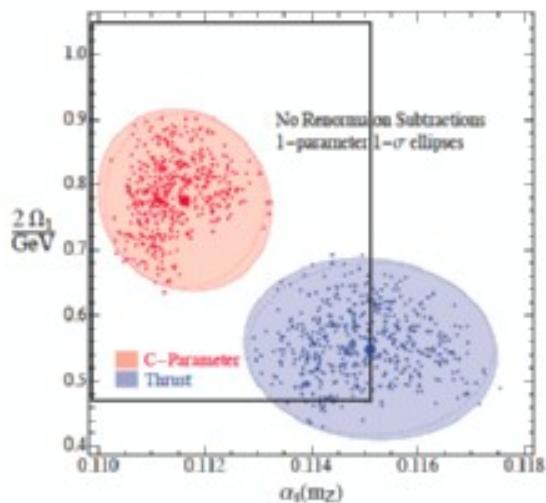


# Top/EW/Loopverein Summary

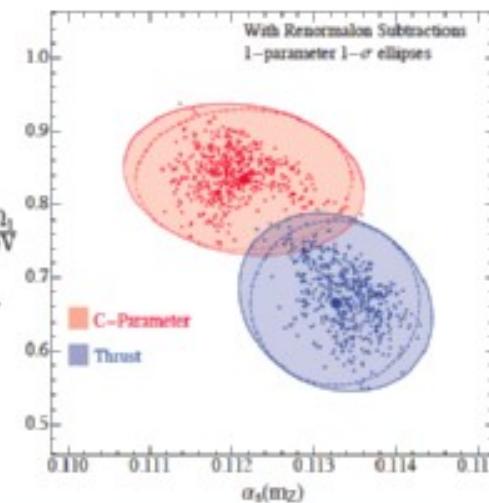
R. Boughezal, P. Marquard, L. Reina,  
F. Simon, H. Yokoya

# Universality: Thrust vs. C-Parameter

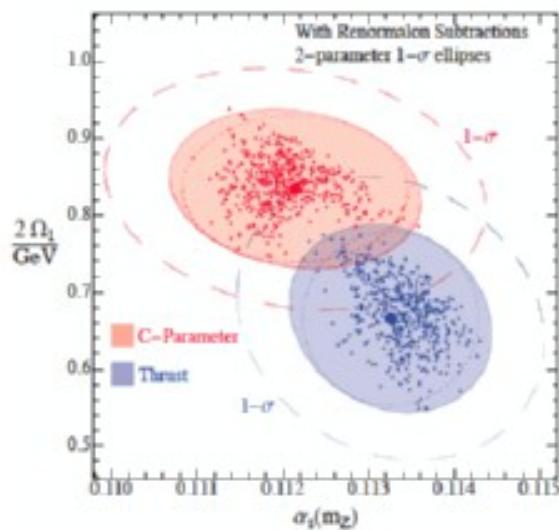
Thrust fits see  
Abbate, Fickinger,  
AH, Mateu, Stewart



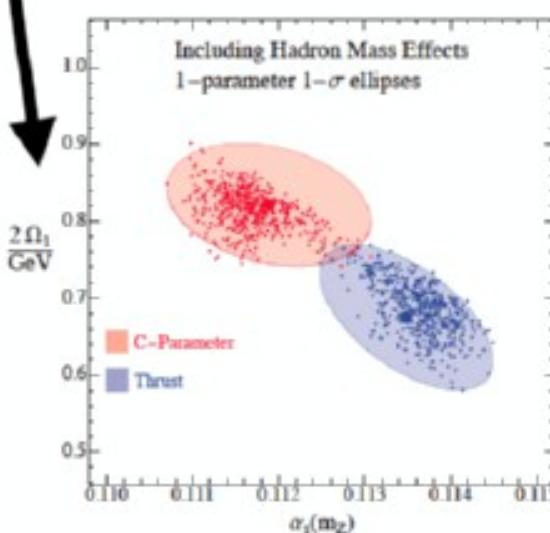
Renormalon subtraction improves  $\alpha_s$  agreement



