



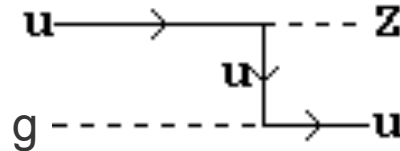
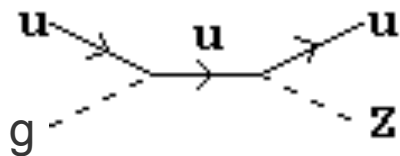
# Z+jets at 7 TeV

Kalanand Mishra

*Fermilab*

Informal W/Z+jets discussion forum  
(Feb 24, 2010)

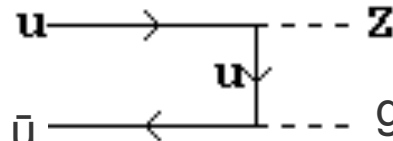
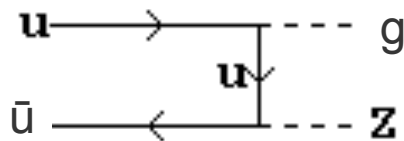
# Contributing processes at Leading Order



Similar diagrams with d,s,c,b and antiquarks

- dominant, 20 diag.
- smaller effect from 10 TeV  $\rightarrow$  7 TeV

Chris Quigg  
arXiv:0908.3660



Similar diagrams with d,s,c,b quarks

10 diagrams

- ◆ At LO, the Z+jet production is a 2 $\rightarrow$ 2 process. Therefore only 1 jet in the final state.
- ◆ At NLO, there are contributions from additional gluon radiation, ISR, FSR, ... etc.
- ◆ Parton's hadronization into final state jet(s) is a non-perturbative process.

