

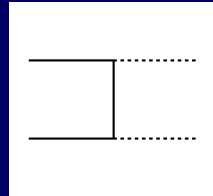
# Experimental needs: Summary

# Presentations:

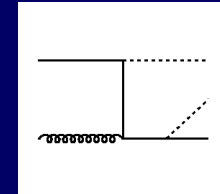
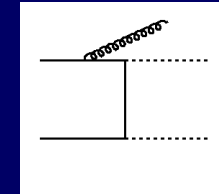
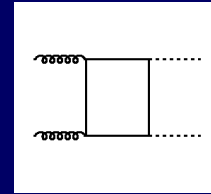
- G. Unal: Experiences with NLO programs for the  $pp \rightarrow \gamma\gamma$  channel
- V. Drollinger : HO effects in  $ttH \rightarrow lvqqbbbb$  - searches at LHC
- S. Paganis :  $tt$  production studies using various MCs
- A. Schälicke : Merging of ME and PS at LO
- S. Frixione : MC@NLO
- D. Soper : NLO QCD with parton showers

# G. Unal : $pp \rightarrow \gamma\gamma$

- Contributions:

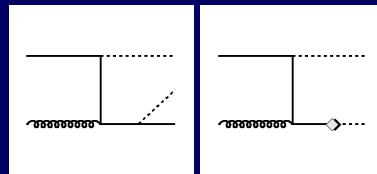


+



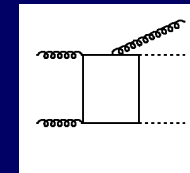
- Calculations used :

- DIPHOX:



Higher orders +  
fragmentation effects

- Analytical calculation by Bern, Dixon, Schmidt  
for NLO contributions to box



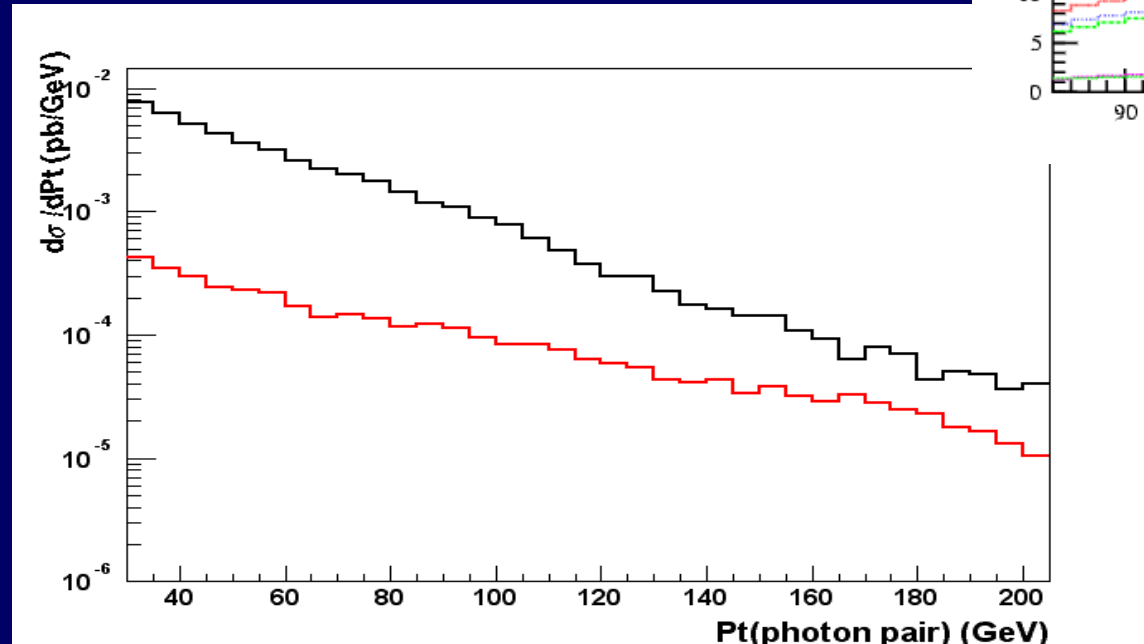
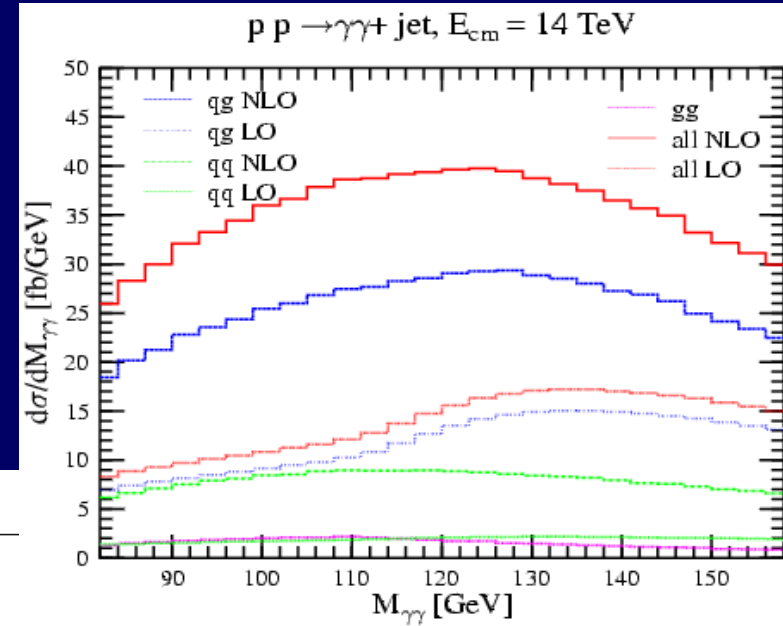
NLO traps:

