ggF Higgs XS WG
Higgs p_T discussion - introduction

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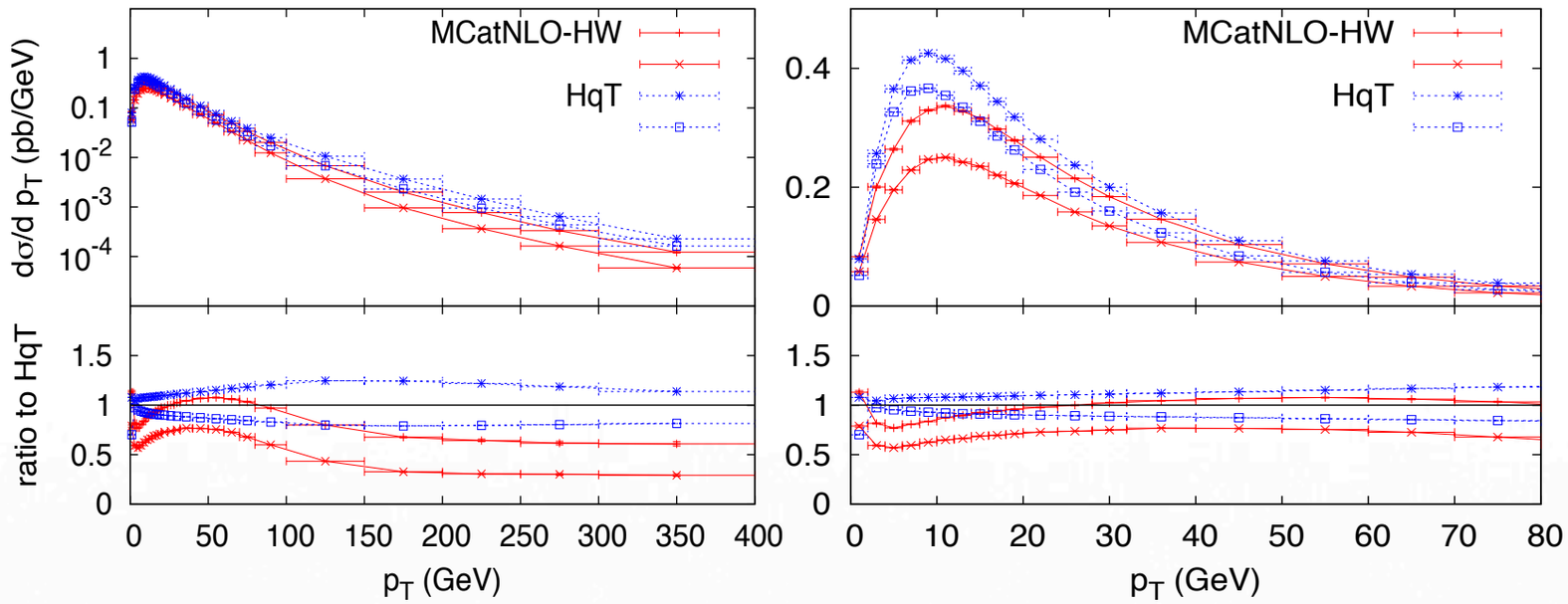
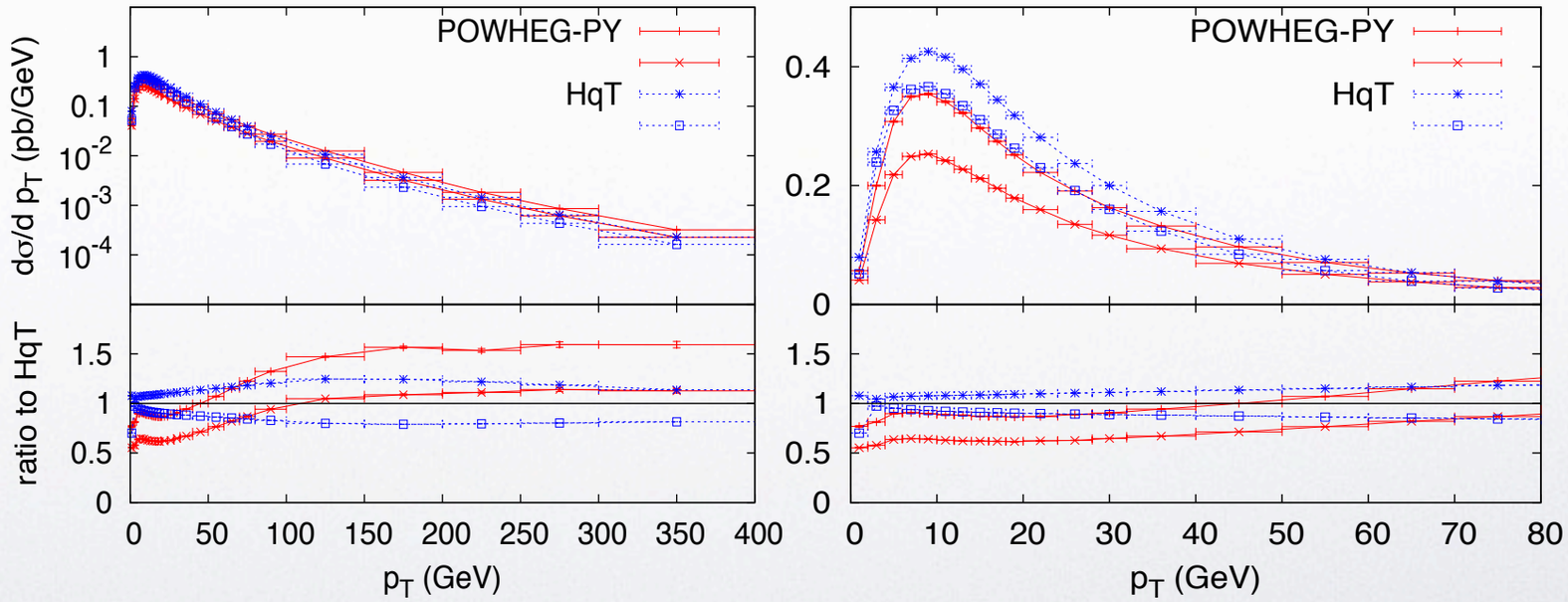
From YR2 Higgs p_T spectra