# How many events we expect with a given $\int L$

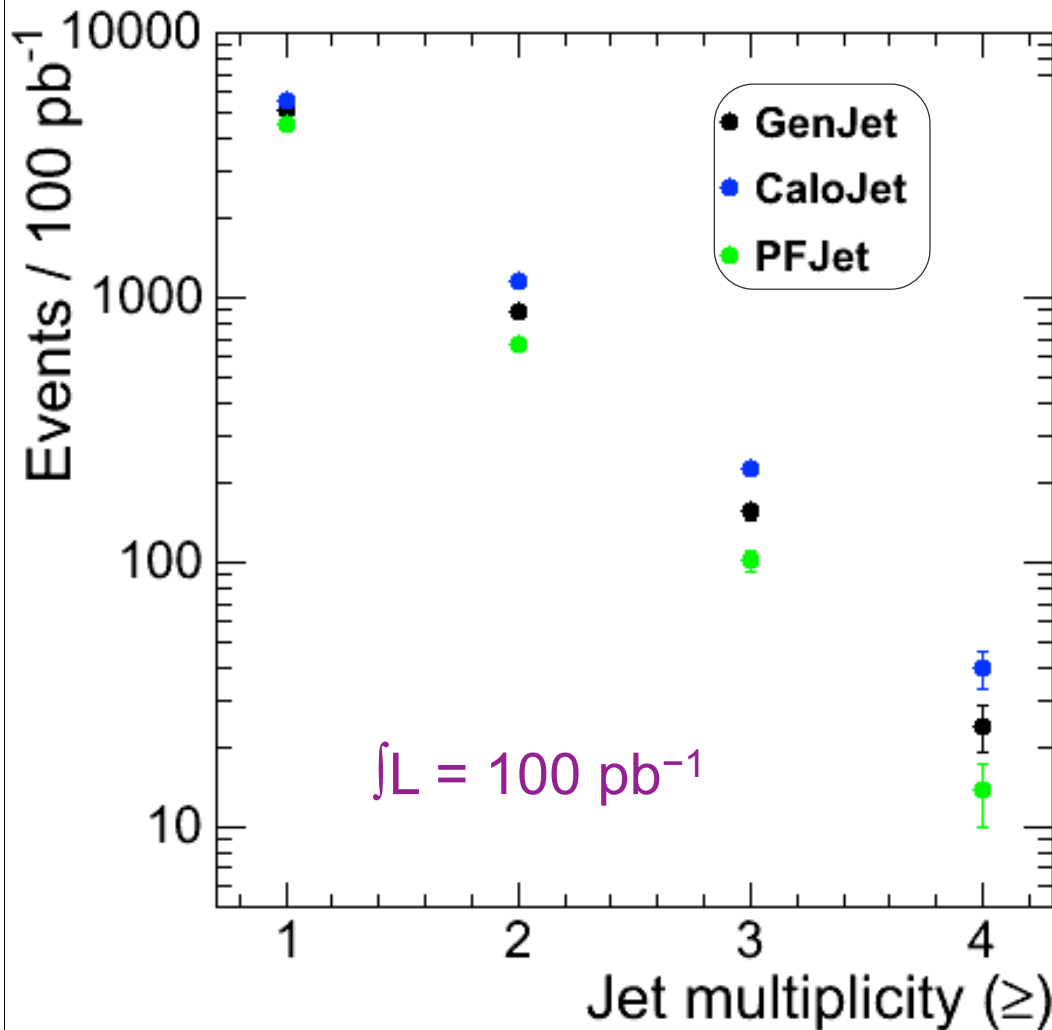


## Cross section as function of $N_{jet}$

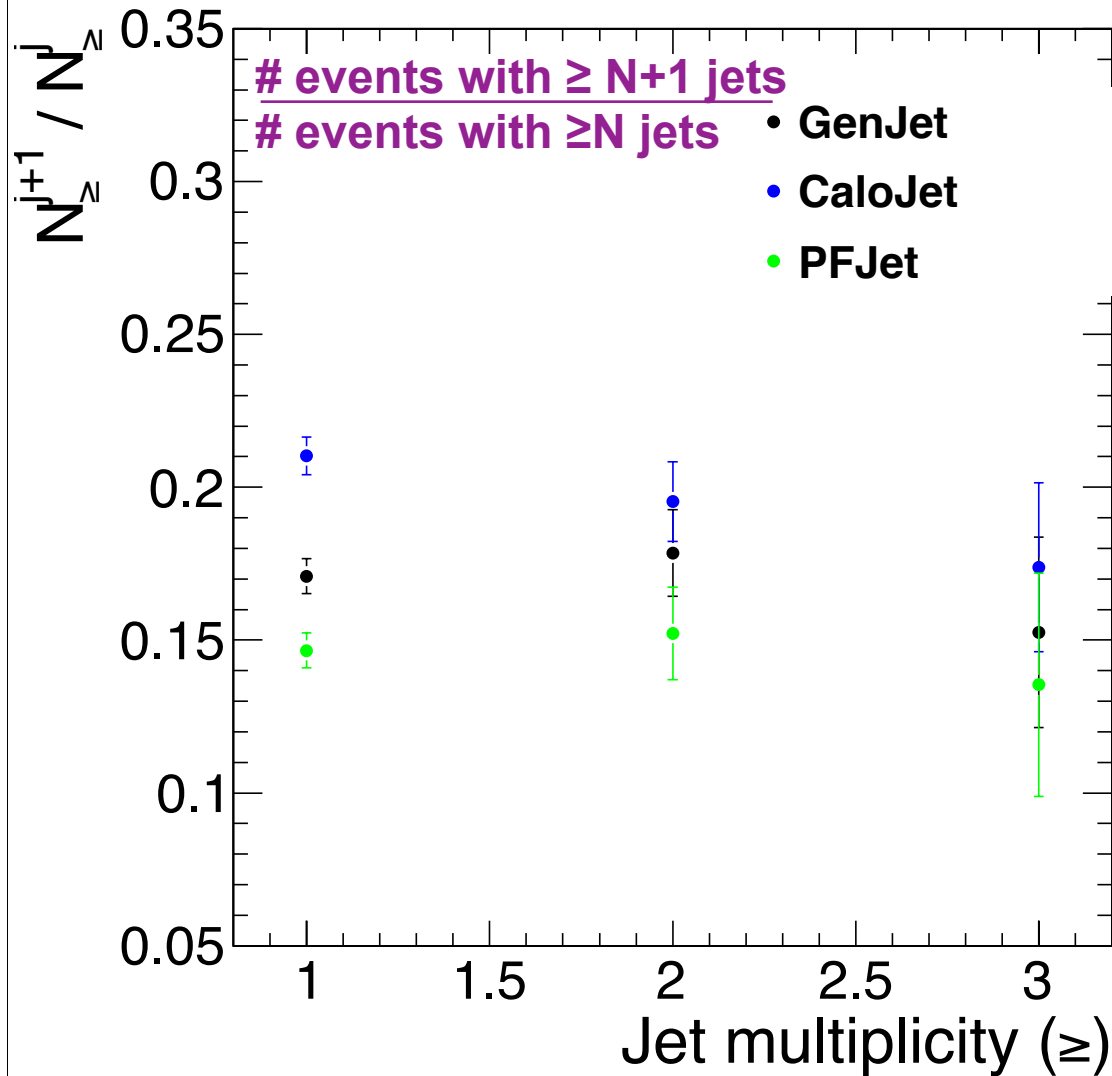
- “Standard” Z selection
- Jets: anti-kT 0.5,  $p_T > 20$  GeV,  $|\eta| < 3.0$
- Efficiency and resolution not accounted for yet