Separating background into different contributions:

Bremsstrahlung = direct+fragmentation, only sum is meaningful

Cut on  $Pt(\text{pair}) \Rightarrow$  improves  $S/B$  (by  $\sim 3-5$ )  
worse  $S/\sqrt{B}$  (by  $\sim 0.6$ )

$Pt(\gamma) > 40 \text{ GeV}$ ,  $Pt(\text{jet seen}) > 40 \text{ GeV}$ ,  
Isolation in 0.4 cone



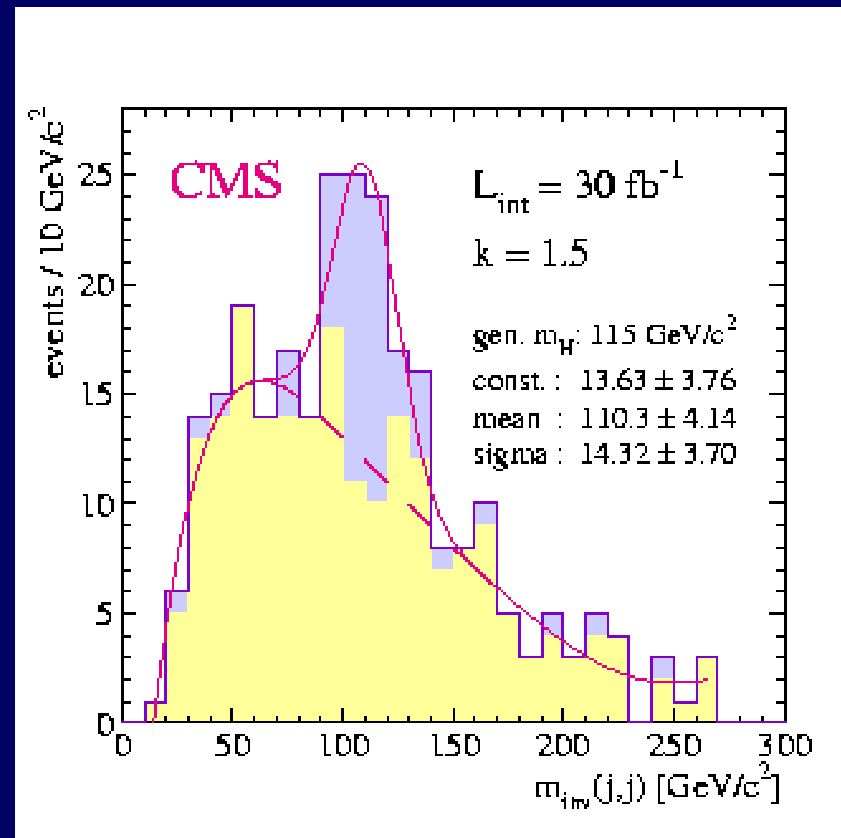
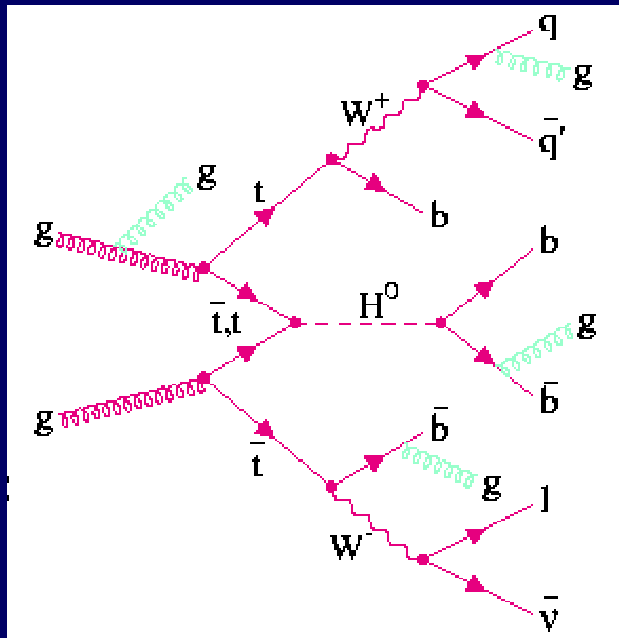
NLO changes the shape !!!  
No universal K-factor

