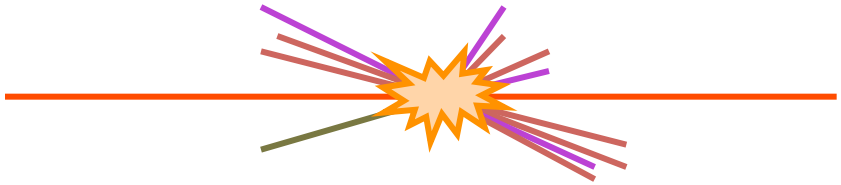
ATLAS-II: Higgs and SM results



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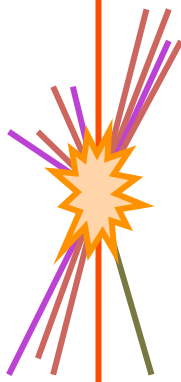
CHIPP Plenary - 2012/09/13

LABORATORIUM FÜR HOCHENERGIEPHYSIK LHEP UNIVERSITÄT BERN

Overview

- Higgs results
- High mass Drell-Yan cross-section
- Top physics
- Conclusions and Outlook



Higgs: H➔ZZ$^{(*)}$➔4lep

Geneva (G. Pásztor, E. Benhar Noccioli) recently joined the effort:

- Maximising performance for low p_T electrons (Brem. track refitting, efficiency studies at low p_T)
- Methods for estimating background contribution in electron channel

The distribution of the four-lepton invariant mass, m4l, for the selected candidates, compared to the background expectation in the 80 to 250 GeV mass range.

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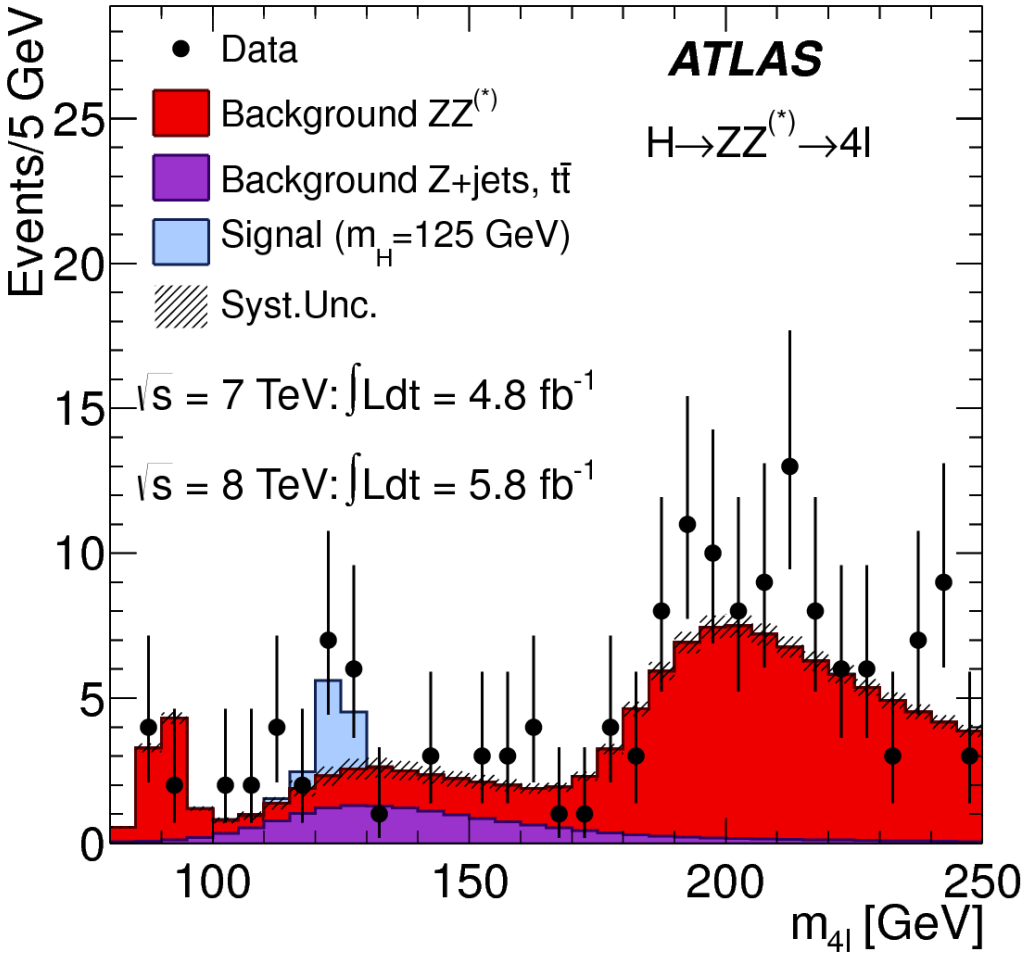


