Top Physics at Munich University
DØ Experiment
ATLAS Experiment
Current Work and Plans for the Future

Frank Fiedler
Munich University

The Munich Group

- The LMU Group:

Otmar Biebel (Professor)
Frank Fiedler (C1 “assistant professor”)
Postdoc:
Philipp Schieferdecker
PhD students:
Marion Erlebach
Alexander Grohsjean
Petra Haefner
Raphael Mameghani

any of us:

[firstname].[lastname]@physik.uni-muenchen.de

Current work:

- Measurement of the top quark mass with the Matrix Element method at DØ, studies towards LHC
- Studies of dilepton events and backgrounds at ATLAS
- Studies of all-jets events and backgrounds at ATLAS

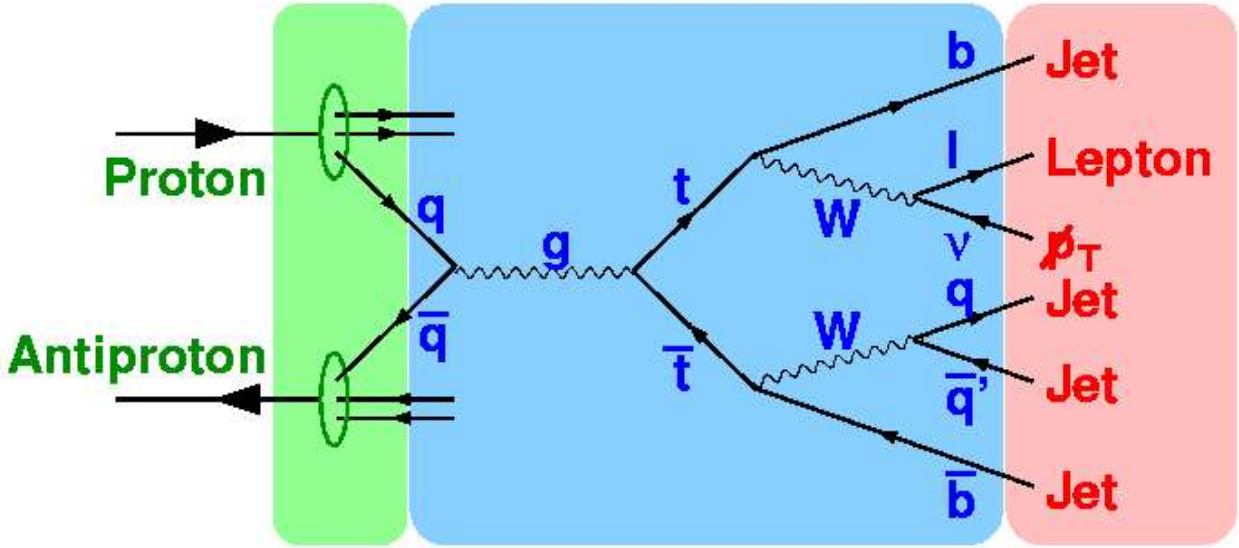
The Munich Group

Matrix Element method:

- Designed to minimize the statistical error of measurements
- Used for top quark mass in lepton+jets channel:
  -> at DØ Run I, DØ Run II, similar method at CDF Run II
- Even at Tevatron Run II, systematics are now dominant for m_{top}
  -> but often statistical information helps to reduce systematics
  -> e.g.: extend method for “in situ” calibration of jet energy scale
- Many more possibilities with LHC statistics
  -> hope to discuss here what could / should be done
  -> in terms of systematics,
  -> for detector calibration, +...
- Adapt method for more channels (dilepton channel, other top quark properties, other physics processes?)
  -> work underway

The Matrix Element Method

- Determine a top mass dependent probability for each event
- Probability P_{tt} is proportional to differential cross-section:



$$\Rightarrow \mathcal{P}_{t\bar{t}}(\vec{x}_l, m_t) = \underbrace{\frac{1}{\sigma_{t\bar{t}}(m_t)}}_{\text{normalisation}} \int \underbrace{dp_q dp_{\bar{q}} f(p_q) f(p_{\bar{q}})}_{\text{PDF}} \underbrace{d\sigma_{t\bar{t}}(\vec{y}, m_t)}_{\text{diff. xs}} \underbrace{W(\vec{x}_l, \vec{y})}_{\text{detector resolution}}$$