HqT is a parton level calculation able to evaluate inclusive observables (like Higgs p_T) at NLO+NNLL (next-to-next to leading log).

The use of resummation allow to include the effect of the parton shower (nominally at Leading Log) on the recoil of the Higgs boson.

Differences in the p_T spectrum predicted by MC@NLO, Powheg and HqT were observed.





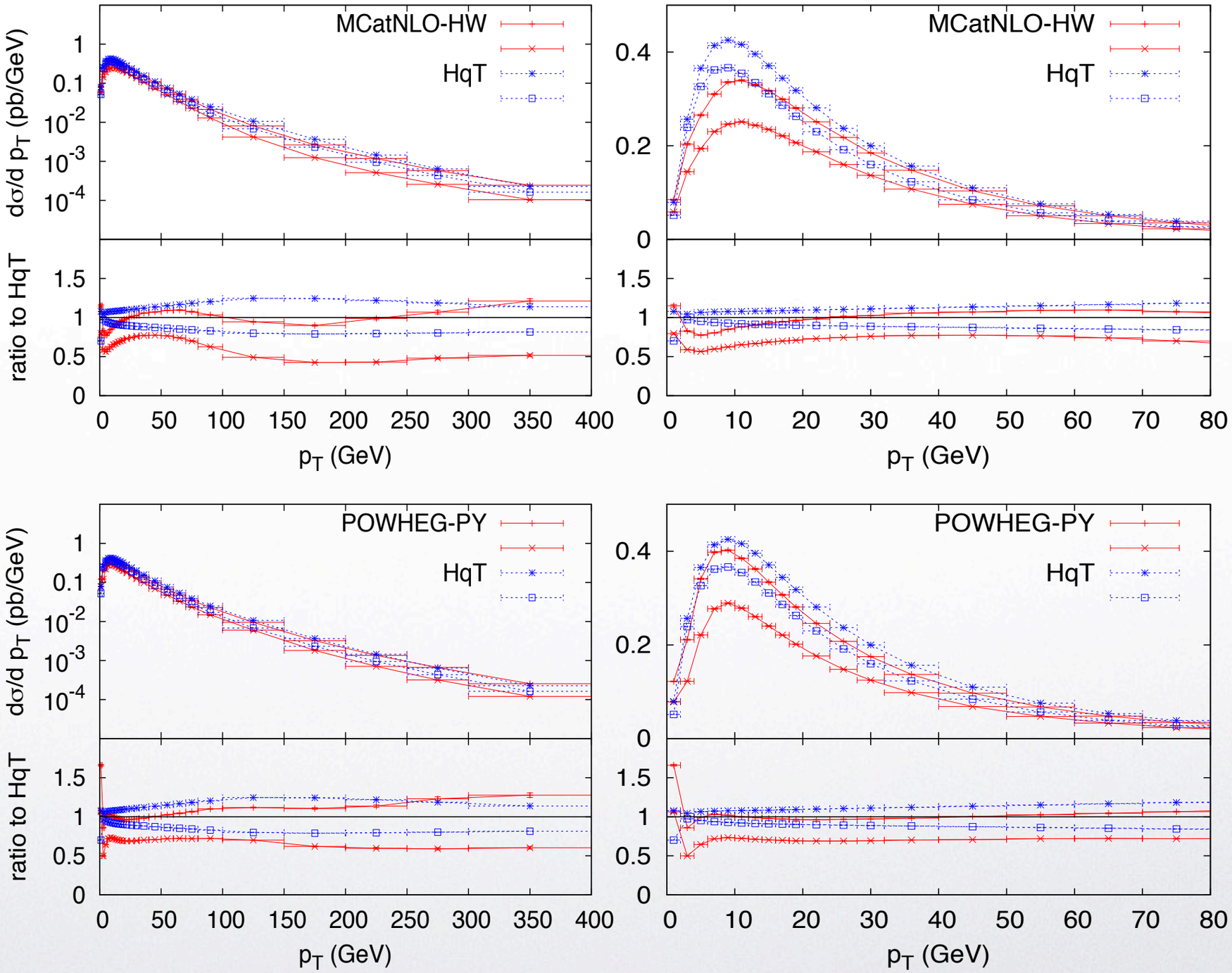
Renormalisation and factorisation scales are set at m_H in HqT and at the transverse energy in MC@NLO ~sqrt($p_T^2 + m_H^2$).

Modified MC@NLO and Powheg spectra.

MC@NLO with scale set at m_H, recovers the behaviour at high p_T.

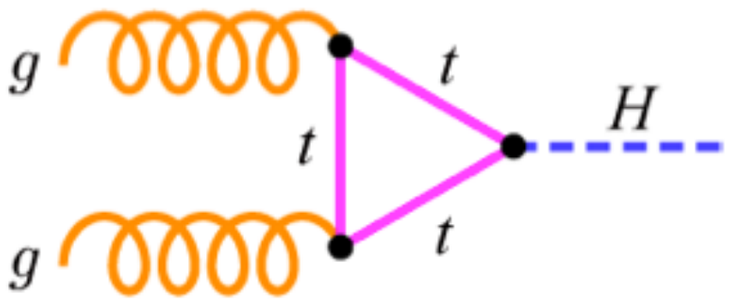
In Powheg a new parameter was introduced *hfact* that works as a dumping factor for the Higgs p_T

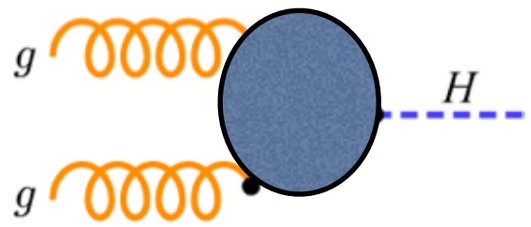
From YR2



Finite quark mass effect.