# Consequences:

1. Intrinsic limitations of fixed order matrix element computations:  
« Low » Pt part not well described => Resummation  
Up to which Pt are these effects important ?
2. Parton level limitations: Isolation cut « crudely » modelled.  
Would need fragmentation+underlying event +... to do a better job
3. Put NLO into parton shower program ?
  - Fix (at least partially) low pt part
  - Isolation better described

# V. Drollinger: $ttH \rightarrow lvqqbbbb$

- Signal calculated with ME generator (CompHEP), used Pythia to generate radiation.
- “Flat peak” over complicated background (+combinatorial), not clear how to extract background from data.

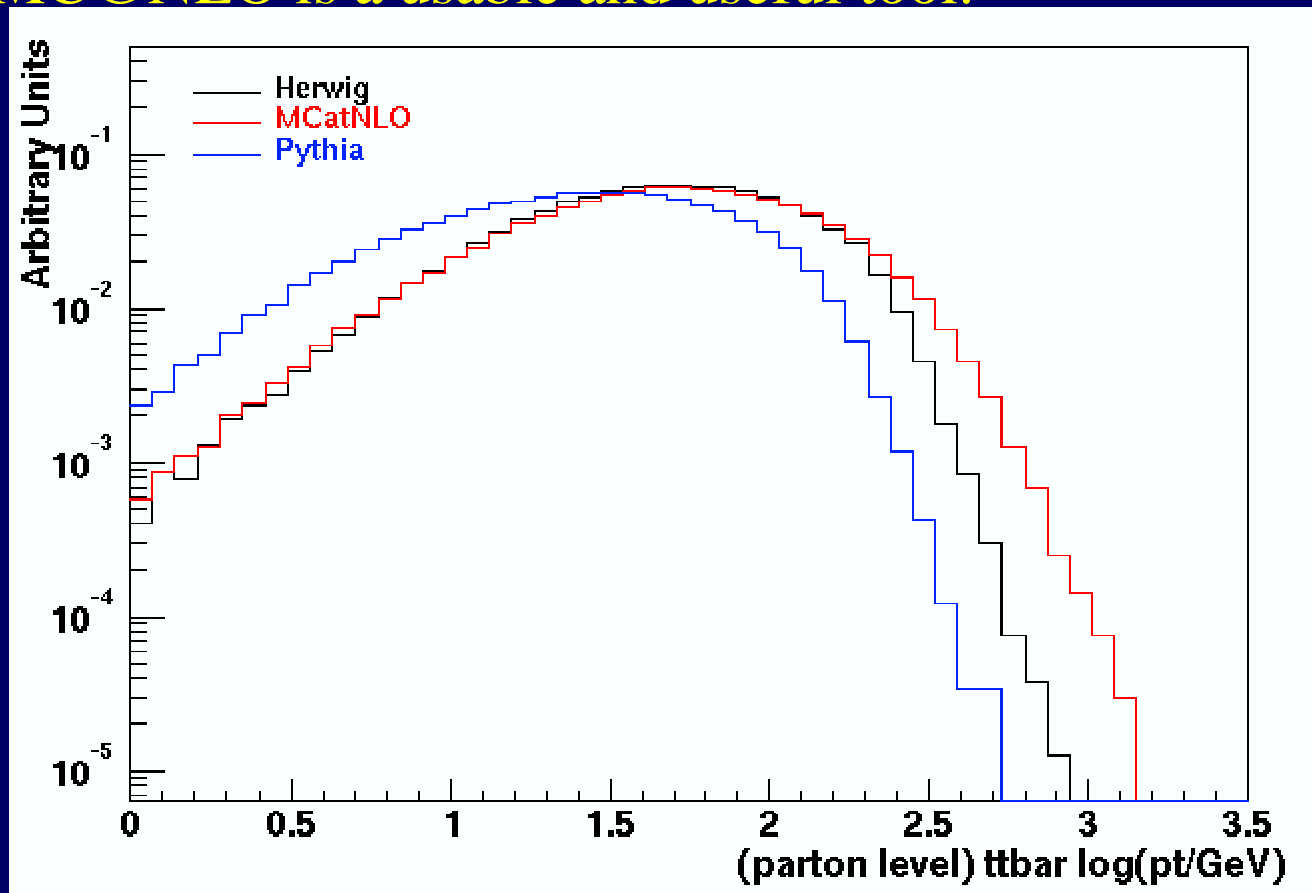


## Consequences:

1. Need for multi-particle production matrix element generators + a merging to parton showers, fragmentation, etc. .
2. If higher (i.e. loop) order is needed the idea would be to have MC@NLO for individual pieces + spin correlations for the decays.