Higgs results: Statistical procedure

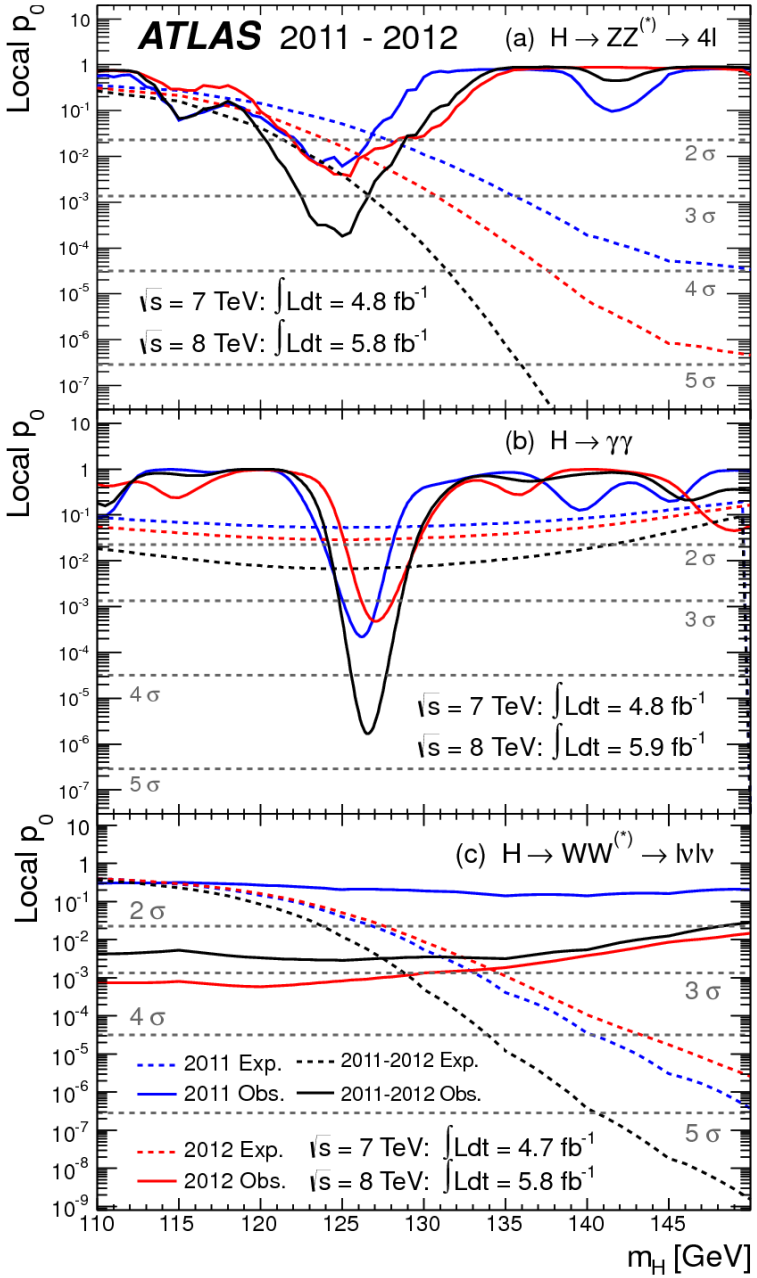
- Define a scale factor (μ) such that μ=0 implies background only and μ=1 implies SM Higgs signal.
  - Used within a profile likelihood ratio, includes systematic uncertainties and associated correlations.
- CL_s method used to set exclusion limits.
  - Excluded at 95% CL when CLs is less than 5% for μ=1 for a given mass.
- The data excess was input using the local p_0, the probability that the background fluctuates to greater than or equal to the expected signal.

Combination inputs

The dashed curves show the expected local p0 under the hypothesis of a SM Higgs boson signal at the given mass.

p0, the probability that the background can produce a fluctuation greater than or equal to the excess observed in data.

