Studies for top mass measurements with Atlas

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- *Kinematic fitter*
- *Top mass with ME method*
- *Outlook / future plans*

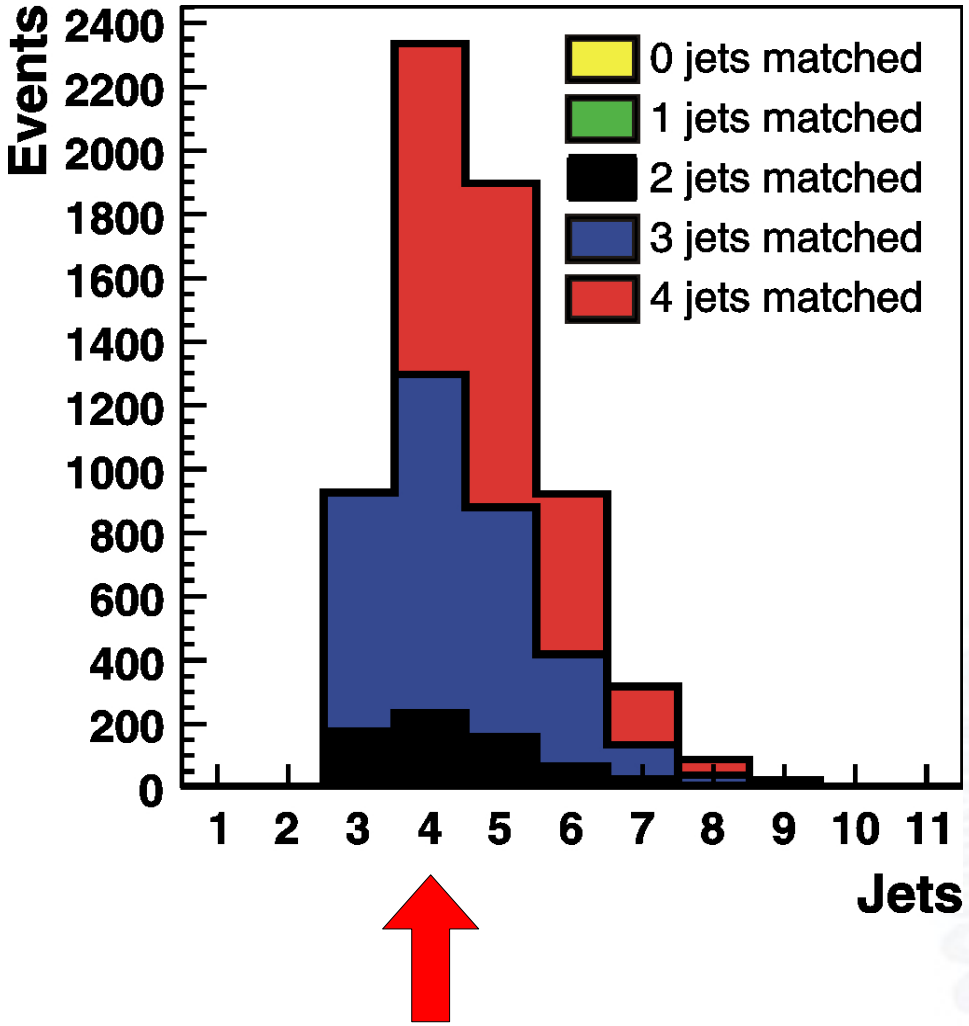
Kinematic ttbar fitter I

Matthias Stein

- Channel: lepton + jets
- Aims:
  - Determine full topology of ttbar events
  - Identify b-jets → b-tagging / JES
- Method: define χ^2 function using
  - Energy resolution terms ~ $(E-E')^2/\sigma^2$
  - Hadronic W-mass constraint
  - Leptonic W-mass constraint → neutrino p_z
  - Equal top-mass constraint (no mass dependence)
  - Studies of p_T of ttbar system