assuming predictions from Pythia

- ◆ With  $100 \text{ pb}^{-1}$ , expect  $\sim 6000$  events in electron channel alone  
~ same as CDF paper of 2008
- ◆ Can be a good result with  $50 \text{ pb}^{-1}$
- ◆ Even with  $10 \text{ pb}^{-1}$ , we will have few events in the 3<sup>rd</sup> jet bin  
- can be good PR plot for conference
- ◆ With  $50 \text{ pb}^{-1}$ , our  $p_T$  reach will go beyond Tevatron



# What we can do with $\int L = 10-50 \text{ pb}^{-1}$



## N+1 / N jet ratio

Not as trivial as it seems !

- You can already see that I have not corrected for Z reconstruction efficiency and jet resolution.
- Ratio is not necessarily a const.
- Different jet reconstruction methods give different number of jets (yes, in MC and even in 900 GeV data) which are not consistent with each other.
- Need to compare with NLO, NLO $\oplus$ PS, NNLO (if available for overall production rate) predictions after tuning. May need help from phenomenologist.

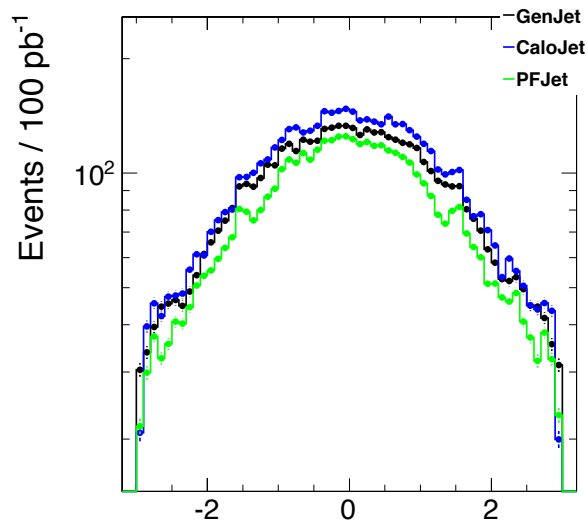
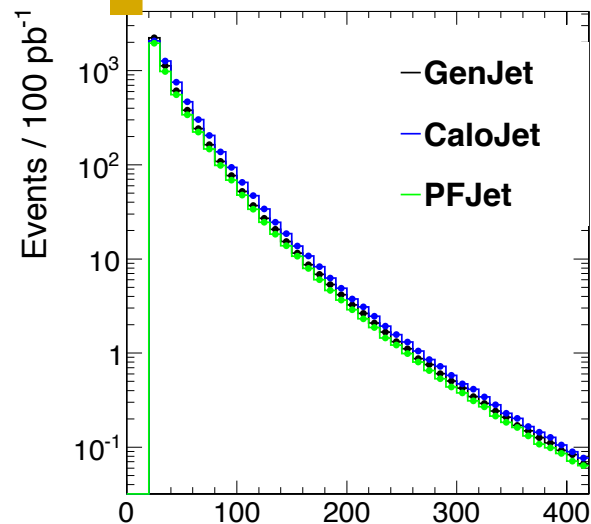


