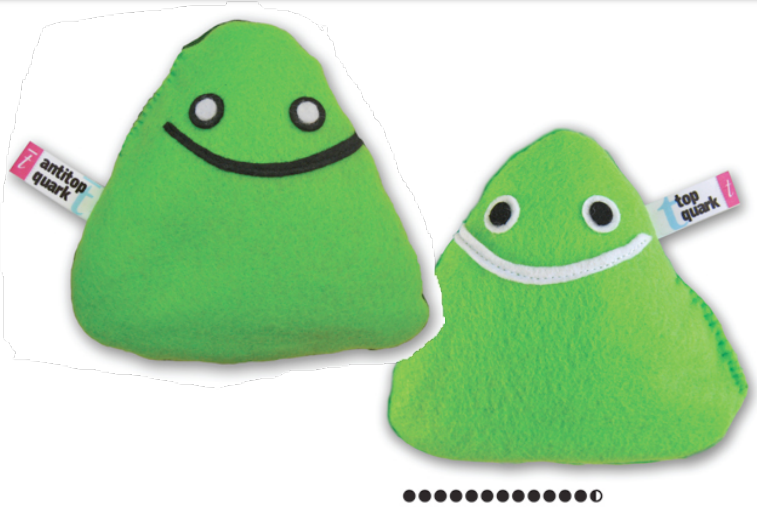
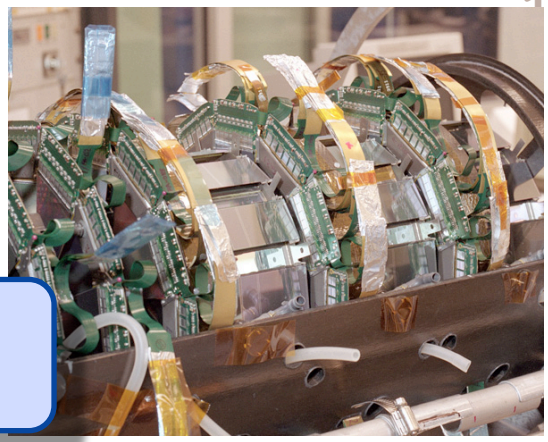
Discussion on recent m_{top} measurement in l+jets final states at D0 for Tevatron combination





Oleg Brandt (U Heidelberg)

Questions from George

- 1. The biggest improvement in the latest lepton+jets analysis is coming from the systematic uncertainty,from 1.25 to 0.49 GeV (~ 300%) Could you walk–through us what changes were done comparing to the 3.6/fb analysis? Some of the systematic uncertainty improvements are more clear, like CR using new sample, some of them are not like I/FSR and hadronization/UE?
- → let's go to slide 51 of W&C slides

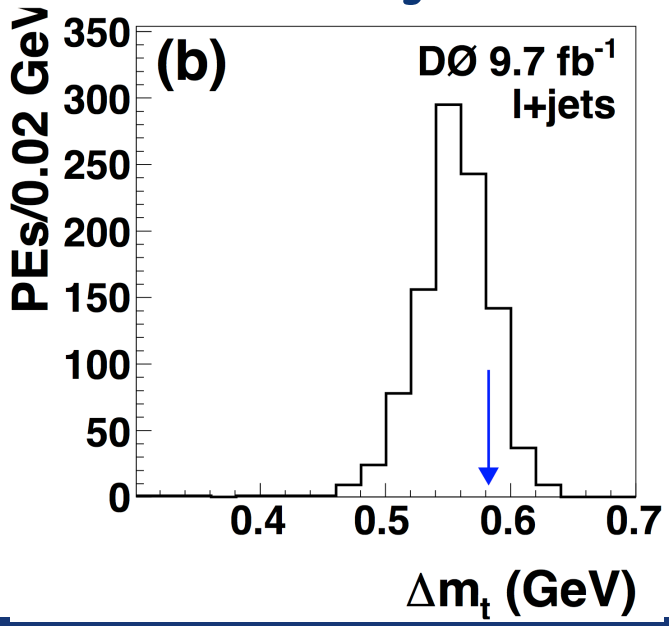
Questions from George

- 2. Stat uncertainty is about 20% lower than expecting from 3.6/fb analysis and CDF ME analysis if rescaled with the luminosity. Any explanation?
- → This is due to a slightly lower signal fraction in Run IIb1:

Epoch	Channel	Signal fraction	$\sigma_{t\bar{t}}$ (pb)
Run IIa	e+jets	0.72	8.9
	μ+jets	0.65	7.8
Run IIb1	e+jets	0.77	7.6
	μ+jets	0.66	6.8
Run IIb2	e+jets	0.68	7.8
	μ+jets	0.66	7.5
Run II3+4	e+jets	0.56	7.6
	μ+jets	0.75	8.0
Run II	e+jets	0.63	7.8
	μ+jets	0.70	7.6