Kinematic ttbar fitter II

Matthias Stein



Event selection:

- Remove events in which energy-momentum-conservation is violated
- 1 charged lepton
- 4 jets with p_T > 20 GeV/c
  (3 jets with p_T >40GeV/c)

prob. of finding correct jet-parton match is < 50% *a priori*

Kinematic ttbar fitter III

Matthias Stein

Efficiency studies:

	4 matched jets:		**no matching:**
all correct:	44%	→	20%
hadronic only:	(0%)	→	1%
leptonic only:	22%	→	24%
all wrong:	34%	→	55%
b-tag:	77%	→	59%
b-tag (two):	57%	→	33%

- including a p_T-fit worsens results

Kinematic ttbar fitter IV

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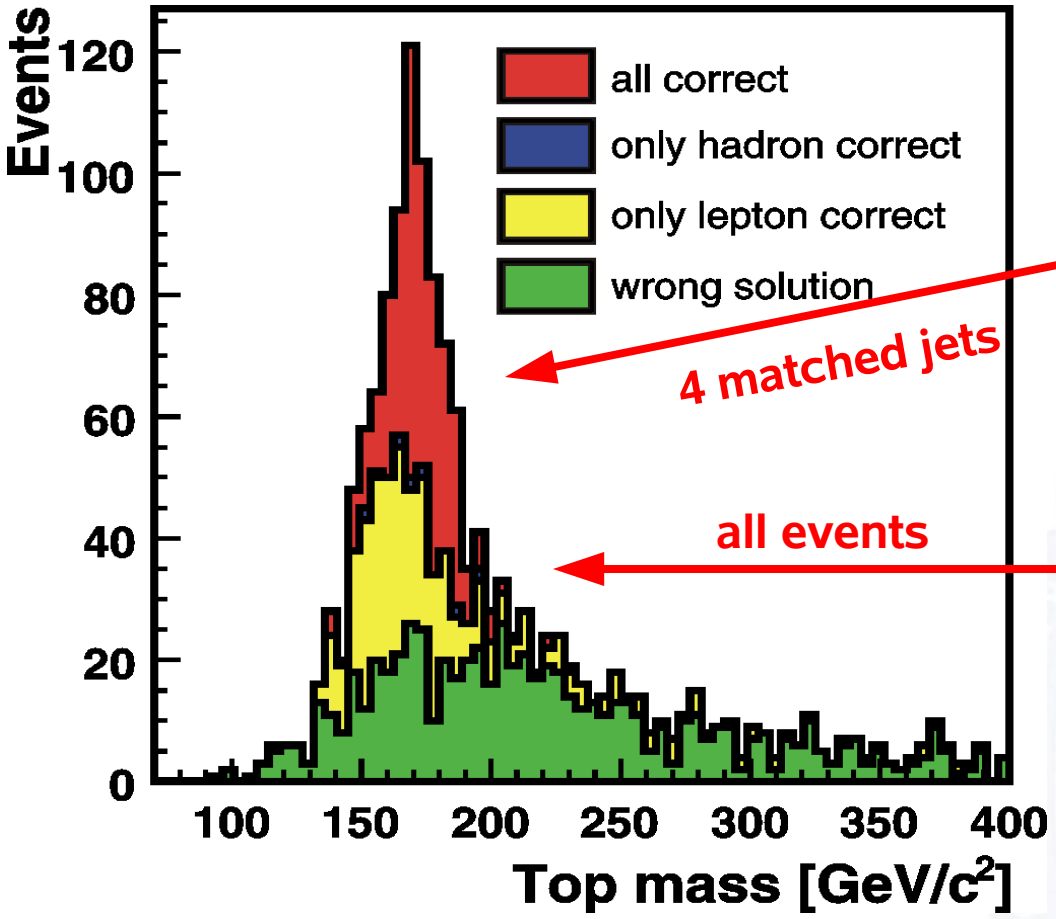
Hadronic top mass



