Very preliminary study with new generator for $t\bar{t}$ production including NLO corrections to decays

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Work in progress with Ellis,Campbell,Re.

- Besides NLO corrections in production, we can include NLO corrections in t and W decays in the narrow width approximation.
- Finite top width effects accounted for with LO accuracy.

WARNING: very preliminary work!

Needs more checking in the `Pythia8-POWHEG` interface. Take it only as an indication of how to proceed with analysis involving end-point observables.

Some plots

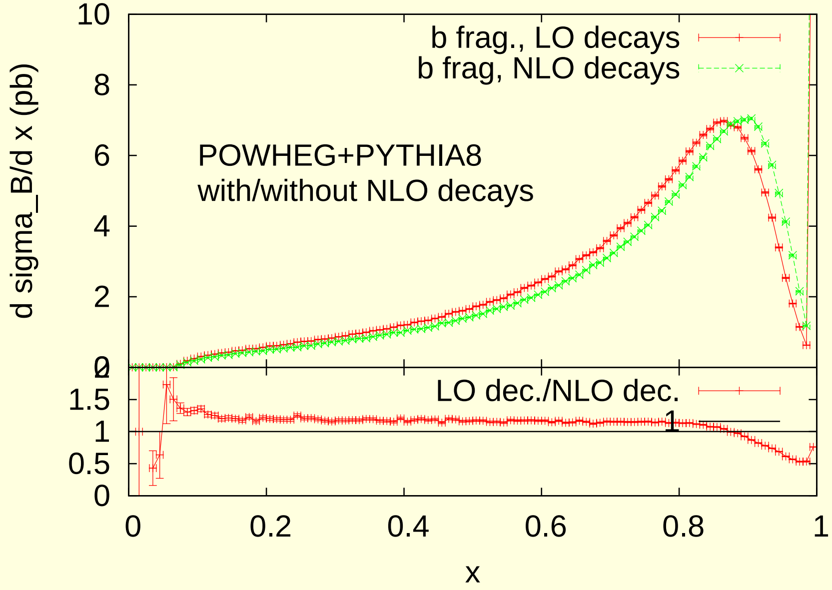
We have generated LH events for leptonic top decays (e^+, μ^-), with radiation in decays not included (LO Dec) and included (NLO Dec).

The events of the LO Dec sample were fed to `Pythia8`, with no further action. Pythia8 takes care of adding radiation in top decays.
The events of the NLO Dec sample were fed to `Pythia8`. Care was taken to compute the transverse momentum of radiation in top decays (in the top rest frame) and instruct `Pythia8` to veto radiation in resonance decays (using `canSetResonanceScale` and `scaleResonance` in `UserHooks` class)

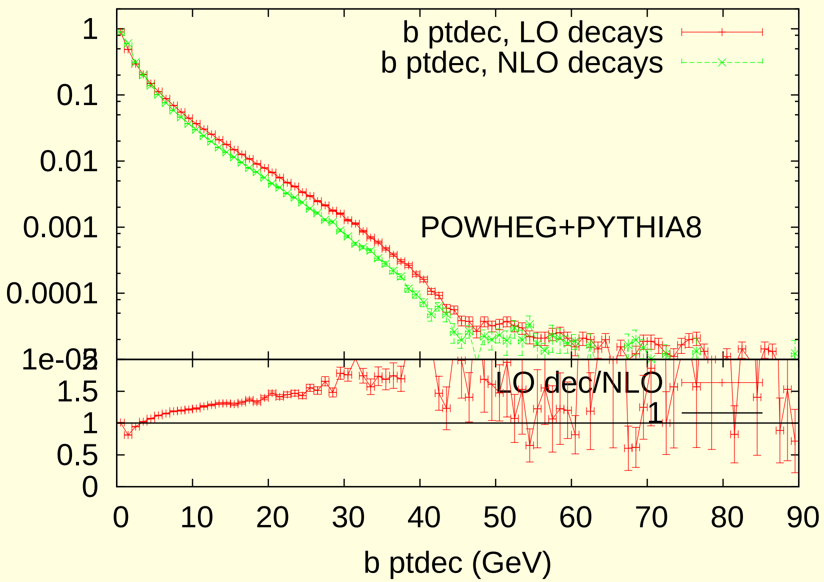
In the following plots:

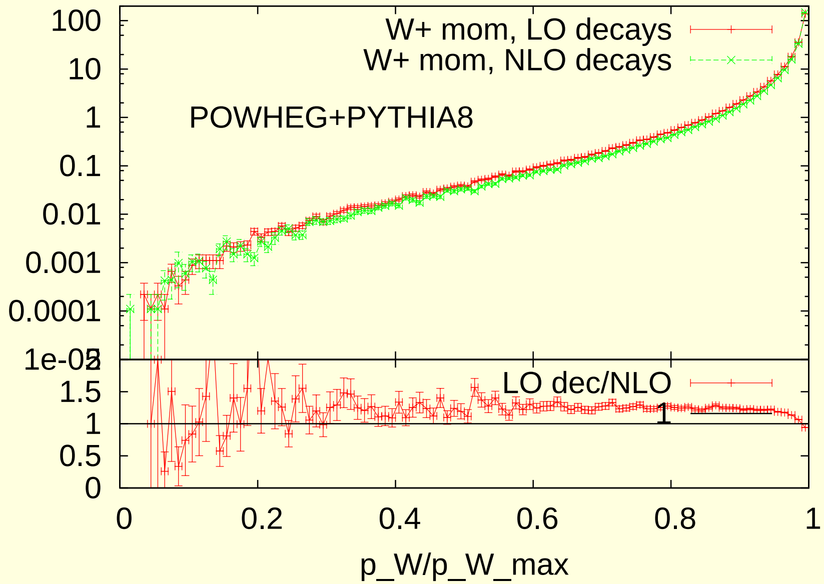
- b stands for the hardest b flavoured hadron (not $\bar{b}$!)
- W^+ stands for the MC truth (last in hep block) W^+
- l^+ stands for fermion coming from $t \to W^+ \to l^+$ (MC truth)
- $b\,\mathrm{jet}$ stands for anti-kt $b\,\mathrm{jet}$ ($R = 0.5$, undecayed B meson!!)

b fragmentation properties in t decays



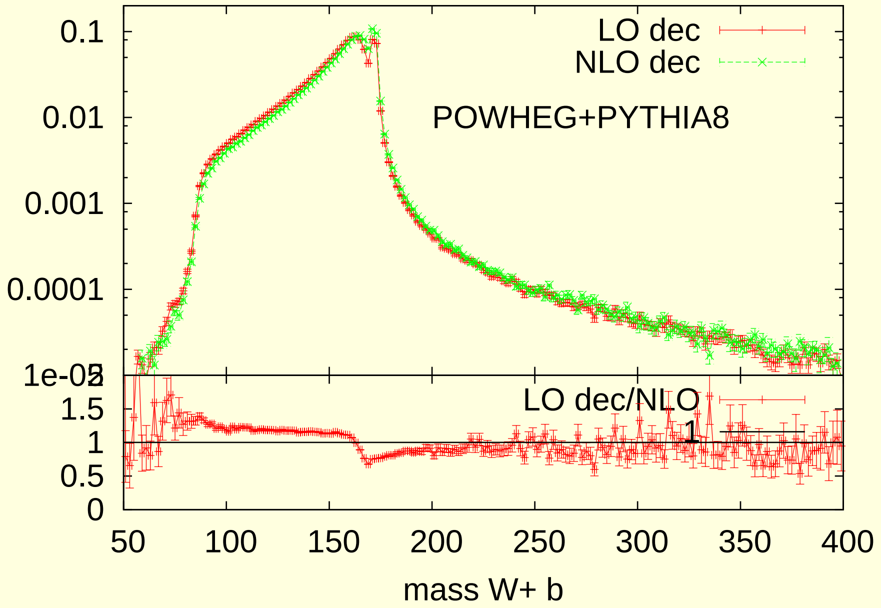
Observables computed in t rest frame.
b stands for hardest b flavoured hadron