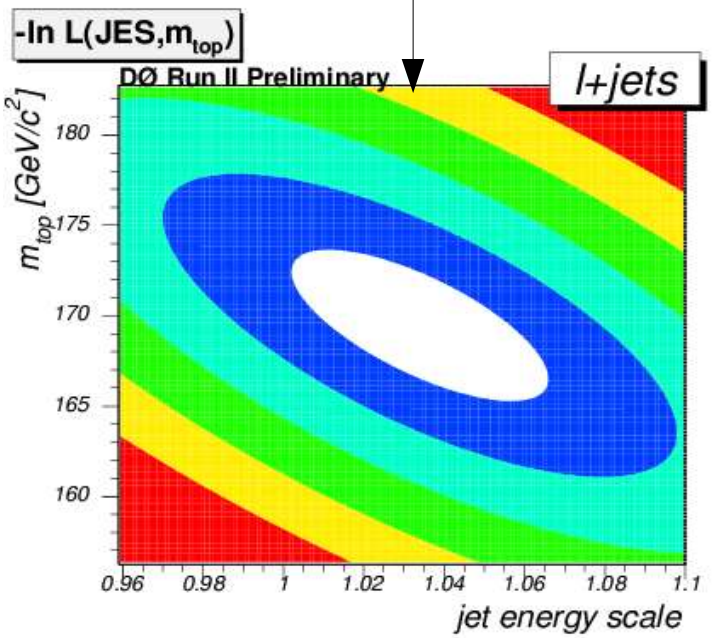
Could add: more/other physics observables here

more/other detector calibration constants (JES) here

- P_{bkg} accordingly -> obtain total event probability

Top Quark Mass Result

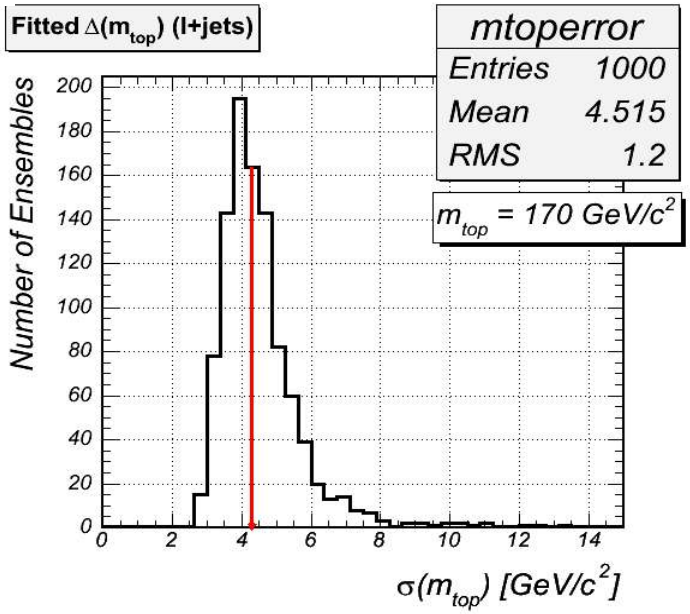
$$f(x,y) = a_0 + a_1 x + a_2 y + a_3 xy + a_4 x^2 + a_5 y^2$$