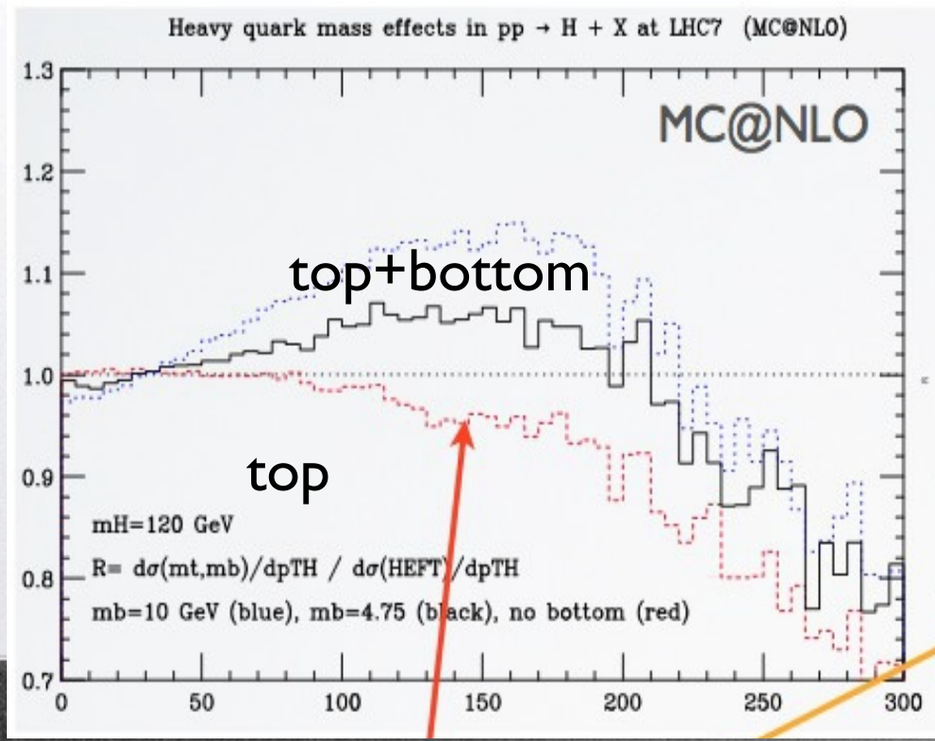
Higgs production was simulated in the $m_t \to \infty$ limit until recently.

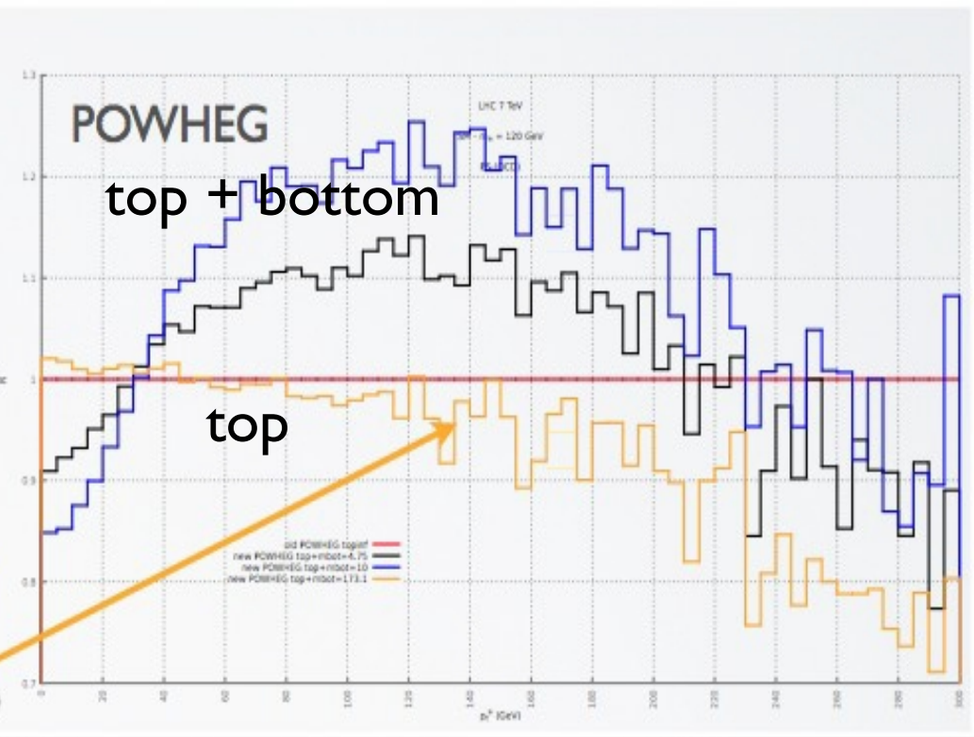




Effective lagrangian with point-like coupling.

Last year finite quark mass effects, t and b, were introduced in Powheg andMC@NLO 4.09. Relevant difference are observed in MC@NLO and Powheg.