## What we can do .... starting now

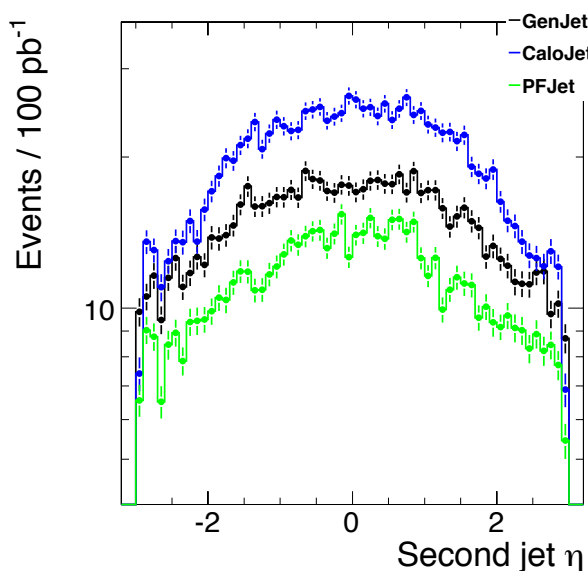
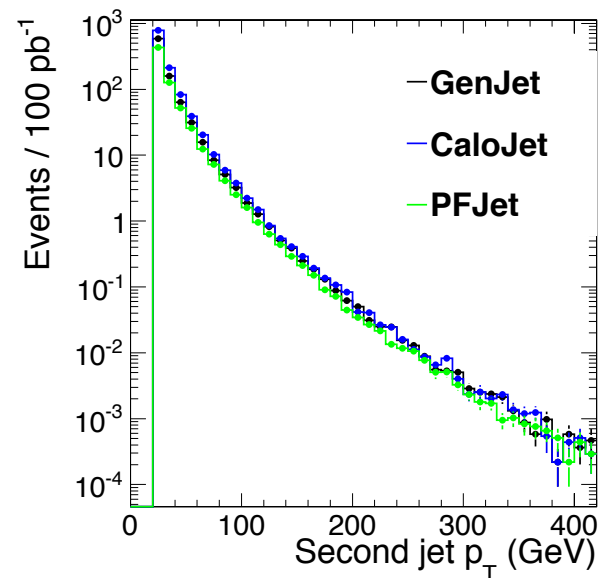
- ✓ **Prepare the analysis workflow**
  - **Assign each person a primary task**
  - **Put all the scripts for first analysis in cvs**
  
- ✓ **Focus on completing  $10 \text{ pb}^{-1}$  analysis in a time period of 2–3 weeks**
  - **We are not in precision game at this step !**
  - **Speed is the key: get the result first, then work on the improvement**
  - **Can use Z lineshape fit to estimate signal yield for this round**
  - **Can use the integrated average efficiency in a single bin**
  
- ✓ **Be ready for surprises and to adjust our strategy**
  - **e.g., we may have to work with photon triggers, or worse - EE trigger may not be available, or we may be dealing with substantially higher backgrounds, PUs etc.**
  
- ✓ **Need to establish a mechanism to meet at short notice**
  - **For now, we can review our preparedness in every biweekly meeting; start working as a close group.**