hadron-mass effects have small effect

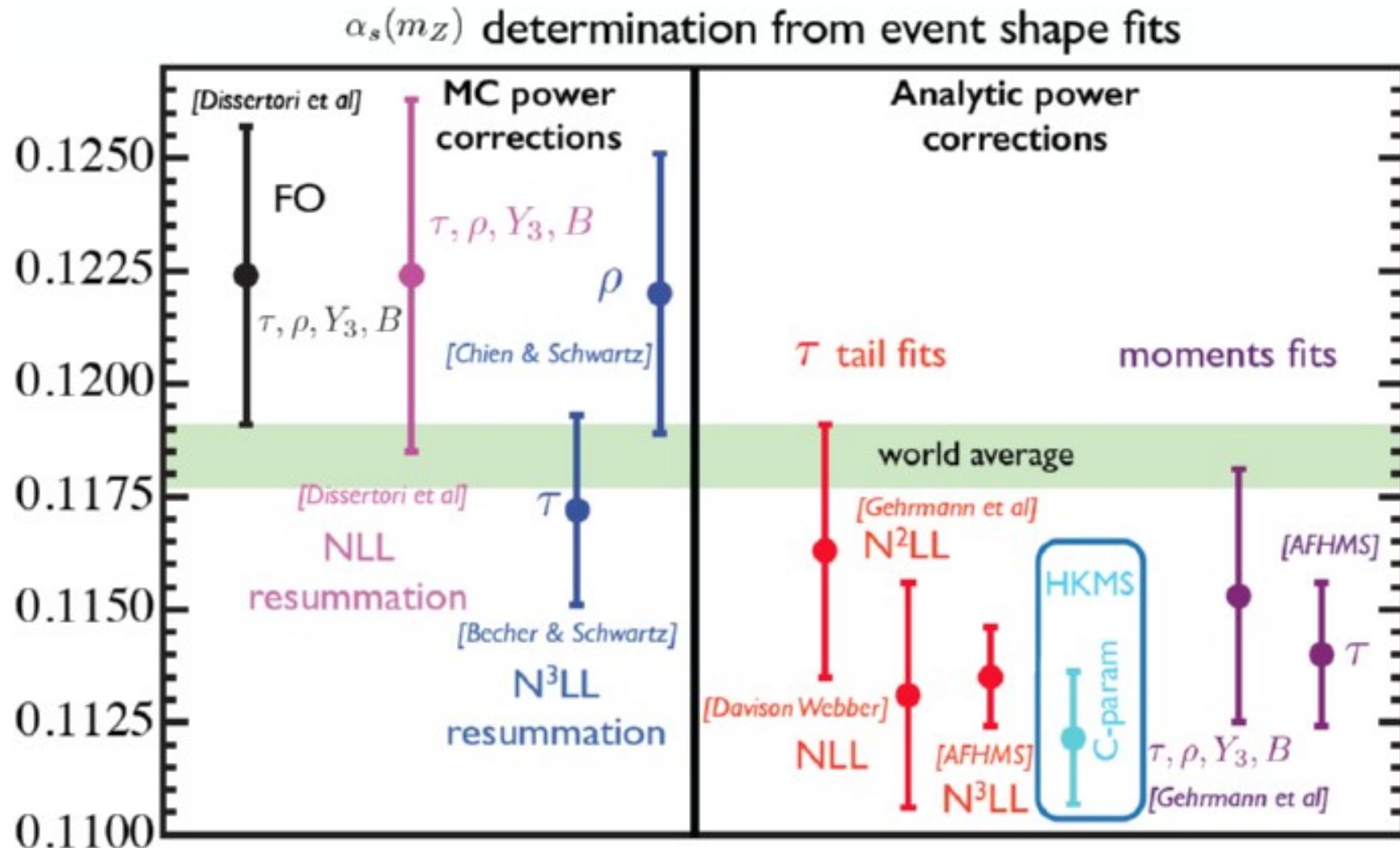


fair comparison with 2-parameter  $1-\sigma$  ellipses