	Reco [GeV/c²]	Fit [GeV/c²]
μ	170.1	171.1
RMS	36.9	36.4
σ	13.6	11.1

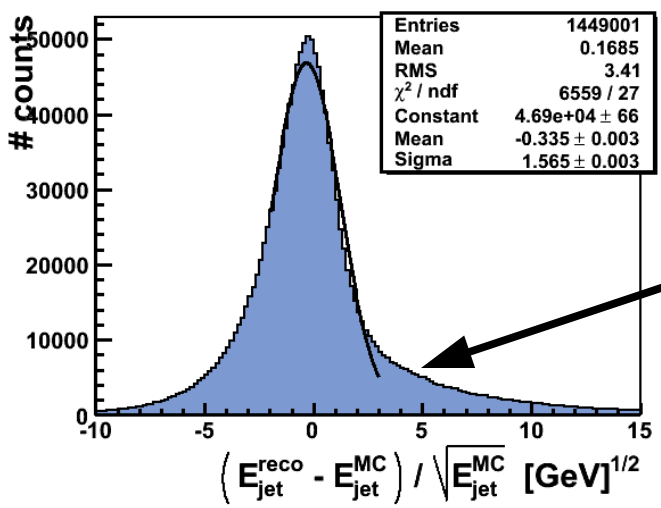
	Reco [GeV/c²]	Fit [GeV/c²]
μ	170.2	171.5
RMS	61.5	59.5
σ	15.6	13.3

Tails in energy resolution cause shift in mean value

Kinematic ttbar fitter V

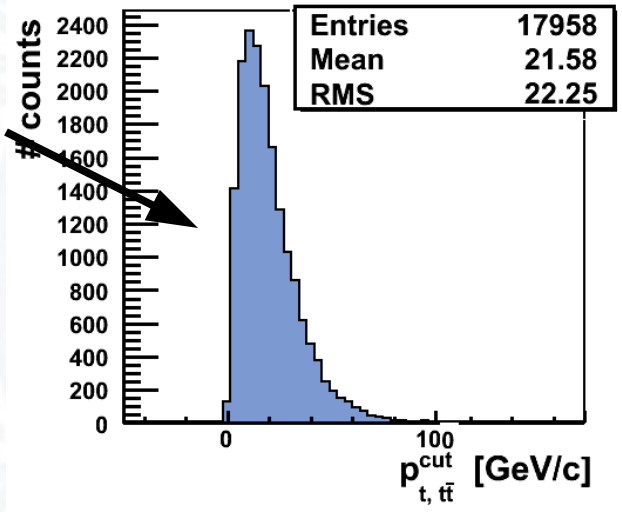
Matthias Stein

- **Next steps:** use likelihood instead of χ^2 function
- **Advantages:**
  - Parameterize energy resolution ("transfer functions") (include non-Gaussian tails)
  - Include Breit-Wigner distribution of W and top masses
  - Fit p_T of ttbar system
  - Study JES (for light and b separately)