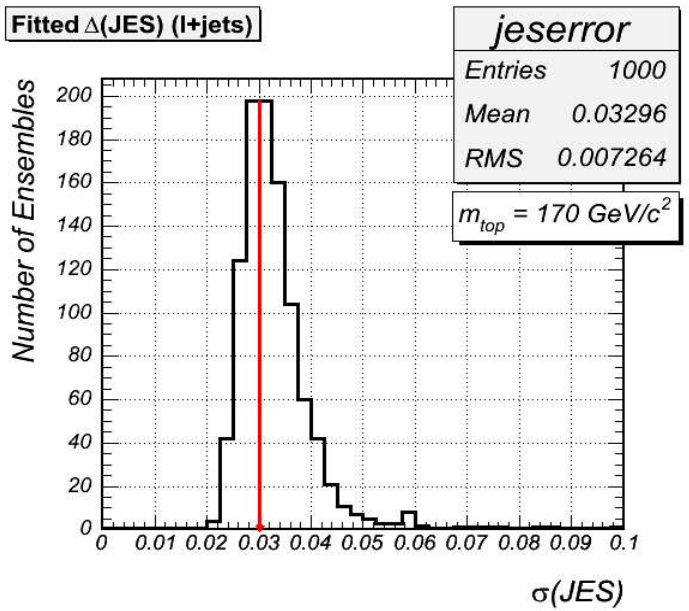


DØ preliminary results

Fit the top quark mass and the overall calorimeter energy scale (“JES”)

Compare with expected errors:



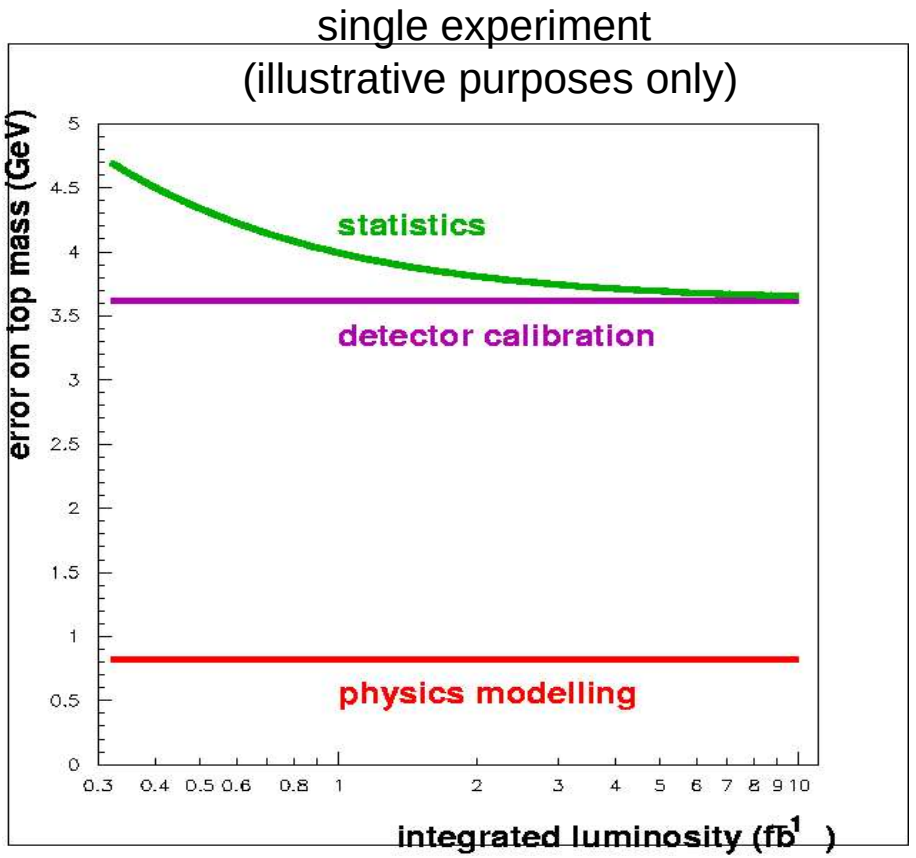


Uncertainties

Uncertainty already (320 pb^{-1}) dominated by systematics:

- statistical uncertainty 3.0 GeV
- systematic uncertainty 3.6 GeV
  - detector calibration 3.5 GeV
    - (overall jet energy scale 3.2 GeV)
  - physics modelling 0.8 GeV