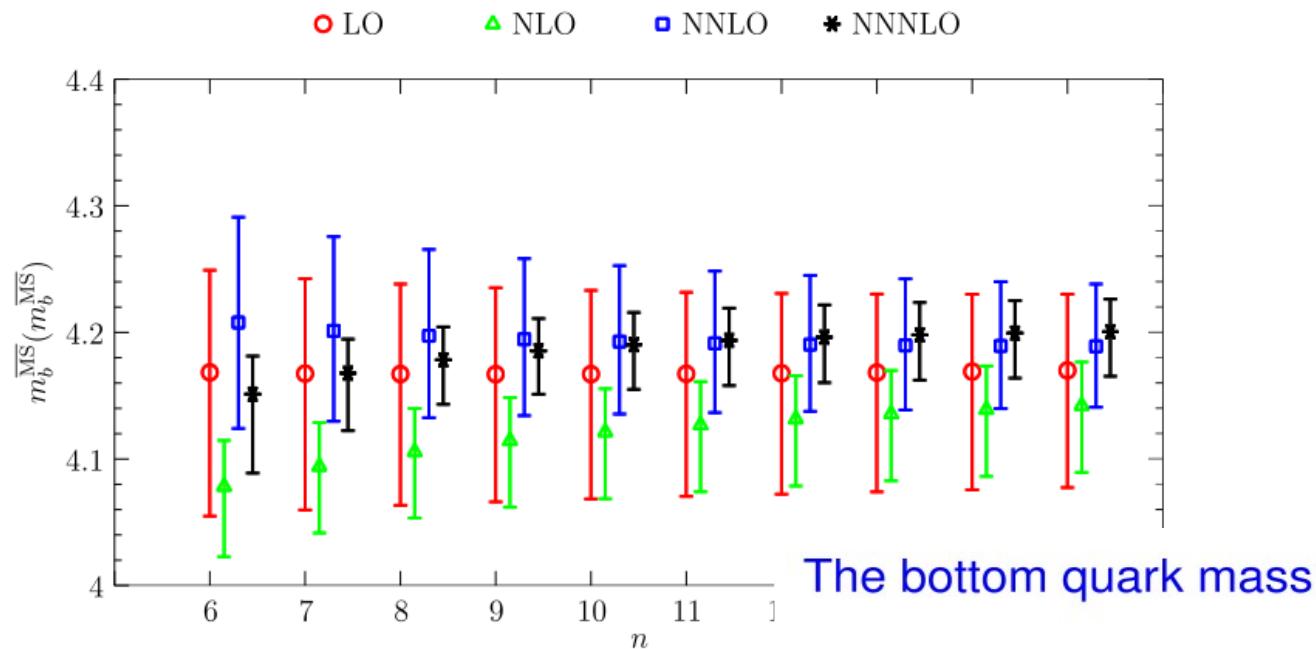
## Result

$$\alpha_s(m_Z) = 0.1121 \pm 0.0013_{\text{th}} \pm 0.0006_{\text{exp}} \pm 0.0002_{\text{had}}$$