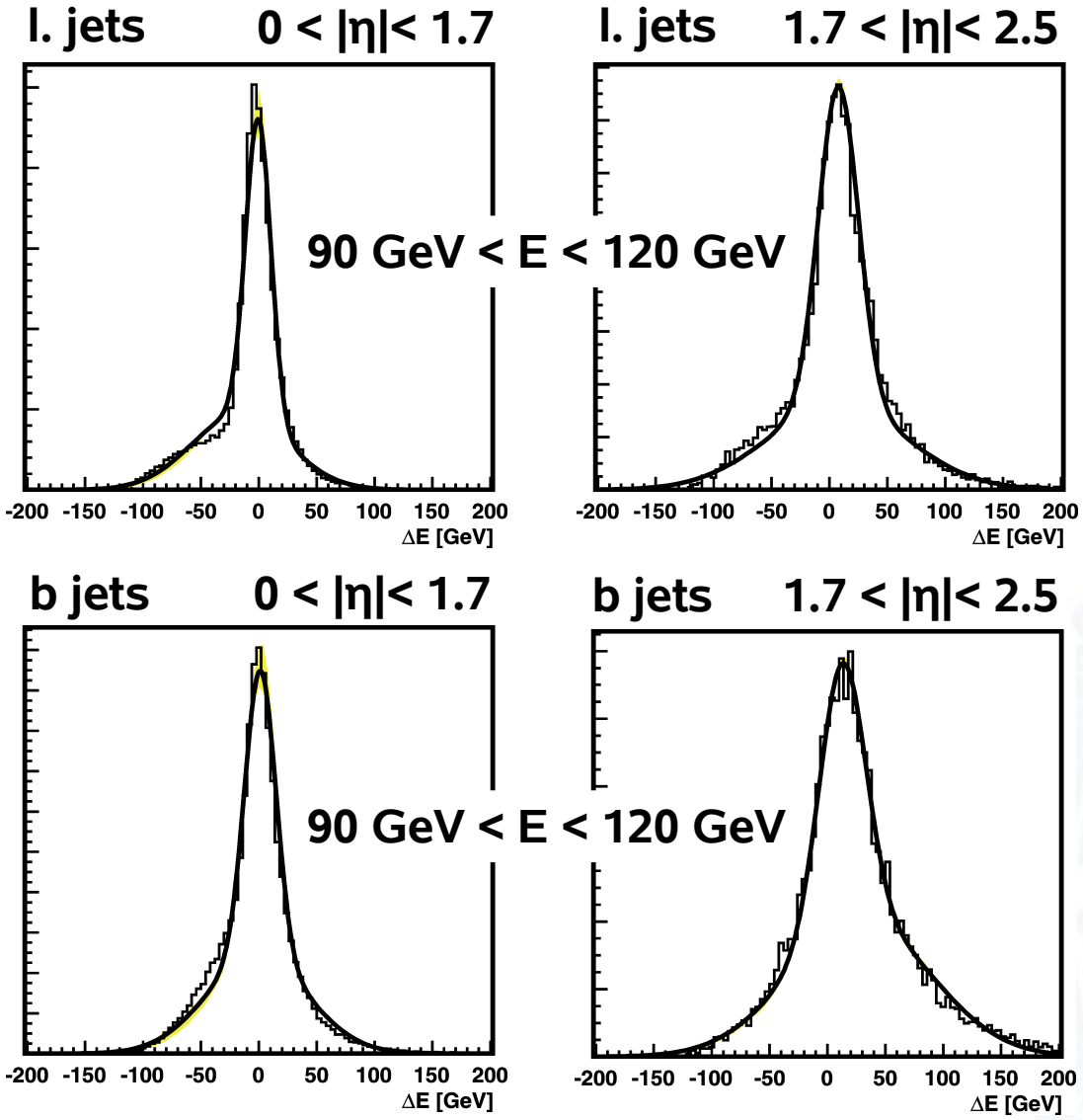


Non-Gaussian tails in energy resolution

p_T of ttbar system is not 0



Transfer functions



KK

- Parameterize energy resolution as double Gaussian
- Energy dependent parameters (linear)
- Eta dependence (two regions)
- Distinguish light jets from b jets

Matrix-element method

Andrea Knue

Introduction:

- ME method uses the diff. cross-section to calculate a probability
- Takes detector resolution into account (transfer functions)
- Uses all kinematical information AND model assumptions
- Pros and cons:
  - Increases sensitivity to process under study, example: measurement of top mass at Tevatron
  - Difficult w.r.t. numerical operations, integrate over detector resolutions, sample n-dimensional space
- Aim: develop general tool for ME method