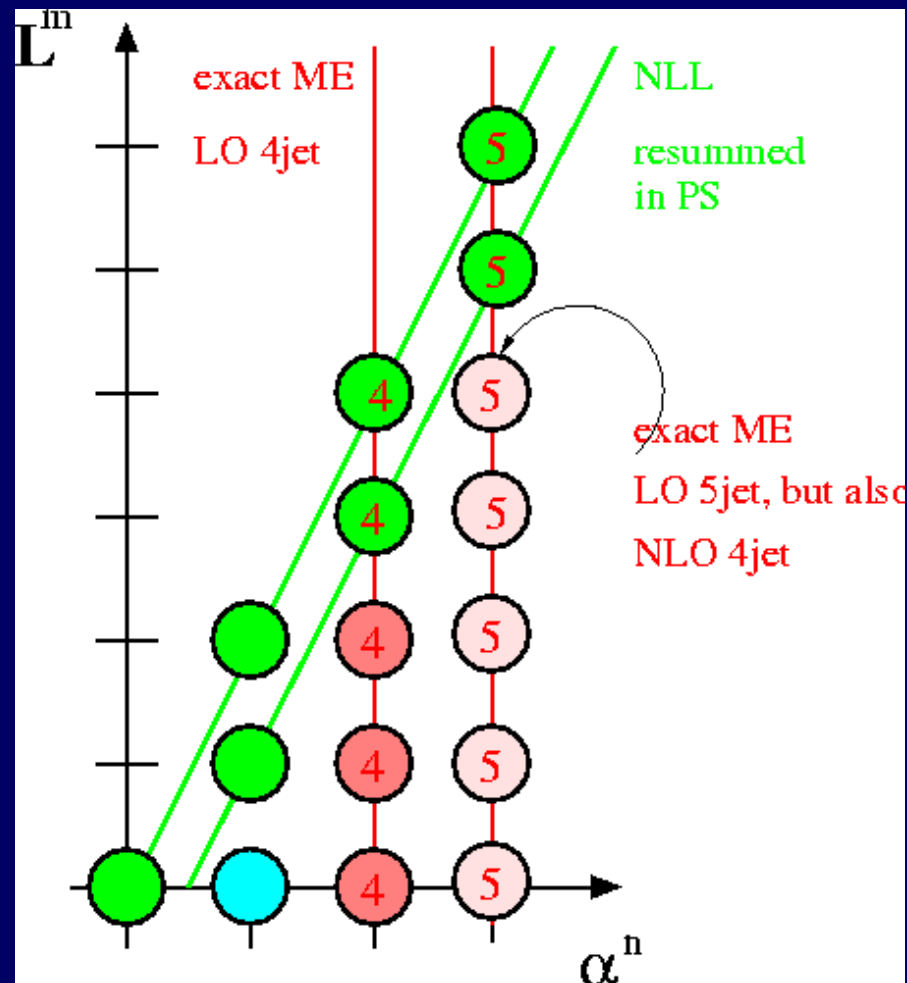
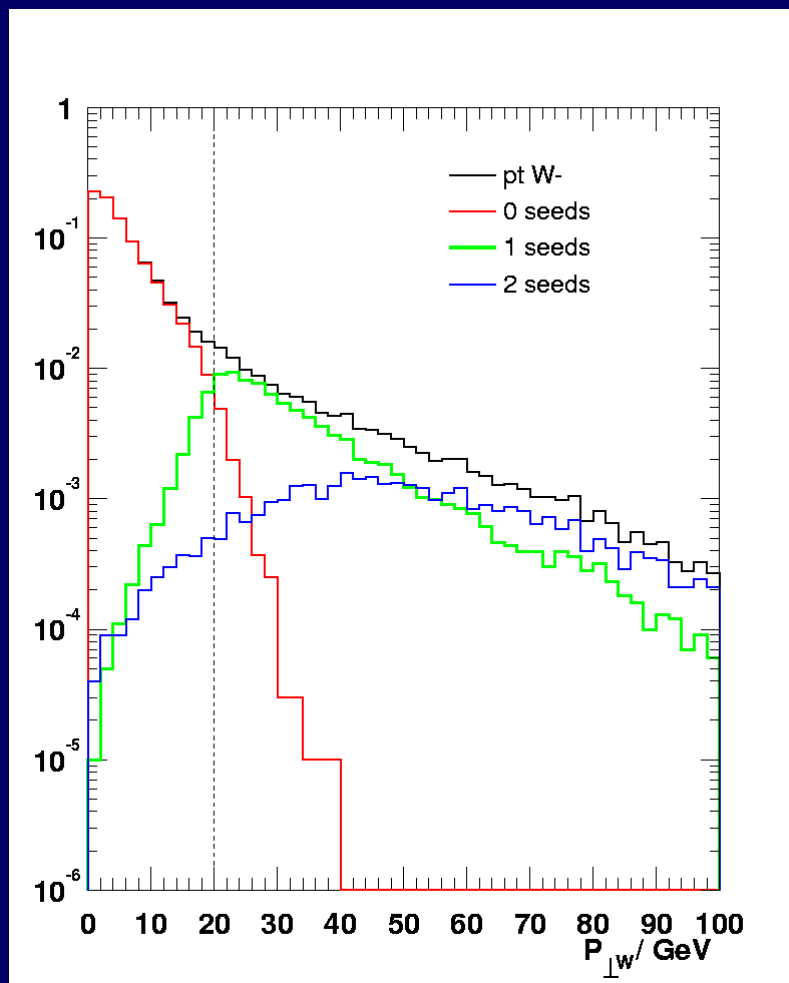
# S. Paganis: $t\bar{t}$ production

- MC@NLO is a usable and useful tool.