- But have improved the situation wrt Run I measurement: →



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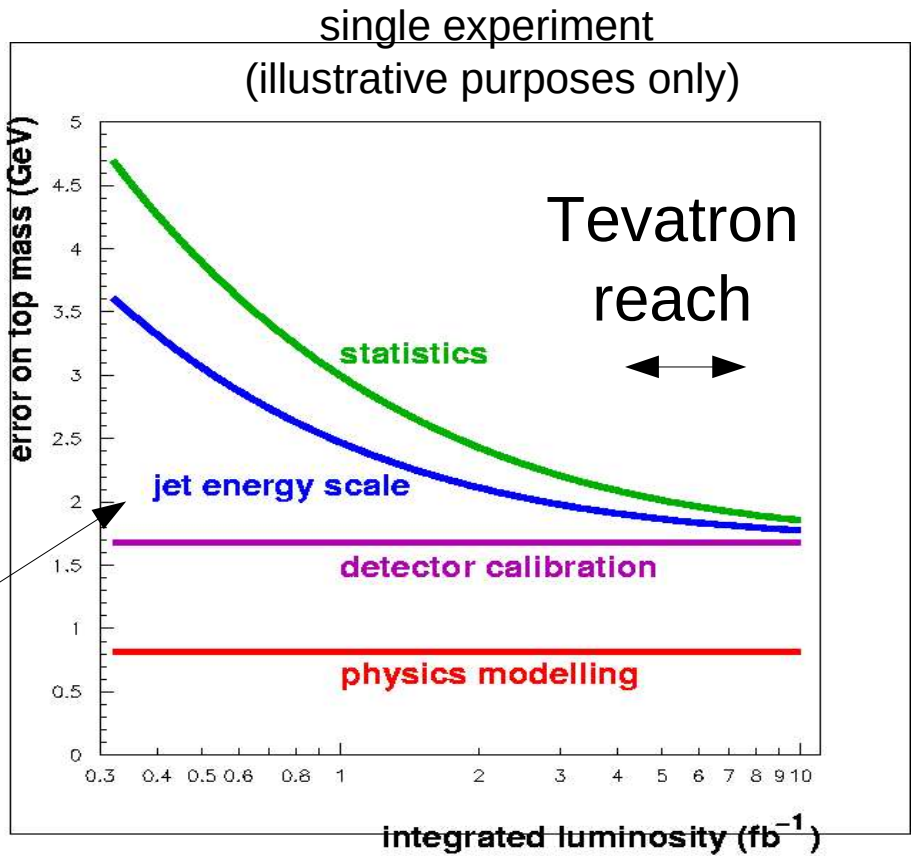
- But have improved the situation wrt Run I measurement:
  Jet energy scale uncertainty now automatically scales with statistics



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    - (b jet energy scale 1.2 GeV)
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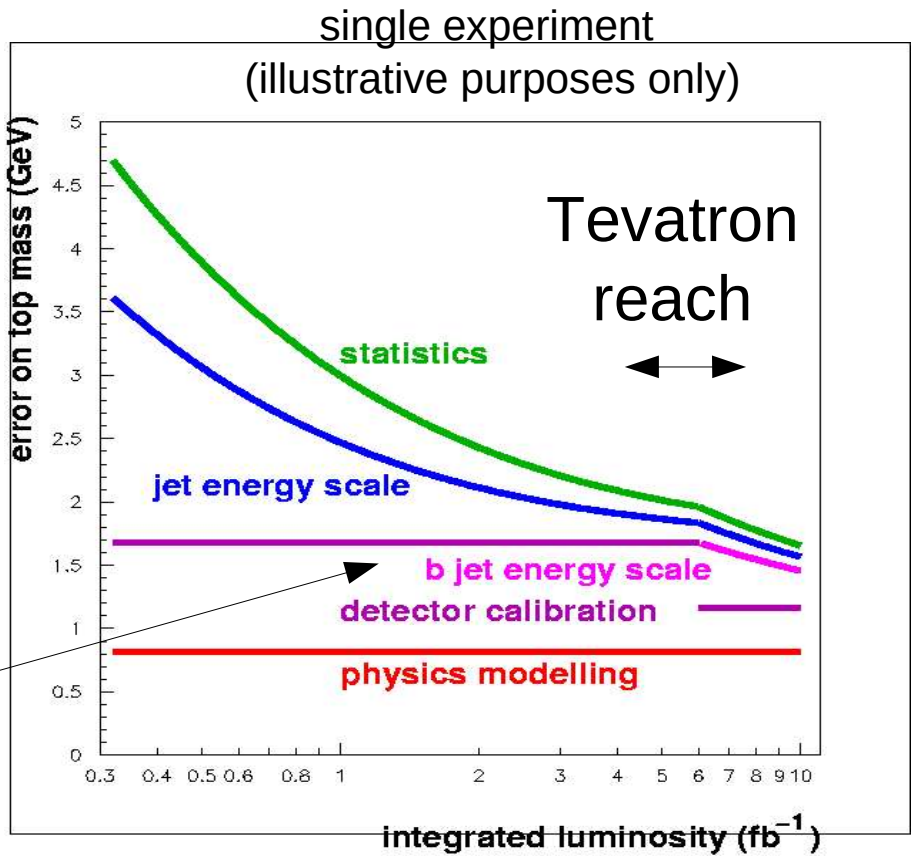
- Further reduction of experimental error possible: simultaneous measurement of b jet energy scale