# Down the line: differential in $p_T, \eta$

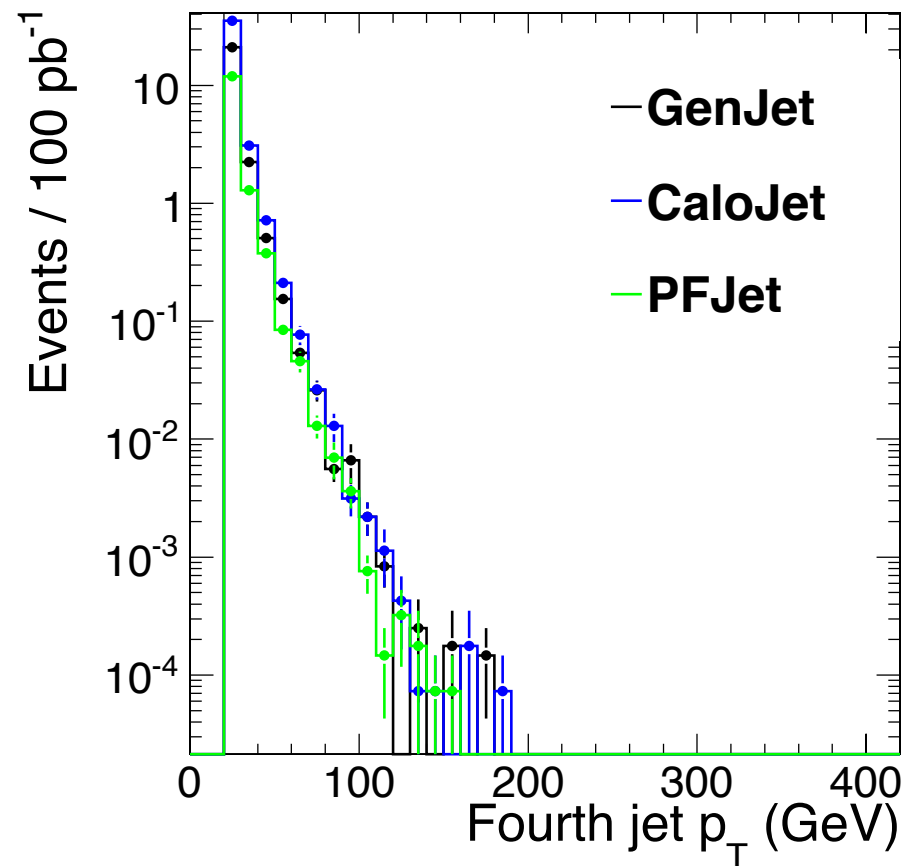
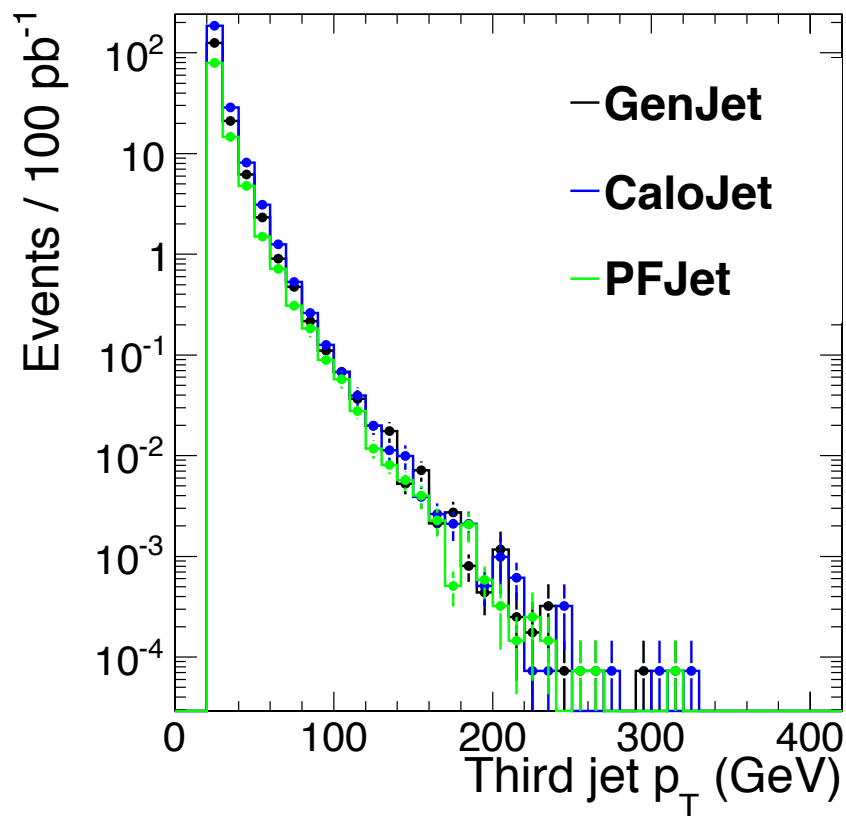


Normalization is a tricky business. We will have to deal with this in the entire analysis.



