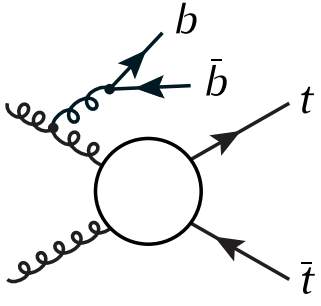
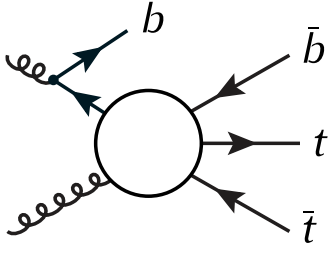
$N_{b-\text{jet}}$ bin migrations in $t\bar{t}b\bar{b}$





- starting from $t\bar{t}b\bar{b}$ production at LO we shower:
  - all the events with Pythia 8.2 (LOPS)
  - only the events that, at LO, belong to $N_{b-\text{jet}} \in \{0, 1\}$ (LOPS cat=1)
  - all the other events (LOPS cat=2)
- to study migration of events across $N_{b-\text{jet}}$ bins due to parton shower

$N_{b\text{-jet}}$ observable

- in bin i the $N_{b\text{-jet}}$ measures the cross section requiring number of b-jets to be $\geq i$
  - 0th bin: the total cross section
  - 1st bin: includes the cross section of 2nd bin it it, etc.

- b-jets:
  - anti-k_t, $R = 0.4$
  - cuts: $p_T > 25$ GeV, $\eta < 2.5$

- 2nd bin at LO
  - b partons form two b-jets that both satisfy the cuts

- 1st bin at LO
  - b partons merged into one b-jet that satisfies the cuts
  - b partons form two b-jets and one escapes the cuts

- 0th bin at LO
  - b partons merged into one b-jet that escapes cuts
  - b partons form two b-jets that both escape cuts

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ΔR shift
p_T shift
both

- 1st bin at LO
  - b partons merged into one b-jet that satisfies the cuts
  - b partons form two b-jets and one escapes the cuts
- 0th bin at LO
  - b partons merged into one b-jet that escapes cuts
  - b partons form two b-jets that both escape cuts