Results are shown separately for the √s = 7 TeV data (dark, blue), the √s = 8 TeV data (light, red), and their combination (black).



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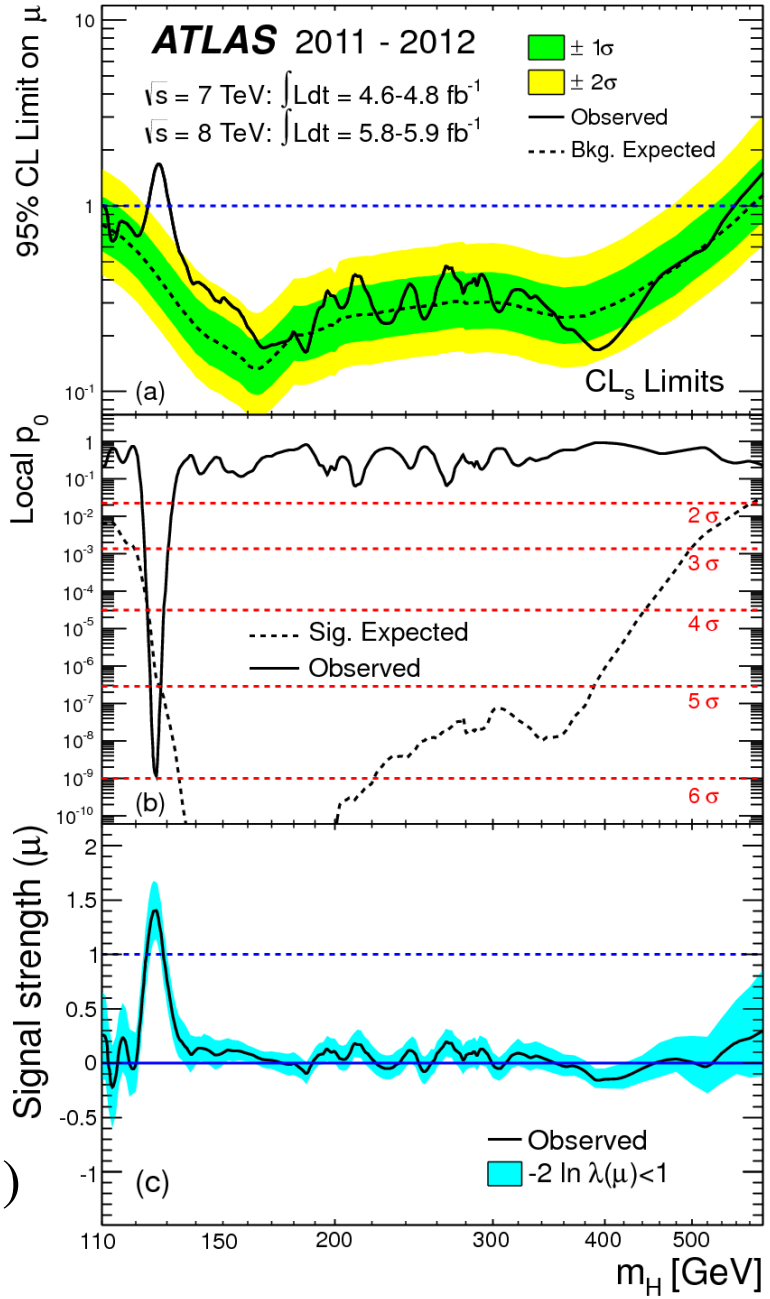
Combined result

(a) The 95% CL upper limit on the signal strength

(b) The p0 for a signal hypothesis (mu=1)

(c) The best-fit strength, where the band is approx. 68% CL interval.



Significance of 5.9 standard deviations, corresponding to a background fluctuation of 1.7×10^{-9}.