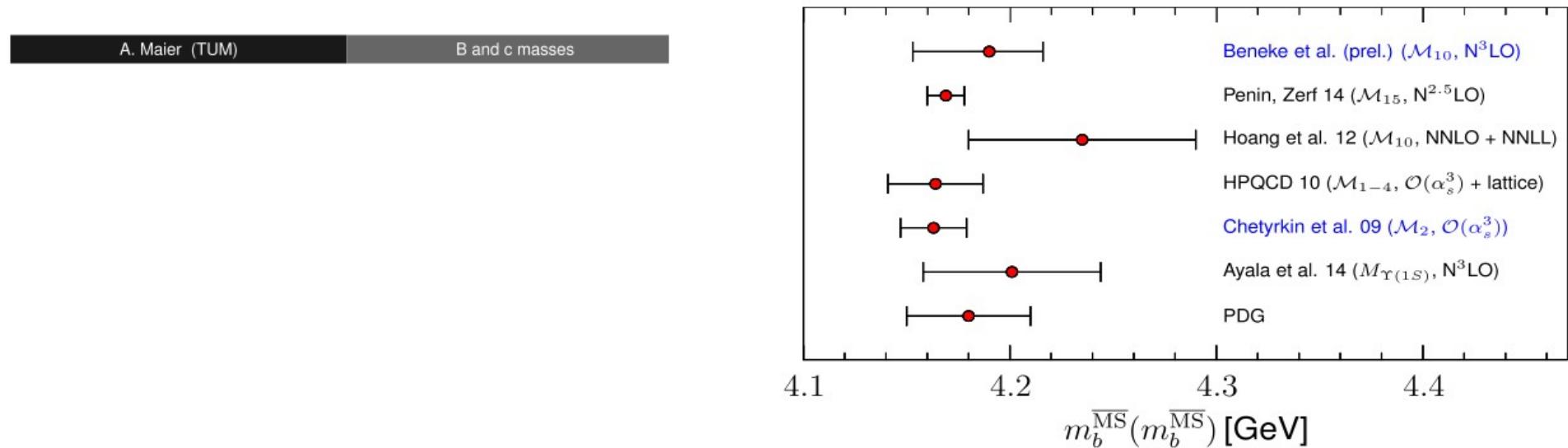


# Non-relativistic sum rules

Preliminary results



The bottom quark mass

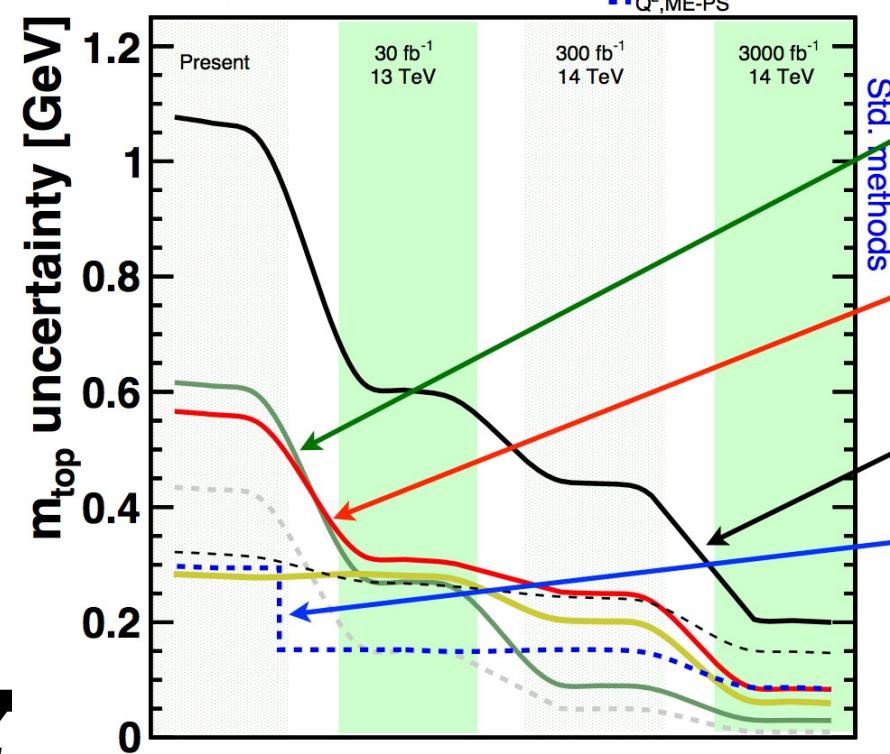


# Top Mass Outlook

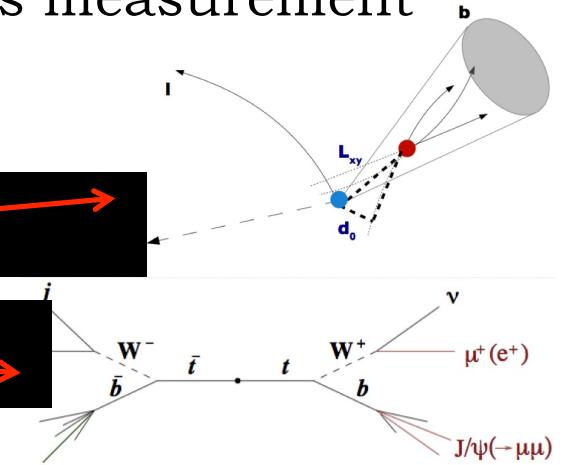
- For the projections used the baseline lepton+jets measurement at 7 TeV: JHEP **12** (2012) 105
  - [CMS PAS FTR-13-017](#)
  - And more methods with higher stats
    - Kinematic endpoints ( $M_{lb}$  di