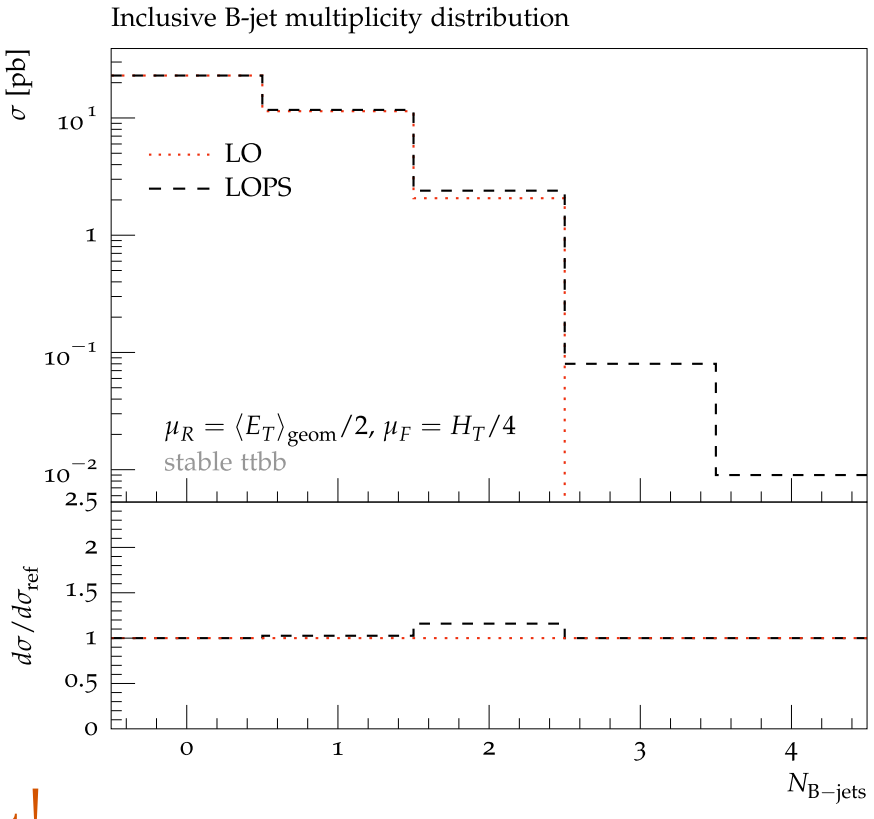
category 1

- 2nd bin at LO
  - b partons form two b-jets that both satisfy the cuts

category 2

$N_{b\text{-jet}}$ and parton shower

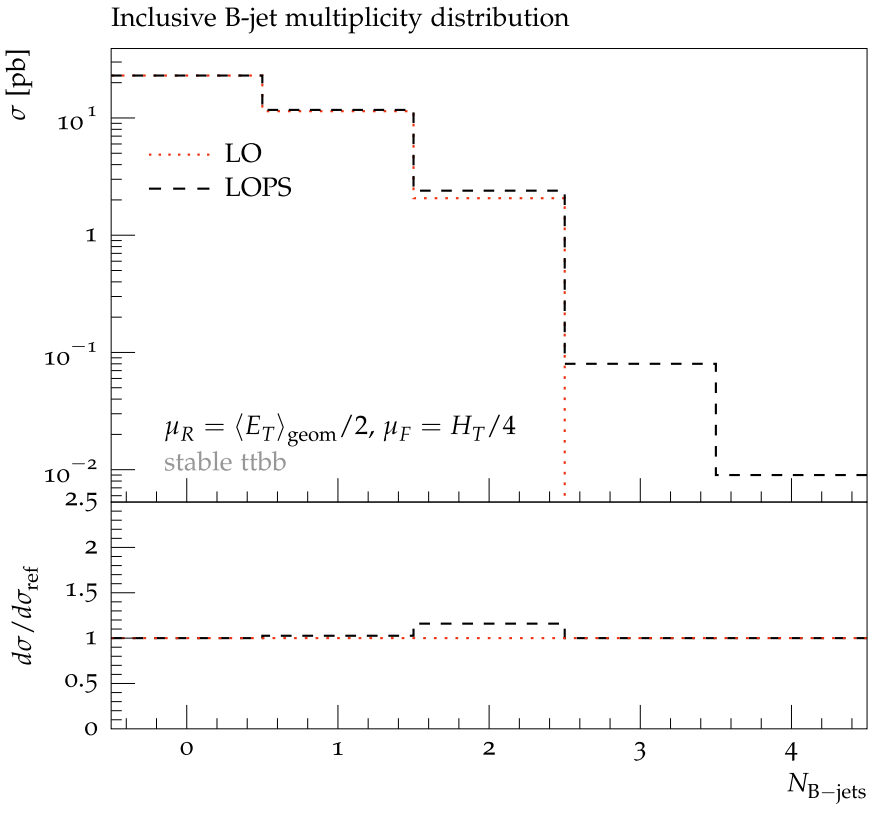
- Parton shower
  - generates emission that gets clustered into b-jets
  - gives recoils to b-partons through momentum reshuffling
  - creates new b-partons via "double-splittings"
- That is:
  - it can move an event from one bin to another bin of $N_{b\text{-jet}}$
  - but not destroy or create new events



Parton shower is a unitary on $N_{b\text{-jet}}$!