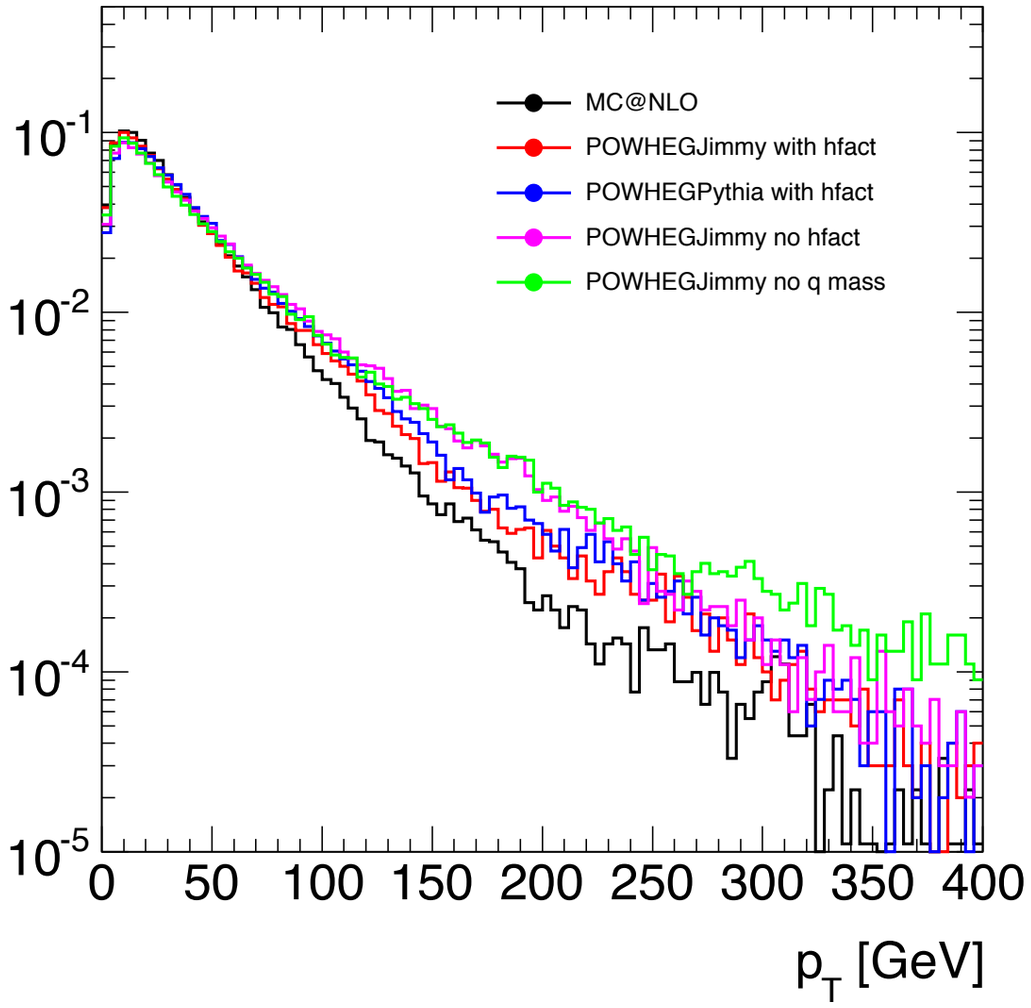


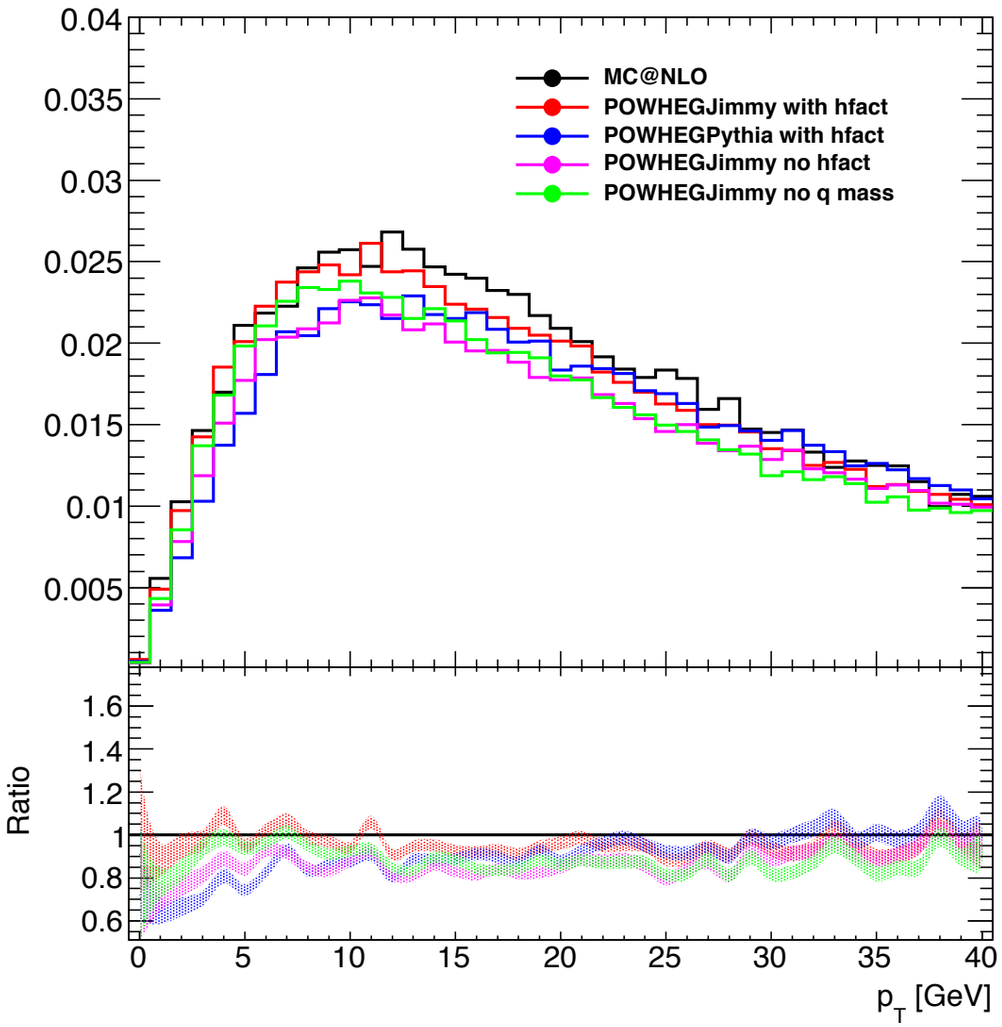


The HQ mass effect is more sizable in Powheg, and MC@NLO matches the parton level calcuations when the scale is set at m_H. The main difference is in the bottom contribution where a new scale $m_b << m_H$ enters in the game (see M. Grazzini talk).

The top contributions seems fine given that $m_t \sim m_H$.

Full comparison (YR3)





Comparison among generators, with Hq mass and hfact.
Low p_T region is dominated by the showering (good match between MC@NLO+Herwig and Powheg+Herwig, deviation with Powheg+Pythia, but it is ok because is part of the showering systematics, the difference is mainly at high p_T.

- at High pT difference between MC@NLO and HRES comes from the use of a fixed scale in HRES and a dynamic scale in MC@NLO;

- At low p_T there is a still a deviation of Powheg with hfact from HRES, and there is also large effect coming from the showering, the different showers used in default ATLAS and MC@NLO will take care of this effect.

- The HQ mass effect has different impact on Higgs pT if implemented in Powheg or MC@NLO (the reason for that seems to be finally understood, more in the next talks).

Preliminary recommendation in ATLAS.

- Nominal ATLAS MC for Higgs simulation

  - Powheg + Pythia8, with Heavy Quark mass effect (t,b) simulated, hfact = m_H/1.2 and renormalisation and factorisation scales set at m_H

- Recommended procedure for uncertainty evaluation

  - Use HRES to evaluate renormalisation, factorisation and resummation scale uncertainties (renormalisation and factorisation scales varied by a factor 2 around the nominal scale m_H, resummation scale changed from m_H/2 to m_H);

  - add the difference between Powheg (with HQ mass effect) and MC@NLO 4.09 with t,b HQ mass effects to take into account several effacts:

Conclusion

Hopefully we will have a more complete understanding of the Powheg-MC@NLO difference and impementation in HRES in the next talks, can we come out with a final recommendation in term of scale variations in the 3(2) scale problem? $m_{b,(}m_H, m_t)$