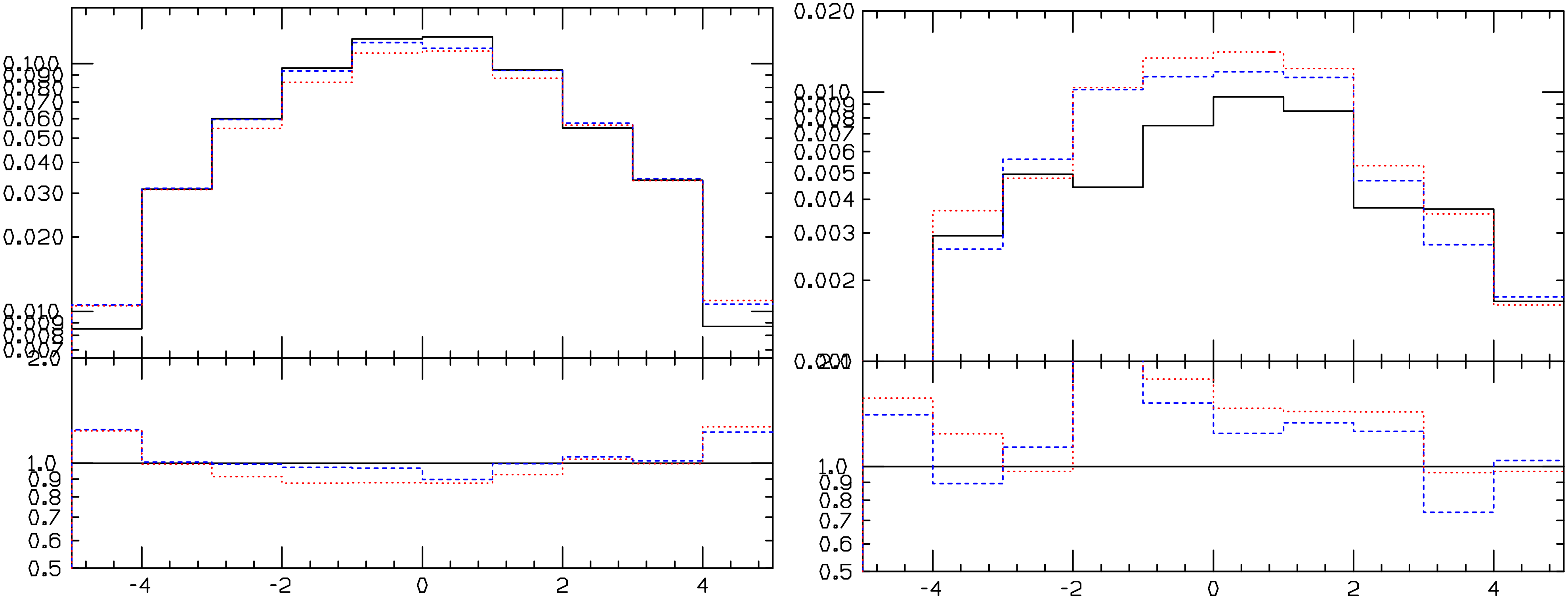
$\Delta\phi_{j_1 j_2}$



$p_T(j_3)$

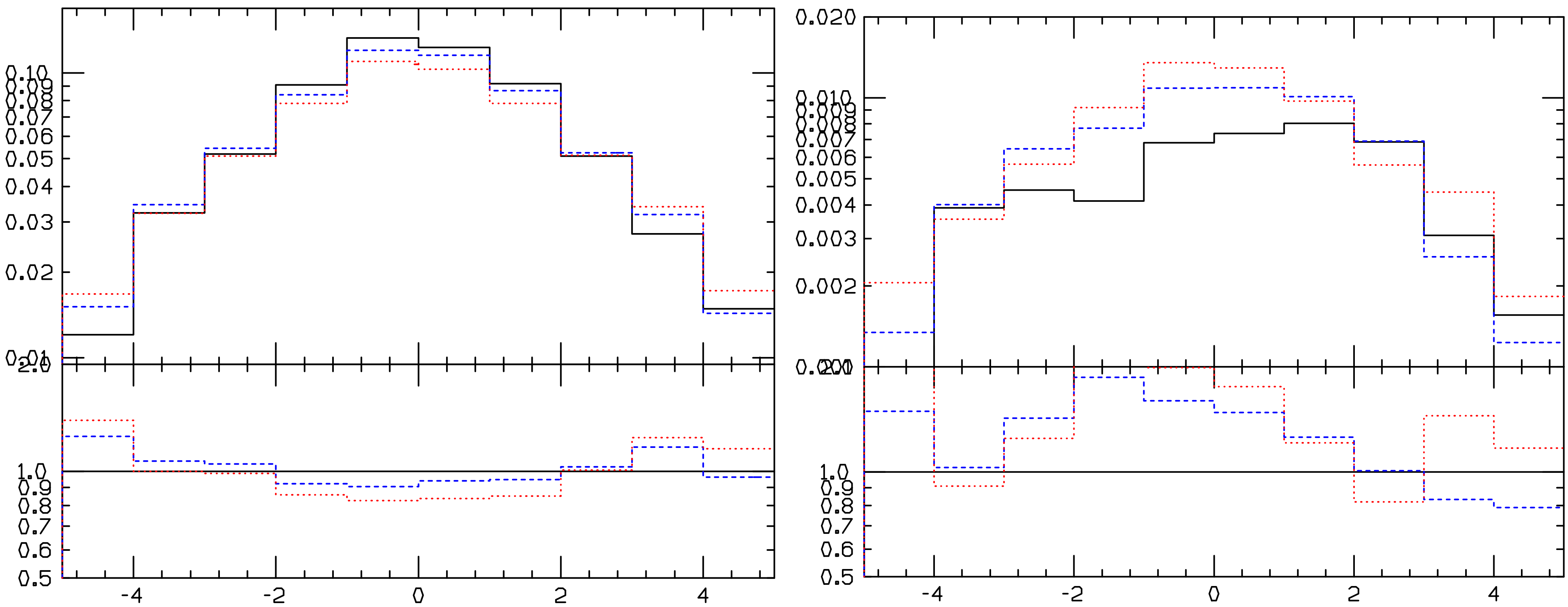

0.500
0.100
0.050
0.010
0.005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
20
40
60
80
100
0.0500
0.0100
0.0050
0.0010
0.0005
2.0
1.0
0.9
0.8
0.7
0.6
0.5
20
40
60
80
100

$y(j_3)$



0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.009
0.008
0.007
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4
0.020
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
2.0
1.0
0.9
0.8
0.7
0.6
0.5
-4
-2
0
2
4

$$y(j_3) - [y(j_1) + y(j_2)]/2$$


0.10
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0.5
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-2
0
2
4

Comments

- The dependence on the merging scale is quite large only when topological cuts are applied – this is driven by large $\Delta y_{j_1 j_2}$. A mismodeling in HW6? In all MCs? Or in MEs?
- The conclusion that one should prefer lower merging scales is tempting, but likely "wrong" (underestimation of uncertainties)
- Unsurprisingly (which is a consistency check on the merging) merged results with $\mu_Q = 30$ GeV are rather similar to un-merged 2-parton ones for most observables. Differences generally follow the expected patterns
- Will need to generate more events (and with more stringent generation cuts, in order to increase the efficiency)