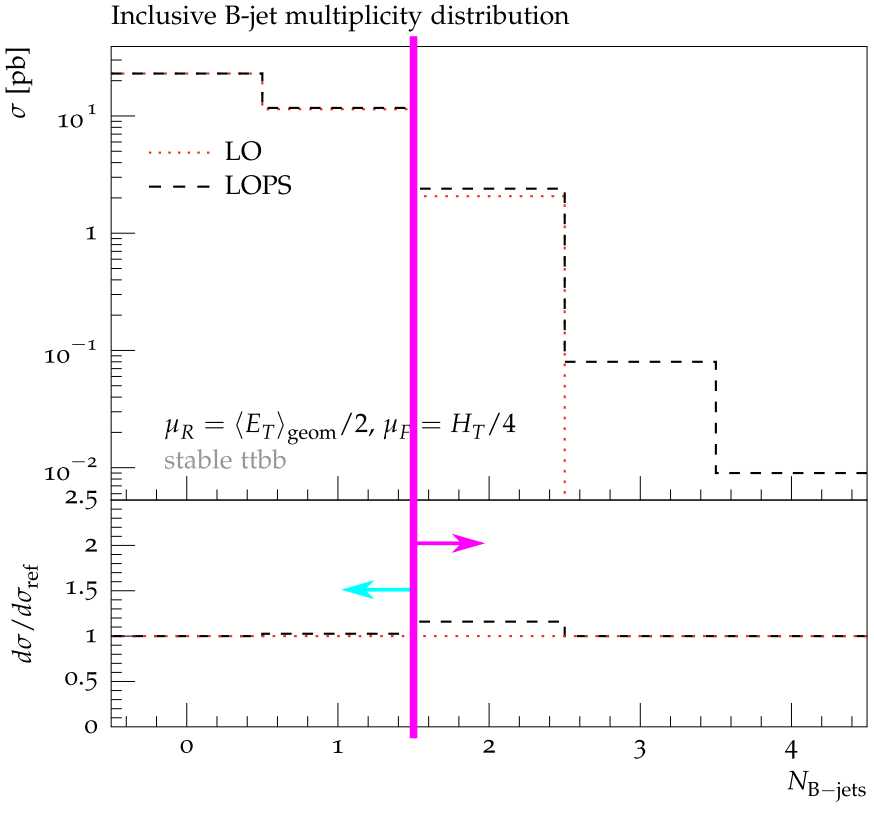
$N_{b\text{-jet}}$ and parton shower

- Parton shower
  - generates emission that gets clustered into b-jets
  - gives recoils to b-partons through momentum reshuffling
  - creates new b-partons via "double-splittings"
- Bin migrations can be large
  - $LO(N_{b\text{-jet}} \geq 0)/LO(N_{b\text{-jet}} \geq 2) \sim 11$
  - $N_{b\text{-jet}} \geq 2$: LOPS/LO $= 1.16$



$N_{b-\text{jet}}$ bin migrations

- We study bin migration across the $N_{b-\text{jet}} \geq 1$ boundary
- `scalup` dependence
  - Multiply the default $H_T/4$ by 2 and 4
- Impact of the first emission vs. the rest
  - We veto all emissions after the first emission has been generated
- We do the same for LHE and NLOPS



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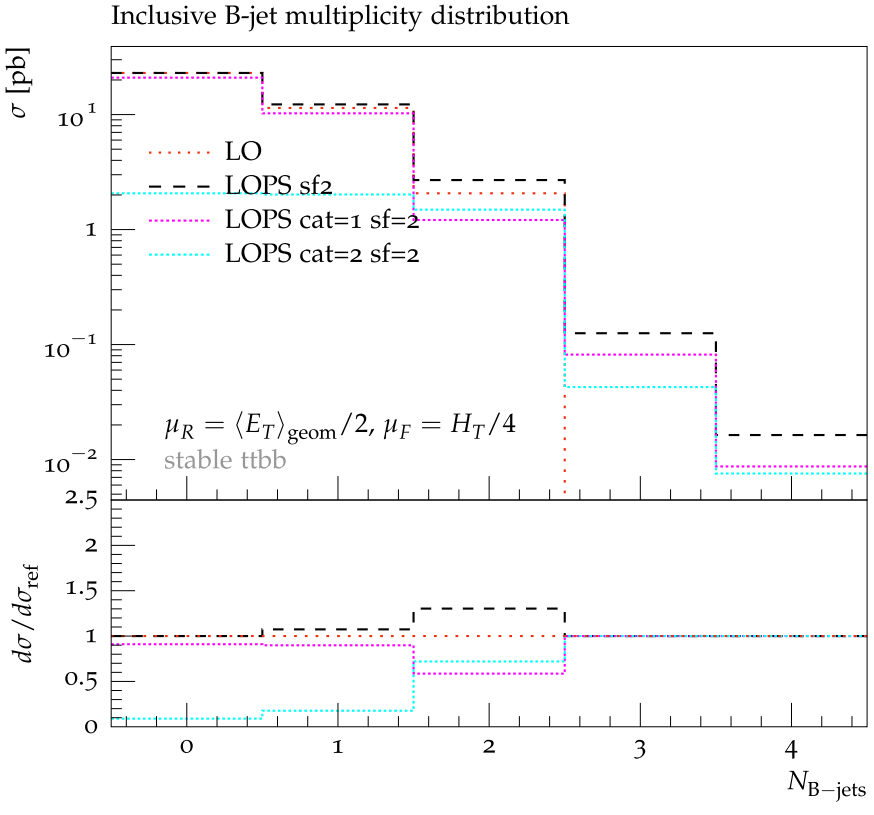

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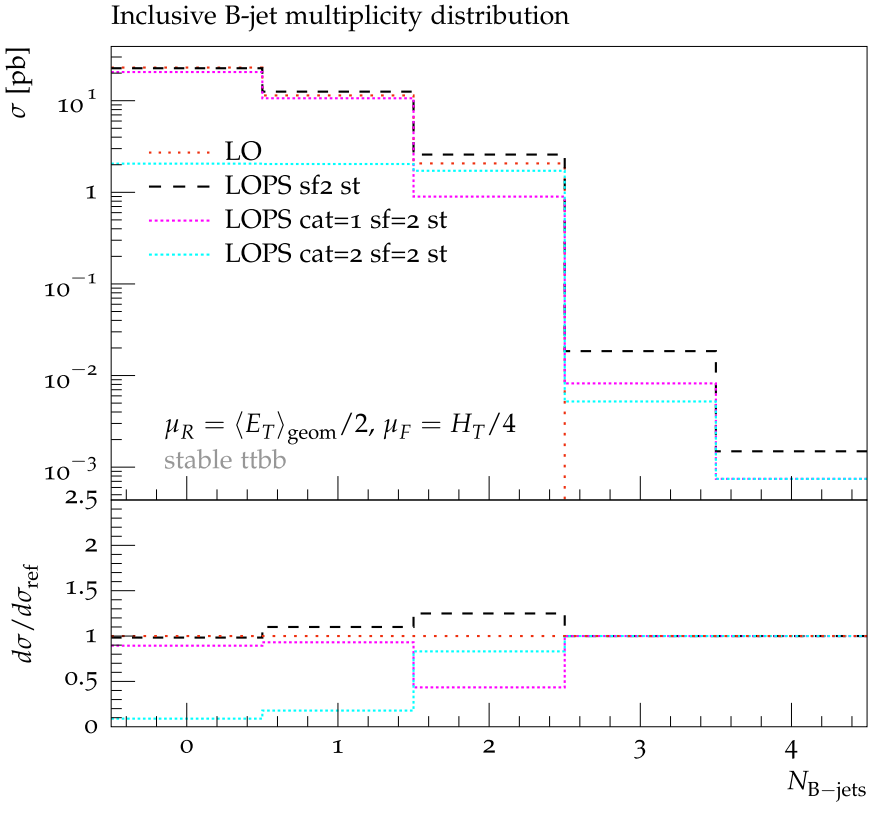