$$m_H = 126 \pm 0.4(stat) \pm 0.4(syst)$$

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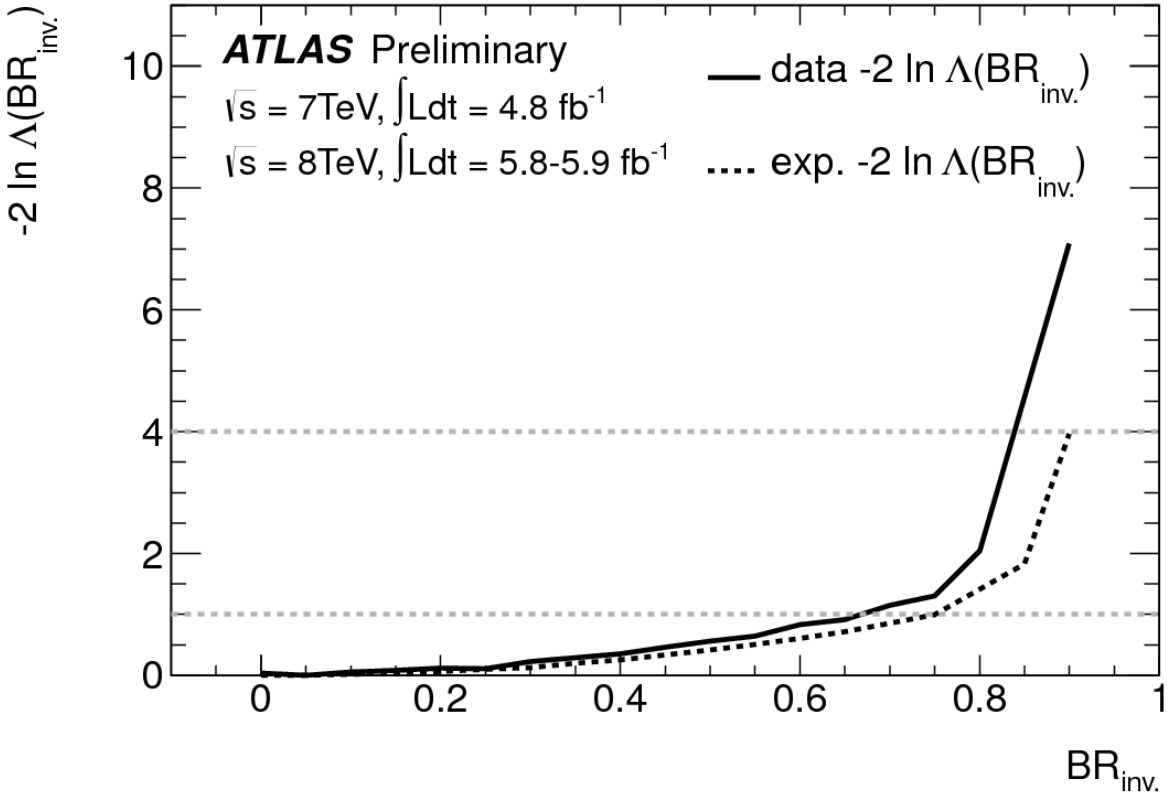
Higgs properties

1D fit for the benchmark model probing for contributions from non-SM.

The solid line represents the result obtained from the data while the dashed line illustrates the average expected in the presence of a SM Higgs boson.