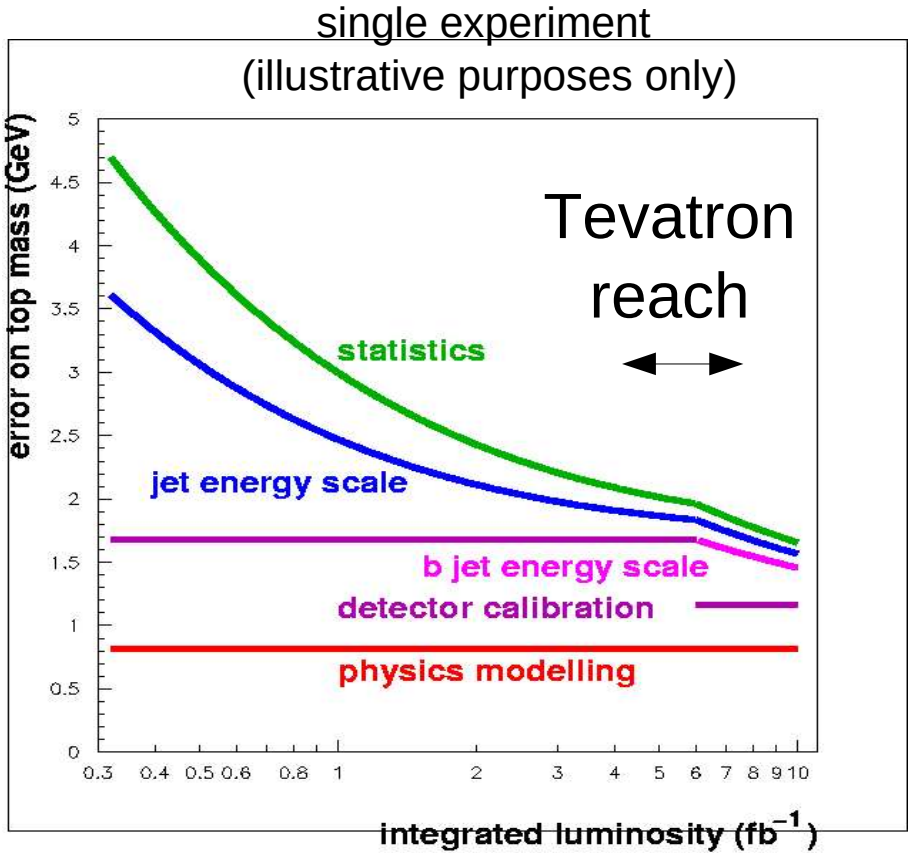


Uncertainties

Questions to discuss:

- How to best use ttbar events to calibrate LHC detectors
  - during startup phase
  - for precision measurements

- How to evaluate (and reduce?) physics modelling errors:
  modelling of ttbar events
  modelling of background events
  PDF uncertainties
  which top mass do we measure?



- These questions are no longer far away!

LHC Startup Phase

Equally important in the meantime:

- Understand ATLAS physics environment
  - signal/background event characteristics
    -> event selection
  - detector calibration
  - software
- Current studies:
  - dilepton events
  - all-hadronic events -> QCD background modelling
    jet algorithms
    event shape variables
- Work has started, but (as before):
  Could profit enormously from coordination among groups!

Conclusions

- **Let us coordinate and work together:**

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