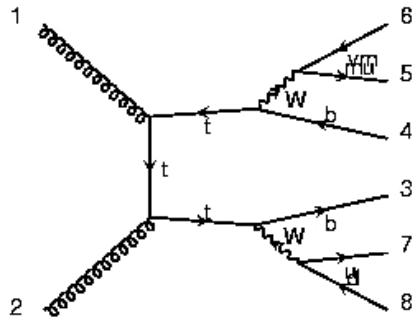
ME top mass analysis I

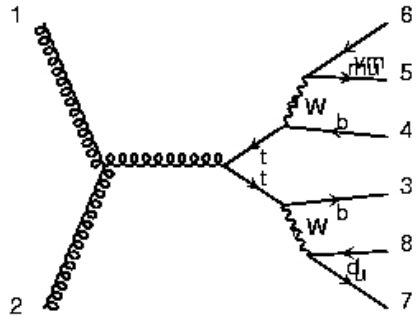
Status of the implementation:

Andrea Knue

- Framework is ready (interface to numerical tools, I/O, ...)
- Interface to MadGraph (MC Generator) is implemented

  gg → ttbar → e/mu + jets for now
- Implementation of phase space calculations, (simplified) transfer functions, pdf's, etc.
- **Integration over 5 dimensions (energy of jets and lepton) works reliably and fast**
- Currently: optimization of MCMC
- Only applied on MadGraph LO MC with smearing





ME top mass analysis II

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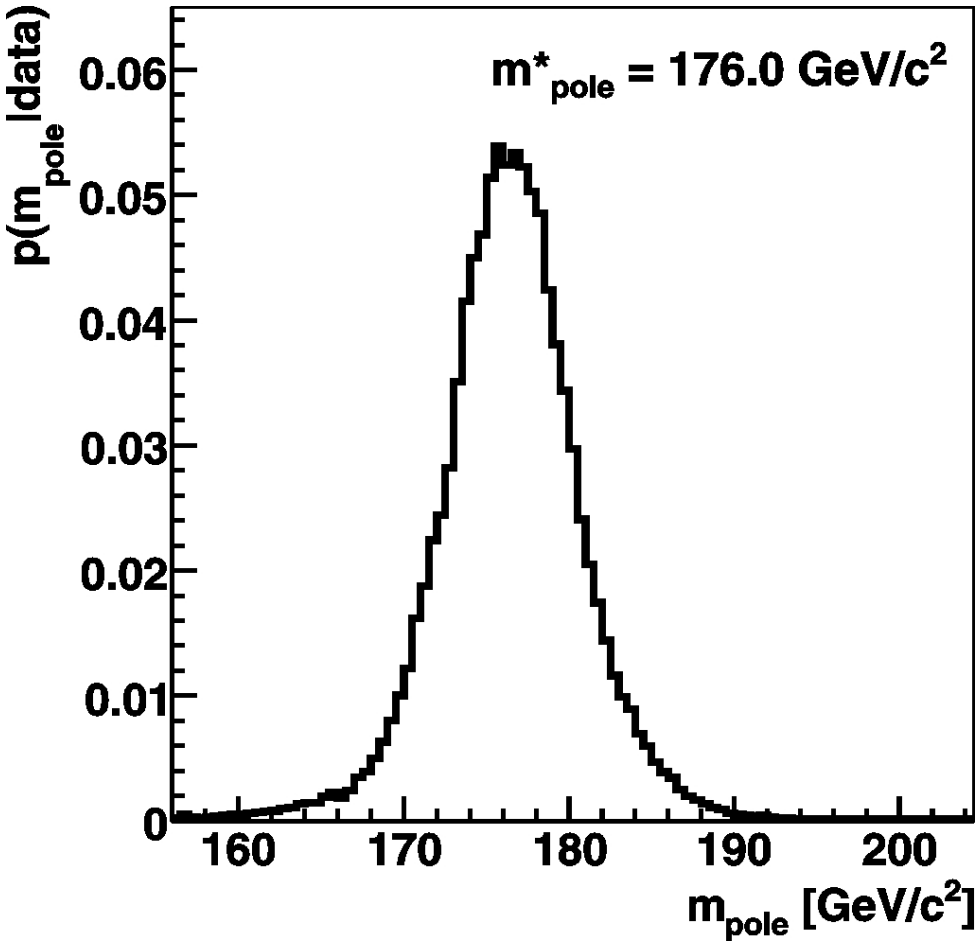
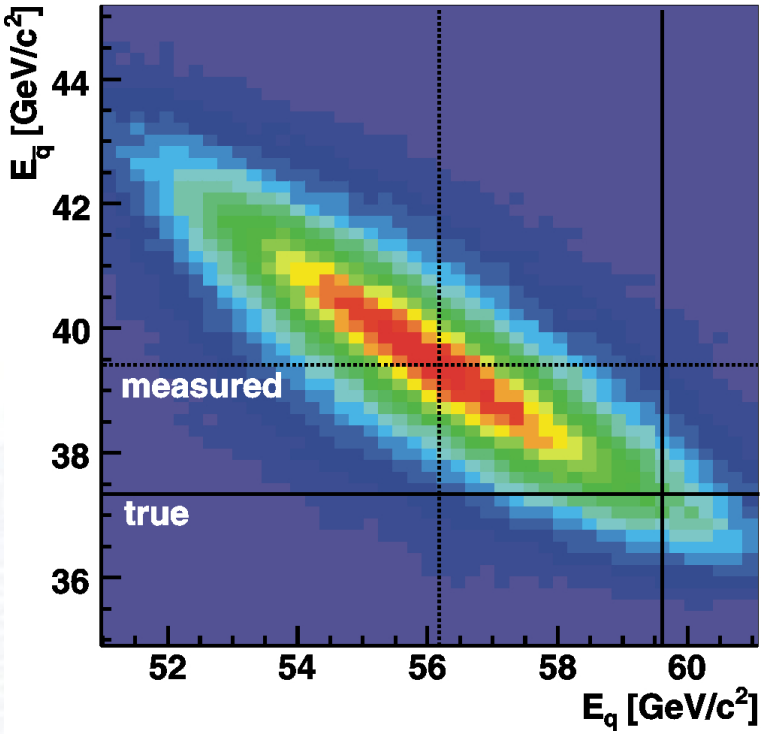
Single event prob. density for top pole mass (@175 GeV/c²)