    - B-hadron lifetime (aka  $L_{xy}$ )
    - J/Psi method

CMS-PAS-FTR-13-017

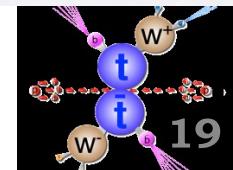
## CMS preliminary projection



LCWS Belgrade October 6-10, 2014

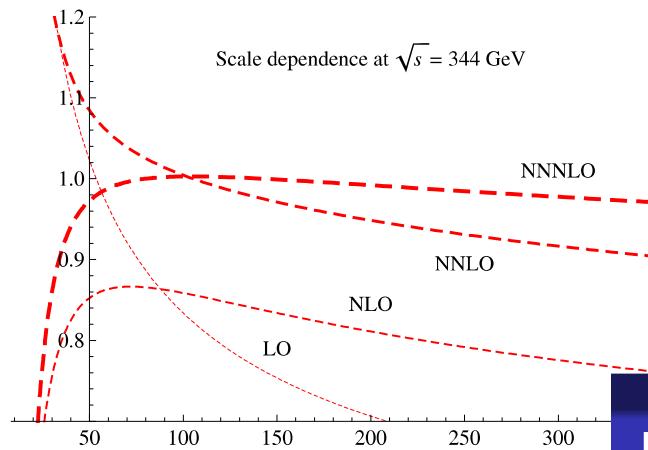


CM (TeV)	7	13	14
$L_{int} (fb^{-1})$	5	30	300
$J/\Psi$		1.8	0.8
$L_{xy} (8 TeV)$	3.4	1.3	0.6
Endpoints	2.1	1.1	0.6
Standard	1.1	0.6	0.4

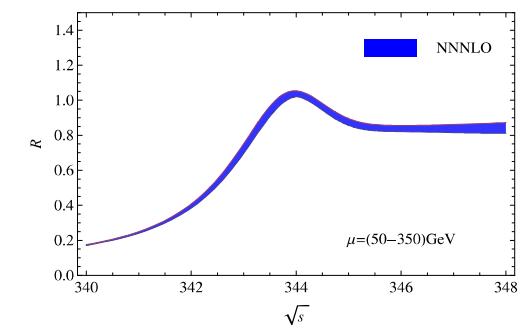
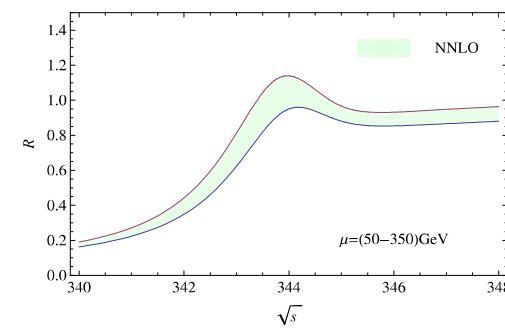