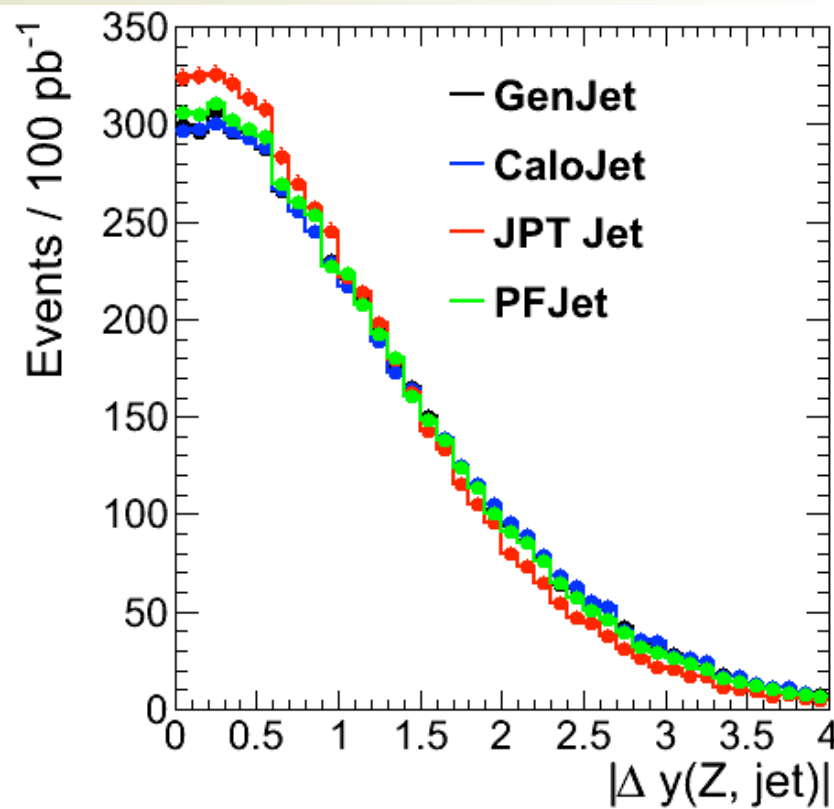
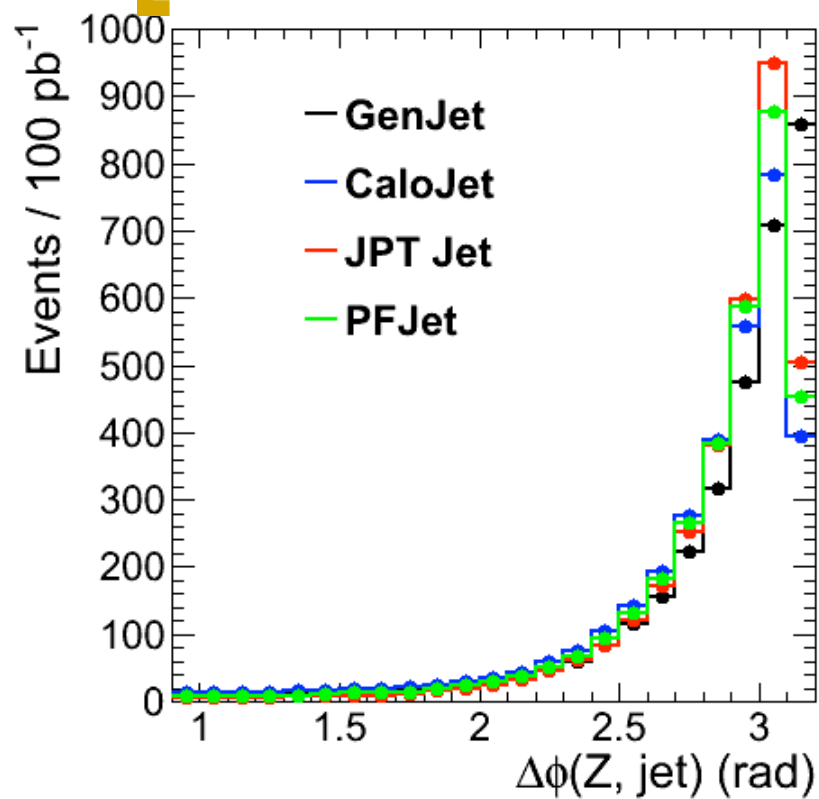
- ◆ 1<sup>st</sup> jet up to  $p_T \approx 300$  GeV
- ◆ 2<sup>nd</sup> jet up to  $p_T \approx 120$  GeV
- ◆ 3<sup>rd</sup> jet up to  $p_T \approx 70$  GeV
- ◆ No meaningful 4<sup>th</sup> jet  $p_T$  with  $100 \text{ pb}^{-1}$  (probably not beyond 50 GeV)

# More: 3<sup>rd</sup>, 4<sup>th</sup> jet distributions





## Other things we can (should) take a look at



- These measurements test the predictions of perturbative QCD and current event generators, which have varied success in describing data.
- can even give hints of new physics production mechanism if you see substantial difference w.r.t NLO predictions.

Take a look at recent D0 measurement: [arXiv:0907.4286](https://arxiv.org/abs/0907.4286)