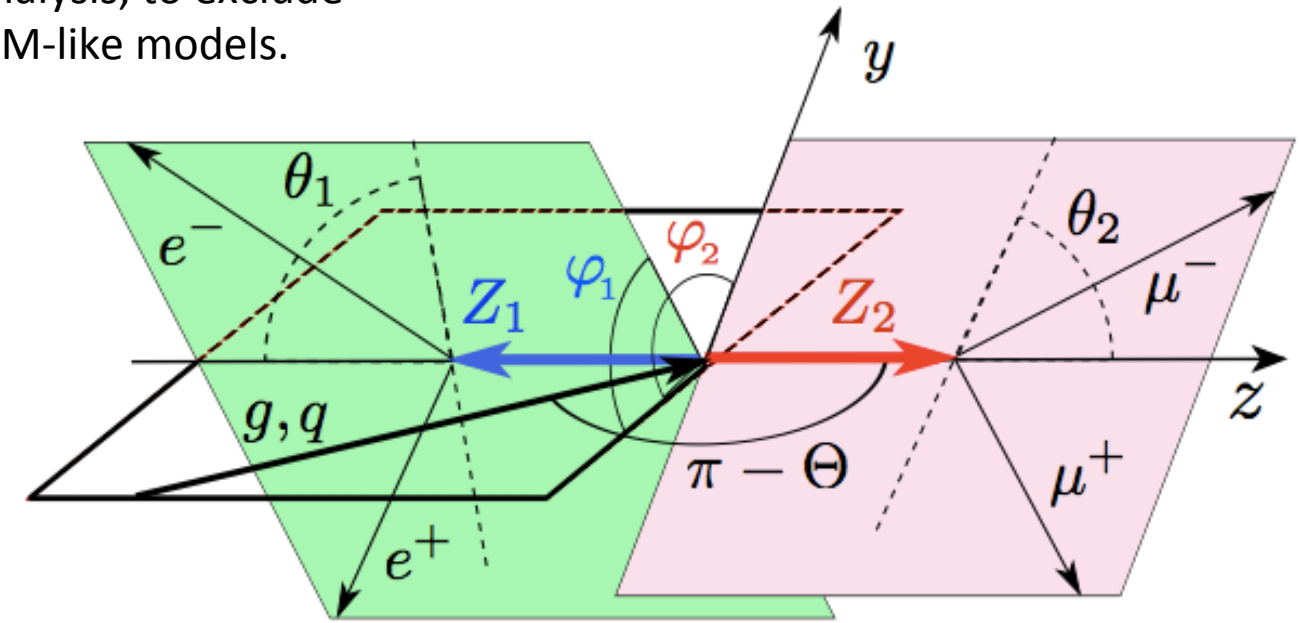


Within the current statistical uncertainties and assumptions, no significant deviations from the Standard Model couplings are observed.