# Results – Preliminary

First look at the scale dependence



Results – Preliminary



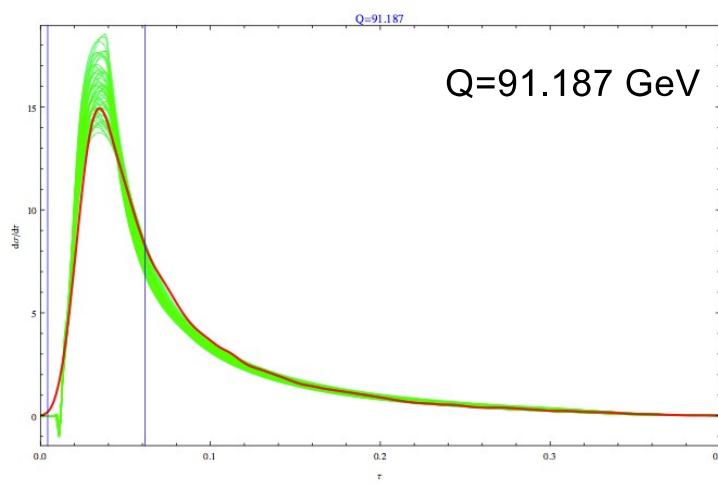
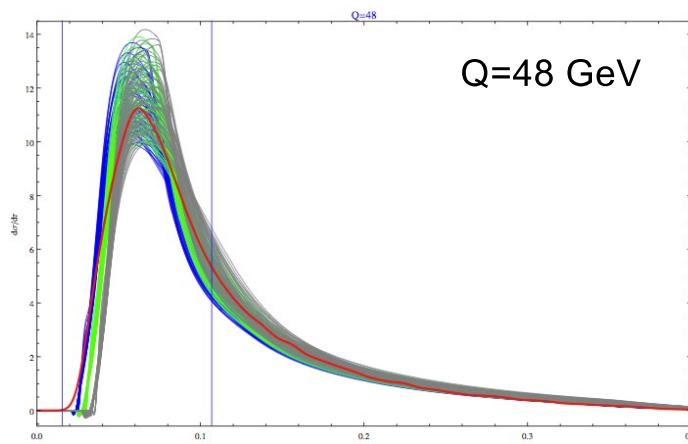
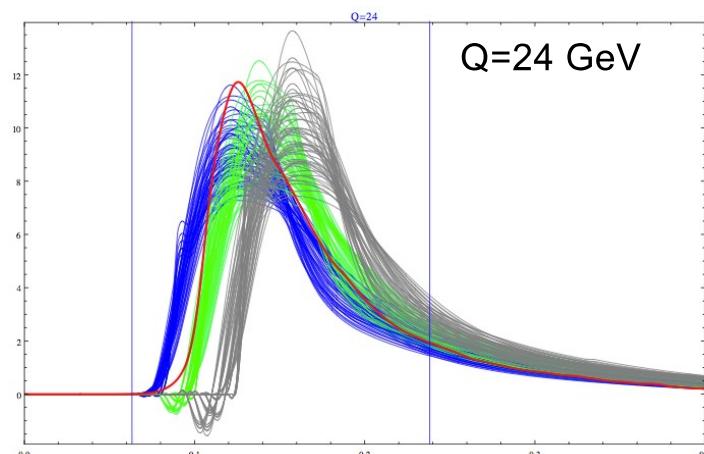
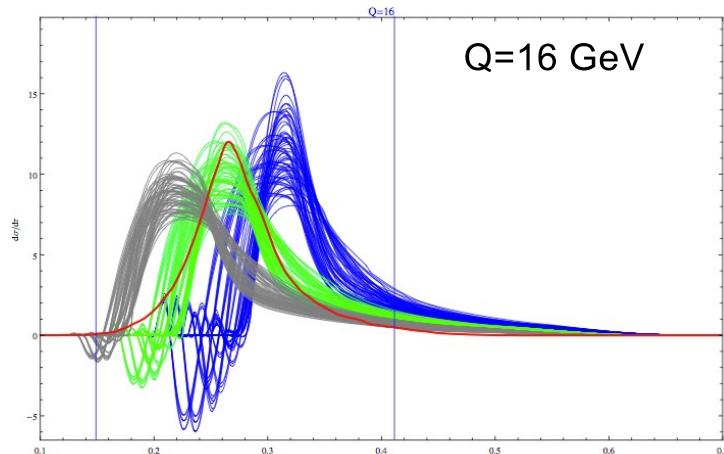
# MC vs. QCD: Primary Bottom Production

Preliminary !! (no fit yet)

all NNLL+NLO

Pythia:  $m_b^{\text{Pythia}} = 4.8 \text{ GeV}$   
QCD calc.:  $\overline{m}_b(\overline{m}_b) = 3.7, 4.2, 4.7 \text{ GeV}$

Mass sensitivity for  $0.1 < m/p_T < 0.3$ .