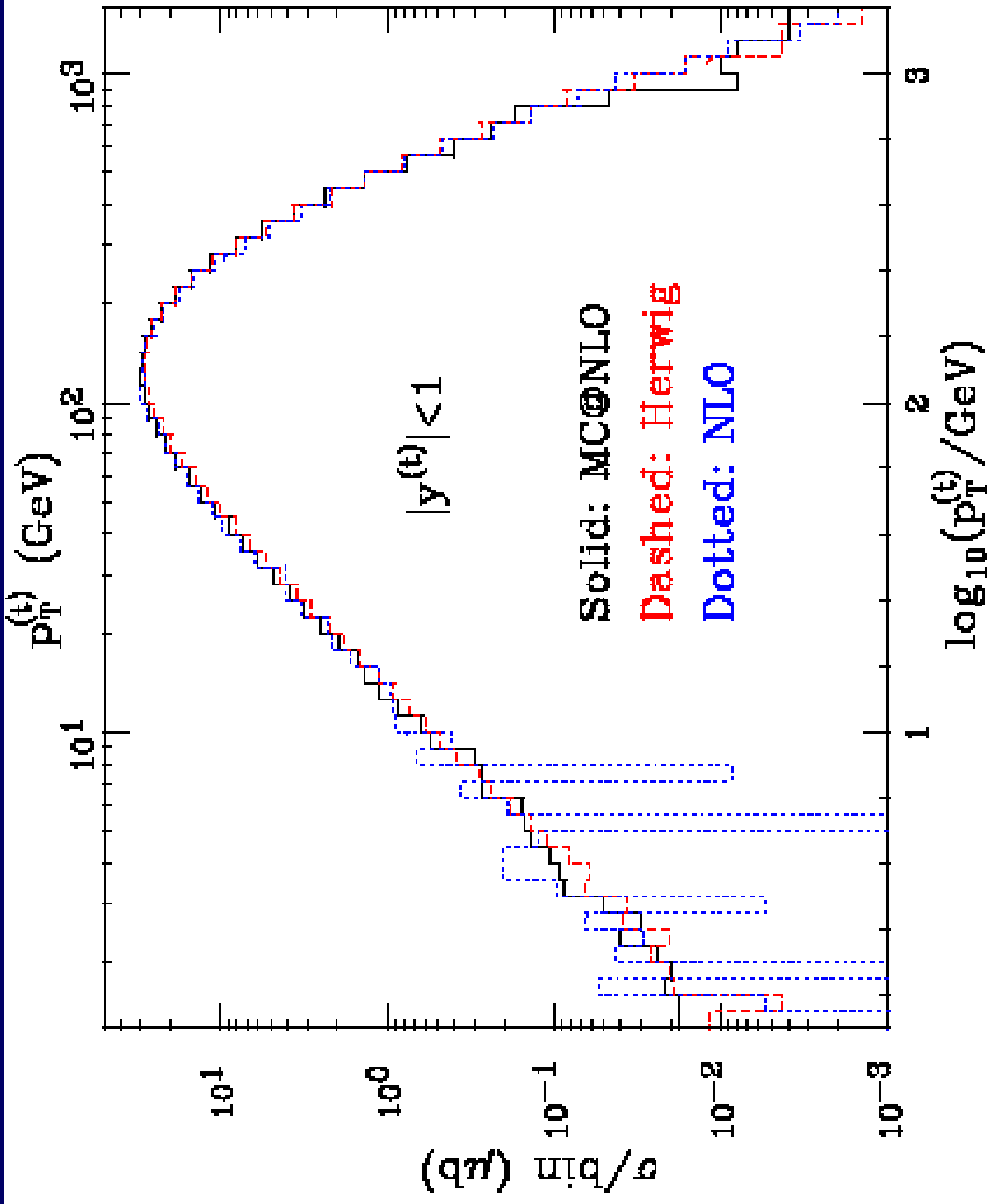


# A. Schälicke : ME + PS at LO



# S. Frixione: MC@NLO

- Systematic approach to match NLO calculations with a parton shower, inherits the full power of the underlying event generator (Herwig in actual implementation)
- Features :
  - NLO normalization of (incl) cross section
  - PS in soft, extra leg in hard region
  - Available : W(Z)W(Z), tt (yesterday), bb (yesterday), Higgs (soon)
  - Authors ask for further wishes ... need manpower !



## D. Soper: NLO QCD + showers

- Independent approach to add parton showers to NLO calculations.
- Test case: 3 jet production in ee collisions.
- So far no real parton shower model has been attached (duty of the user).

# Outcome of the (long) discussion

- Strategy to be implemented:
  - validate the existing tools
  - if not sufficient, you've got an excellent reason for better ones !
  - this can be done only on a case by case basis !
- Examples :
  - W production (cross section for lumi, W mass ...) with MC@NLO, check theory uncertainties (PDF, scale, ...) and compare with experimental uncertainties, if theory not sufficient, NNLO is a must !
  - Vector boson fusion with ME+PS (tree-level), check jet veto. If theory not sufficient, NLO is a must !