Questions from George

- We checked explicitly for Run IIa:
  - Δm_t^{old} = 1.76 GeV
  - Δm_t^{new} = 1.88 GeV
- For Run IIb1:
  - Δm_t^{old} = 1.28 GeV
  - Δm_t^{new} = 1.16 GeV (rescaling Run IIb1 to 2.6 fb^{-1})
- What matters is that the measured uncertainty is consistent with the expectation:



Questions from George

- 3. JES uncertainty is somehow not changing between 3.6 and 9.7 fb-1 analyses. Naively one could expect that having more Ws will improve the in-situ calibration uncertainty. Any comment?
- → We believe this is a misunderstanding:
  - $\Delta m_t(k_{JES})^{old,3.6/fb} = 0.78$ GeV
    - $\Delta m_t(k_{JES})^{old,9.7/fb} = 0.48$ GeV
  - $\Delta m_t(k_{JES})^{new} = 0.41$ GeV
    - (improvement by 17%, consistent with 20% improvement for total stat. uncert. on m_t)

Questions from George

- 4. Could you comment about possible conflict with latest CMS result? How many sigma is it?
- → We think this question should be addressed in a future World combination, as correlations between uncertainty categories are highly relevant, as you certainly know. We did our measurement blinded, and validated all calibrations, the value is what it is.

Questions from George

- 5. JES returned by the fit is 2.5% higher. If I recollect correctly 2% is ~ 1 sigma in the D0 JES uncertainty. Is it so non-linear dependence of the JES vs the Jet energy that 40 GeV jets are pulling 2.5 % from the detector calibration? This jets are the same like in the gamma+jets calibration sample.
- → you are right: the JES uncertainty is about 2% for the jet p_T spectra found in typical tt analysis
  - However, one should be cautious with interpreting the k_{JES} value:
    - It relates detector level to parton level by definition through the transfer function
    - The standard JES relates detector level to particle level
  - Translating k_{JES} to particle level gives ≈ 1.5% above 1
    - → consistency

Questions from George

- **6. What is the mass if JES is forced to be 0?**

$$\ell + \text{jets}, k_{\text{JES}} = 1 \quad : \quad m_t \quad = \quad 176.88 \pm 0.41 \text{ (stat) GeV}$$

Questions from Dave

- The statistical uncertainty dropped below 500 MeV. That's impressive. How does this comply with previous measurements? Is it because of the increase of luminosity? Increase of acceptance? New event categories? Better S/B?
- → See answers to George's questions

Questions from Dave

- 7. My understanding is that the method uncertainty is what is much better. Is that right? Can you more about the method? Something about a faster multi-dimensional integration? Can you say more about what used to be the method and why it's result was larger? More about how the new method makes the error reduced?
- → there are two aspects of this:
  - Improvements in systematic uncertainties due to reduction of the statistical component
    - ¼ GeV → 0.01-0.05 GeV
    - This was achieved by increasing the size of the systematics samples
    - In turn, this was made possible due to acceleration of the method by o(100)

Questions from Dave

- **Question 7 cont'd:**
  - Using low-discrepancy sequences for integration
    - Better convergence of numerical integration using MC method
    - Gain o(10) in CPU time
  - Calculating the ME only once for k_{JES}=1 and then translating it to kJES=0.90,0.91,0.92, … 1.10 using the transfer function
    - Before we were rerunning the ME calculation at each point of the (m_t,k_{JES}) grid
    - Gain o(10) in CPU time
- Another aspect is the improvement of the approach to estimate systematic uncertainties
  - → discussed in answers to George

Questions from Dave

- 8. Do you have plots of the pulls? The linearity plots?
- → Let's go to slide 84 of the W&C slides

Questions from Dave

- 9. Can you share some of the sanity checks? For example, what are the systematics from unintegrated dimensions? My understanding is that you don't integrate the lepton kinematics. Is that right? What about transfer function systematics and Matrix element systematics?
- → Impact of unintegrated dimensions is negligible:
  - All energy resolutions accounted for through the transfer function for jets and e/μ
  - The effect of angular resolution is negligible
    - For jets, $\Delta R \approx 0.05$
  - In any case, such aspects would only affect the statistical sensitivity of the method
  - Method response calibrated using pseudo-experiments

Questions from Dave

- There is no explicit systematics from:
  - LO ME for qQ→tT
  - Transfer functions
- Both are an integral part of the method
  - Accounted for through calibration of the method response
  - Associated systematic uncertainty from method calibration included (0.07 GeV)