# Summary

- Direct measurement of top Yukawa coupling
- Estimate impact of systematic uncertainties on sensitivity
- Systematic uncertainties are not small,  
but statistical uncertainty is dominant in this study.

$\sqrt{s} = 500 \text{ GeV}, 500 \text{ fb}^{-1}, P(e^-, e^+) = (-0.8, +0.3)$

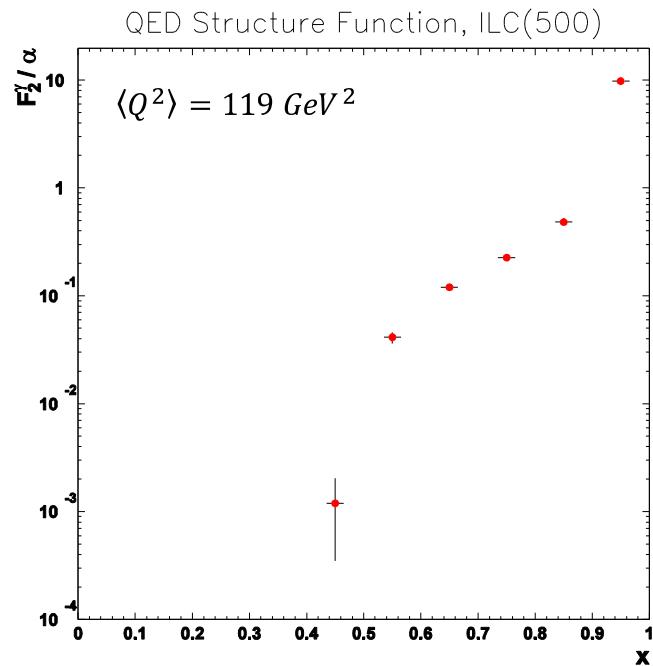
$S/\sqrt{S + B}$  ( $|\Delta g_{t\bar{t}h}/g_{t\bar{t}h}|$ ): stat. only  $\rightarrow$  include 1% syst.  
 $t\bar{t}h \rightarrow 8\text{jets}$  : 2.351 (22.11%)  $\rightarrow$  2.345 (22.17%)  
 $t\bar{t}h \rightarrow l\nu + 6\text{jets}$  : 2.029 (25.62%)  $\rightarrow$  2.016 (25.79%)

- to improve sensitivity
  - counting analysis  $\rightarrow$  MVA
  - $W \rightarrow e, \mu, \tau + \nu$  inclusive analysis  $\rightarrow$  separate  $\tau$  channel
  - Lepton identification
  - $t\bar{t}h \rightarrow l\nu l\nu + 4b$  channel
  - $h \rightarrow WW, h \rightarrow \tau\tau$  channel