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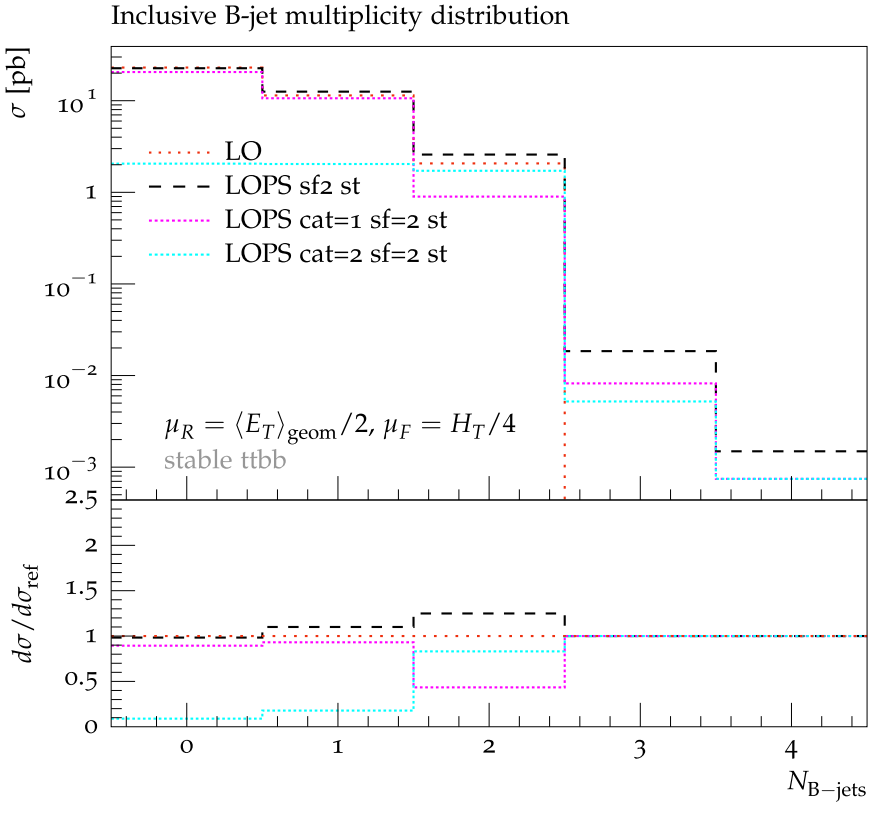

Results

- LO vs LOPS
  - Negative migration
    - only weakly dependent of scalup (esp. cont. of higher emissions)
    - interpreted as fragmentation effect
  - Positive migration
    - dominates the total migration effect
    - strong scalup dependence, dominated by 1st emission

muR,muF	muQ	cat=1 (first/higher)	cat=2 (first/higher)	total (first/higher)
def/2,HT/4	HT/4	+42.5 (+32.2/+10.3)	-26.6 (-13.6/-13.0)	+16.0 (+21.4/- 5.4)
def/2,HT/4	HT/2	+58.6 (+43.4/+15.2)	-28.0 (-16.8/-11.2)	+30.3 (+24.9/+ 5.4)
def/2,HT/4	HT	+71.0 (+51.3/+19.7)	-30.8 (-18.0/-12.8)	+40.2 (+33.3/+ 6.9)
def/2,HT/4	HT - HT/4	+28.5 (+19.1/+ 9.4)	- 4.2 (- 4.4/+ 0.2)	+24.2 (+11.9/+12.3)

- LHE vs NLOPS

muR,muF	cat=1	cat=2	total
def/2,HT/4	+ 32.5	- 21.8	+ 11.7