Correlation between light jets in hadr. W decay



ME top mass analysis III

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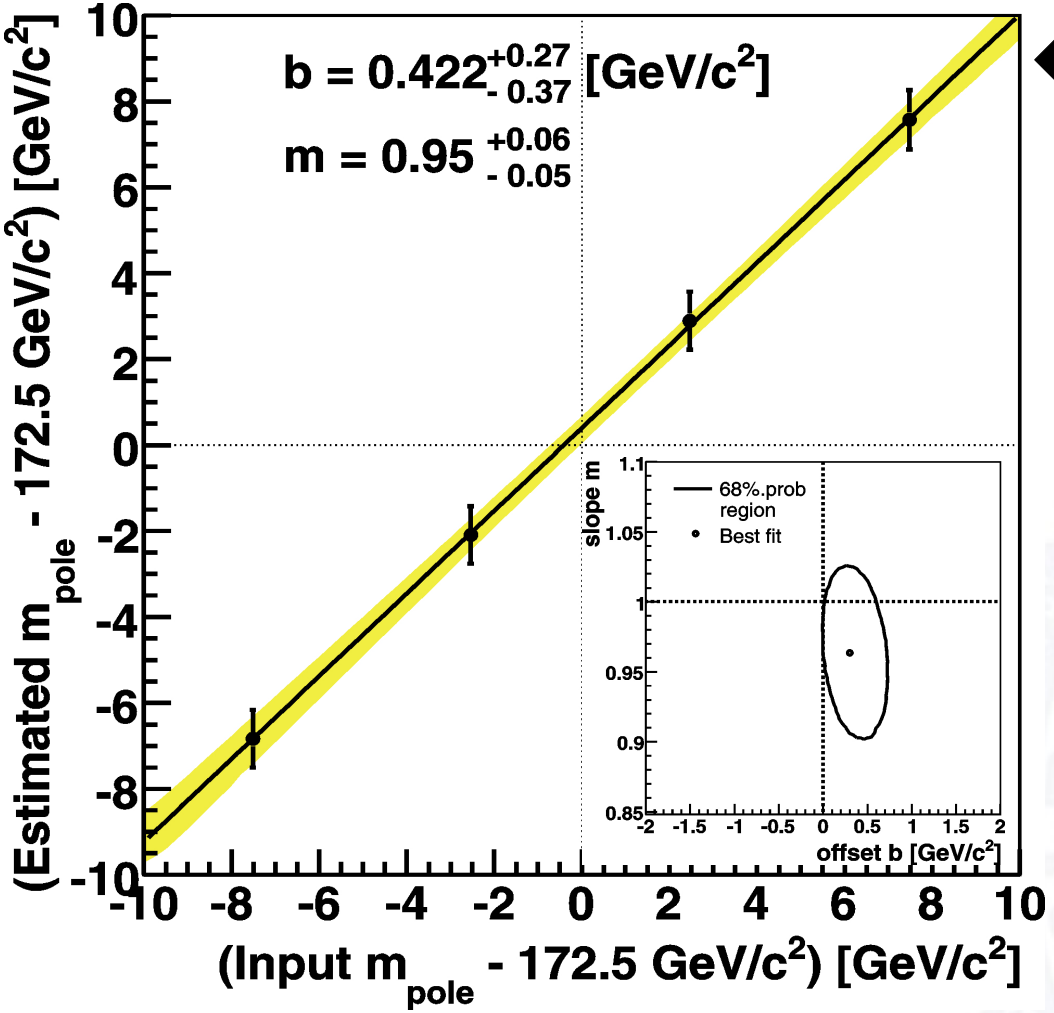
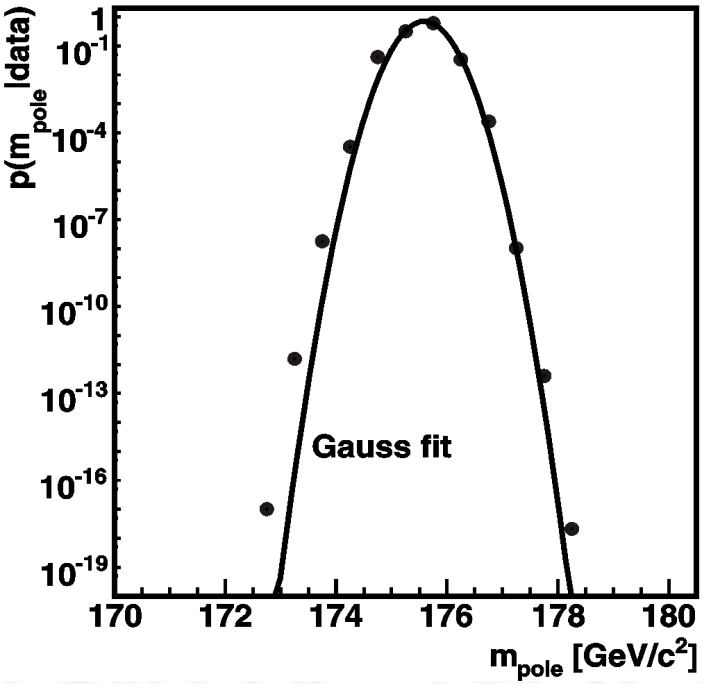


Calibration curve (300 events)