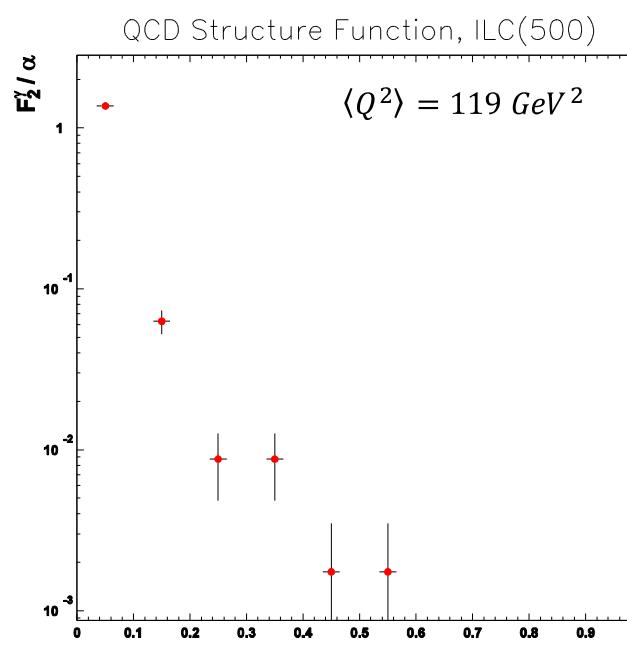
# Photon structure function

PYTHIA Monte Carlo studies

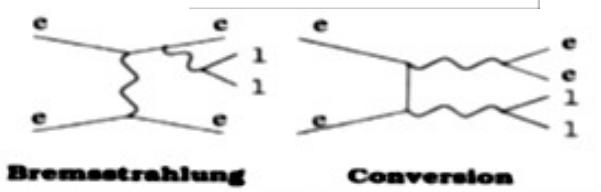
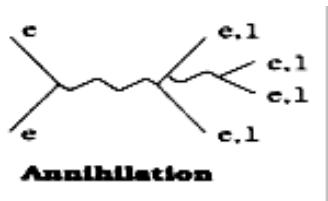
$$e^+e^- \rightarrow e^+e^- \gamma^*\gamma \rightarrow \mu^+\mu^-$$



$$e^+e^- \rightarrow e^+e^- \gamma^*\gamma \rightarrow \text{hadrons}$$



possible background :



The expected dominant background :

$$\begin{aligned} e^+e^- &\rightarrow e^+e^- \tau^+\tau^- \\ Z^0/\gamma &\rightarrow \text{hadrons} \end{aligned}$$

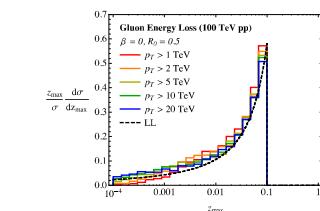
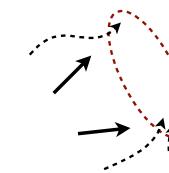
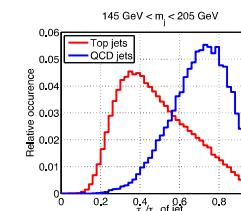
These processes as possible background will be studied in the next step of analysis



# Jet substructure and boosted objects: state of the art

Mario Campanelli

## The Case for Jet Substructure



Exceptional LHC performance + Extreme kinematics + Jet contamination + (B)SM physics

## Maximize discovery potential of LHC

Creative analysis strategies for hadronic final states

## Enhance understanding of QCD

New analytic results in (non)perturbative field theory

# Conclusion

- LHC physics requires efficient and precise jet measurements
- Jet finding techniques are adapted to the detectors:
  - Calorimeter jets with topo clusters which use the good calorimeter resolution to hadrons in ATLAS
  - Particle flow jets which use the precise tracker and the precise calorimeter track matching in CMS
- Jet calibration and correction take into account high pileup environment
- Energy scales explored at LHC can lead to fat jets: dedicated algorithms were developed and will become more and more important as LHC will restart at 13 TeV

# Summary

Particle flow detector concepts exist that measure stable particles very precisely:

$\Delta E/E \sim 3\%$  (weighted for relative abundance of particle species in jets)

Jet clustering is far from trivial in many-jet final states and with background overlay

- perturbative corrections
- non-perturbative (hadronization) corrections
- confusion due to multi-jet final states
- $\gamma\gamma \rightarrow$  hadrons background

LC is qualitatively different from LEP/SLC: a fresh look at  $e^+e^-$  jet reconstruction is needed

- Back to basic: understand what you optimize
- Isolate and quantify the impact on performance of above effects
  - a mild boost helps to sharpen the algorithm-related jet energy resolution
- Adapt new tools from the LHC: groomed jets may yield better performance

Jet-related systematics are important

- evaluate sensitivity of key analyses while we come up with estimates

Every EW-scale particle is a boosted object in a high energy (1-3 TeV) linear  $e^+e^-$  collider

Distinguish di-boson from  $q\bar{q}$  production AND separate W, Z and Higgs

Highly granular particle flow calorimetry is great for substructure response

Background is a powerful enemy of fat jet substructure

Preliminary results indicate adapting existing tools (grooming) for pile-up mitigation is effective