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-127/

Higgs properties

G. Pásztor and summer student are implementing an angular analysis, to exclude possible SM-like models.



Cabibbo-Maksymowicz angles

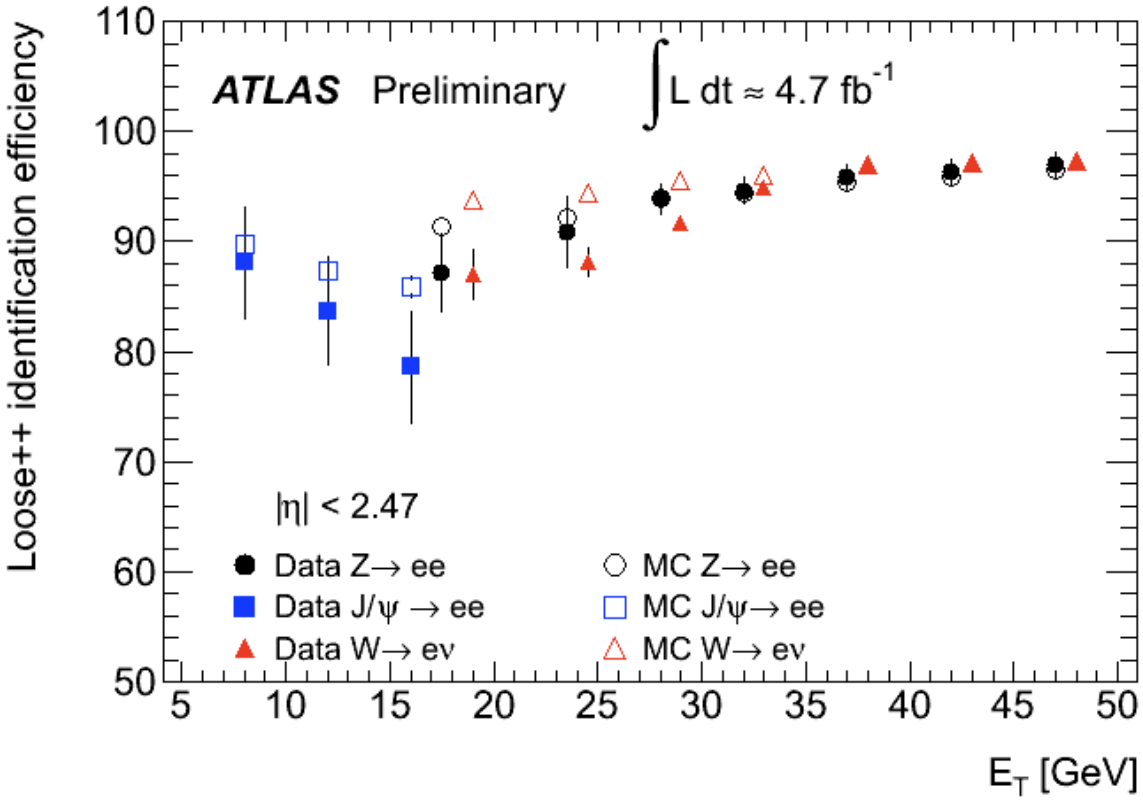
Electron performance studies

E. Niccioli improved efficiency measurement at low ET using J/ψ events (for use in Higgs to 4-leptons analysis)

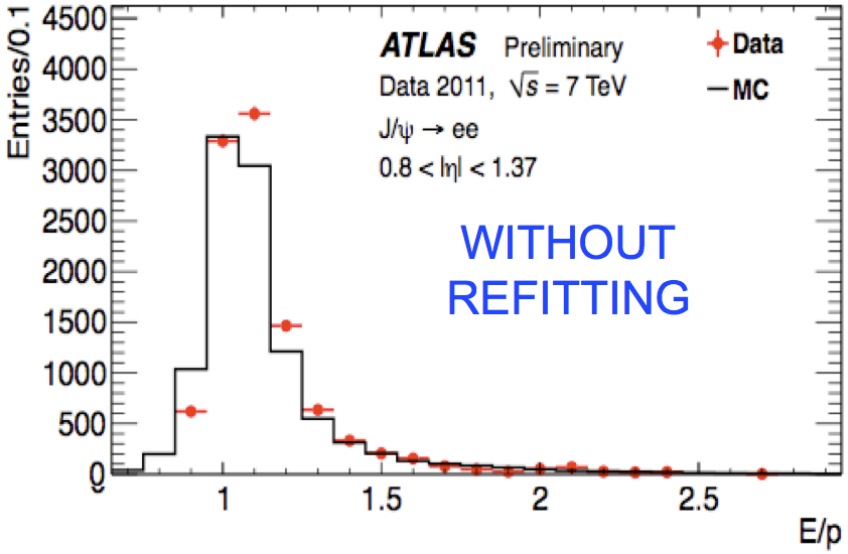
K. Nikolics extended the data measurement to high E_T range beyond 50 GeV

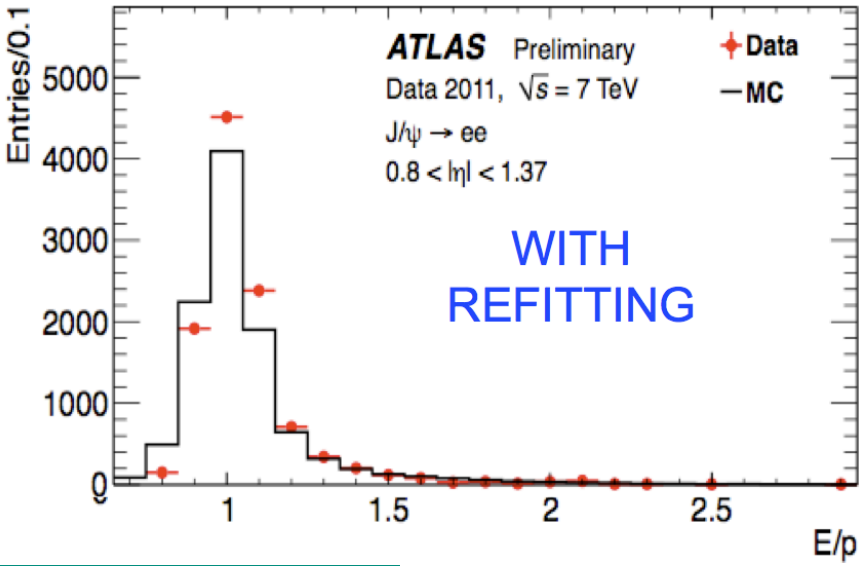
Methods documented in 2010 performance paper edited by G. Pásztor.