Example: 300 events @ 175 GeV/c²



ME top mass analysis IV

Andrea Knue

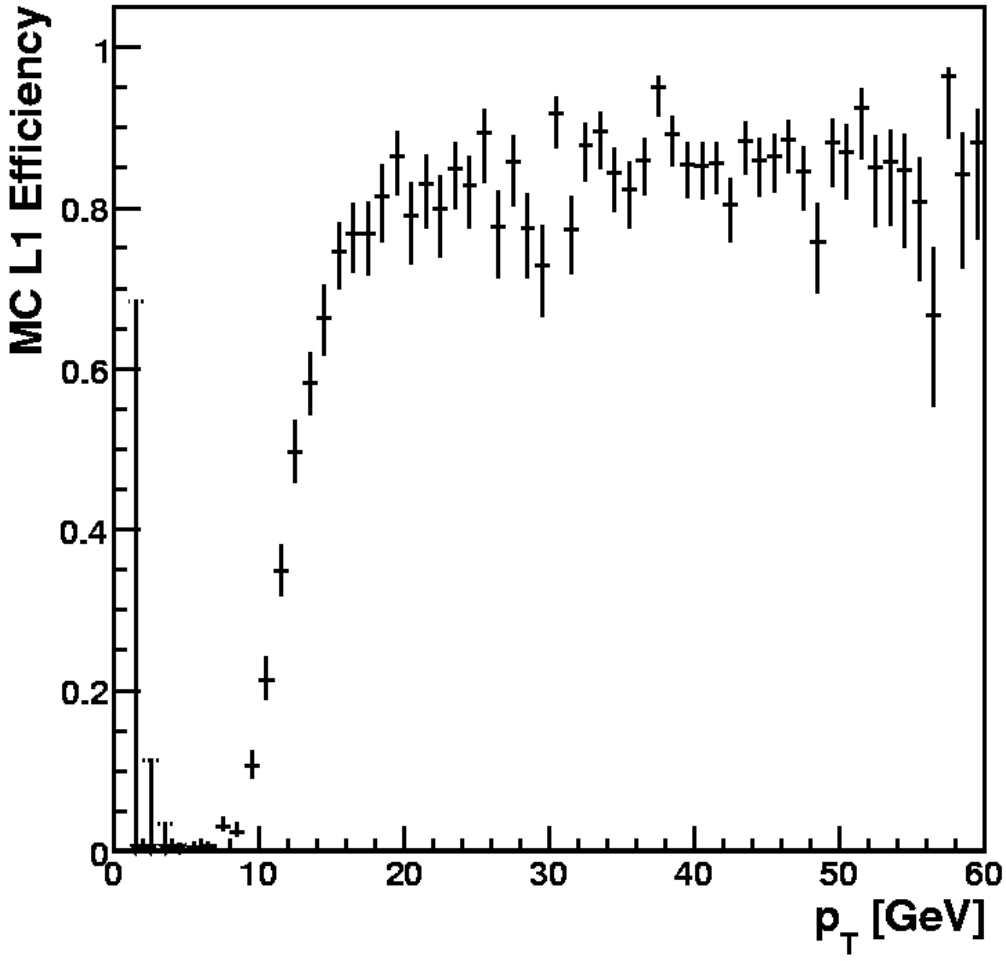
Next steps:

- Include transfer functions from ATLAS Monte Carlo
- Study NLO vs. LO Monte Carlo (MadGraph vs. MC@NLO)
- Include JES parameter(s) (1-2 more dimensions)
- Include jet combinatorics / combination with kinematic fitter
- Studies of background and background probability
- Develop a strategy for quality tests / model testing

Muon trigger studies

Fabian Kohn

- Develop methods to estimate the muon trigger efficiency from data
- Monte Carlo counting method vs. tag & probe
- Important for cross-section measurements and for all normalization issues



Outlook / plans

- Currently 1 postdoc, 2 diploma students working on top
- Additional man power expected soon (~ 2 PhD students for top)
- **Foci (KK, Arnulf Quadt):**
  - Study of top properties
  - Studies of b-JES
  - Development of statistical tools and application for ME method in particular
  - Model testing (does our model describe the data well?)