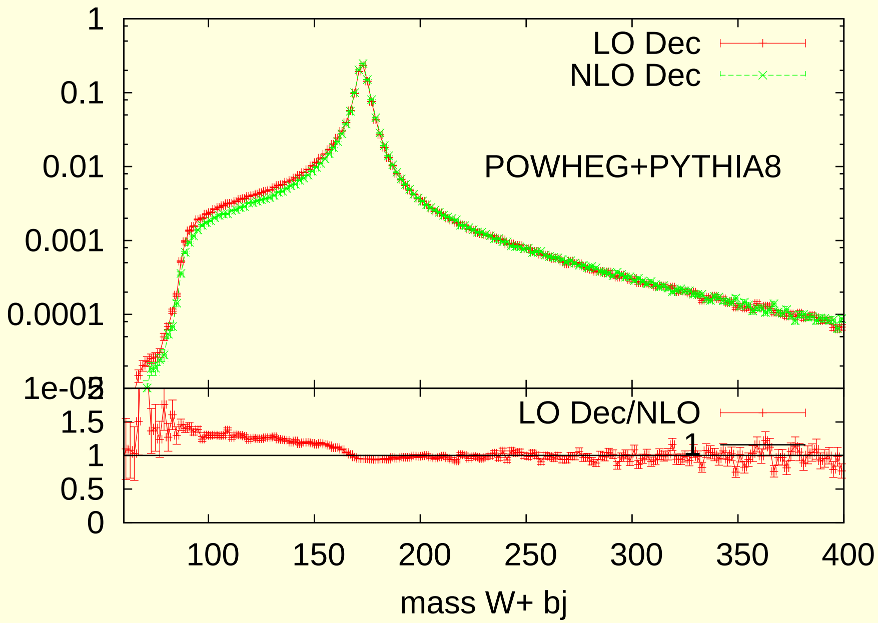




- No attempt made to tune Pytia8. These plots may be considered as a first step towards giving realistic simulation of b production in top events. Further work needed:
  - Validate Pythia8 b fragmentation model by tuning Z decays to $b\bar{b}$ fragmentation functions in both frameworks (POWHEG+Pythia8, Pythia8 standalone)
  - Verify if compatible results are obtained with the two setup
- Marked peak at $x=1$ in both cases (is it realistic? Not there in Z decays?)
- Sensibly different b fragm. functions and transverse momentum properties.

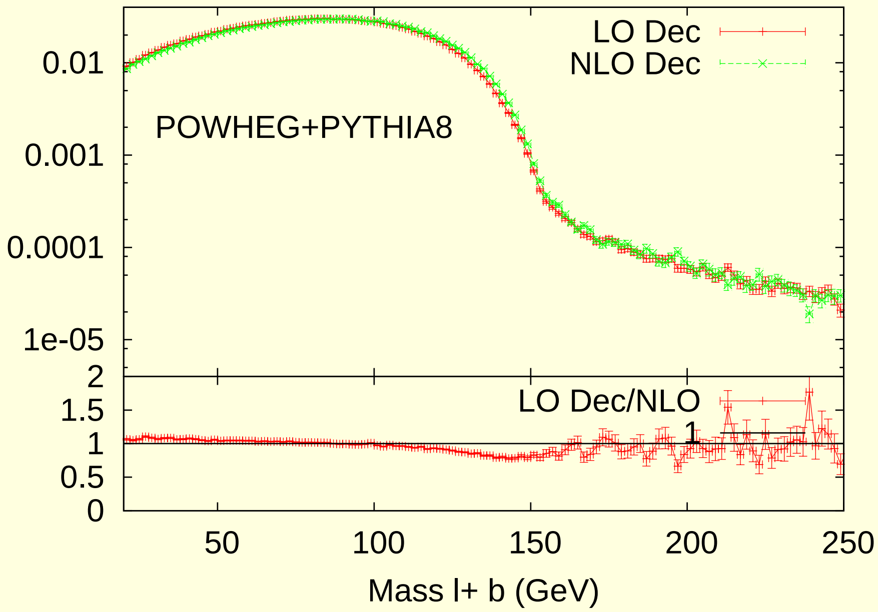
t mass (pseudo) observables

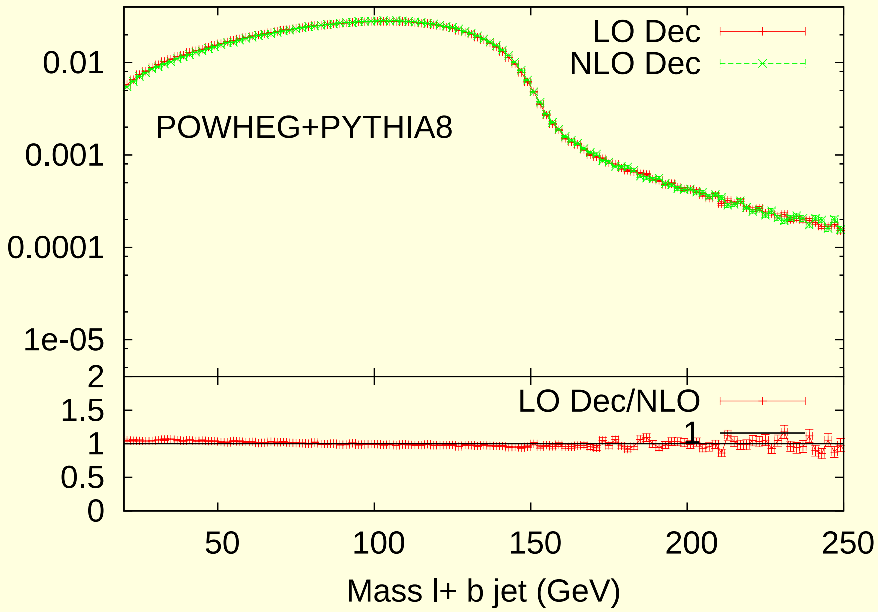




Notice small peak in W^+b plot, due to $x=1$ peak in b fragmentation function.

Sensibli different shapes around the top peak.





Effect of different fragmentation behaviour shows up in M_{l+b}, but not in $M_{l+b\,\mathrm{jet}}$.

Only caveat: the two results on b fragmentation may turn out more compatible if the two approaches are tuned using $Z \to b\bar{b}$ data.