P. Bell is coordinating the e/γ trigger.

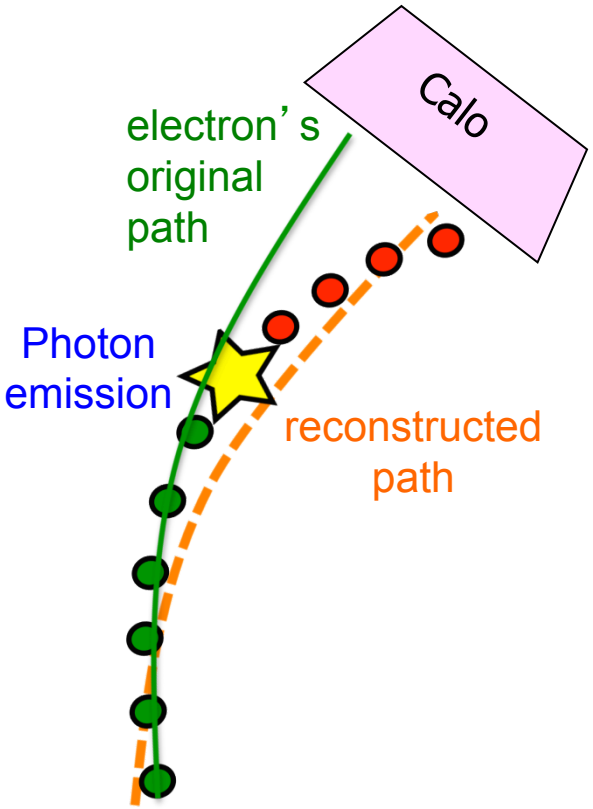


Bremsstrahlung Track Refitting





Low energy electron reconstruction efficiency improved by refit.

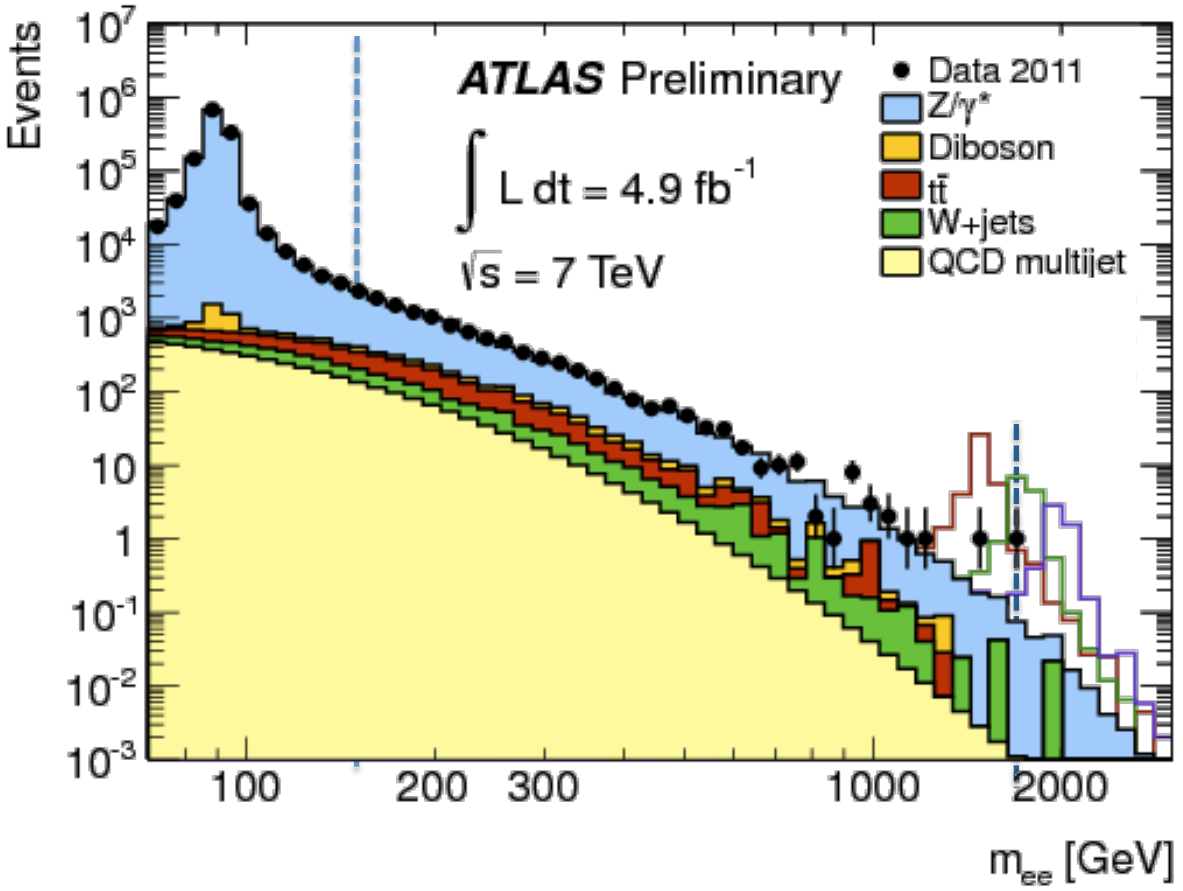


G. Pásztor & E. Benhar Noccioli contributed to the validation of the bremsstrahlung fitting algorithm.

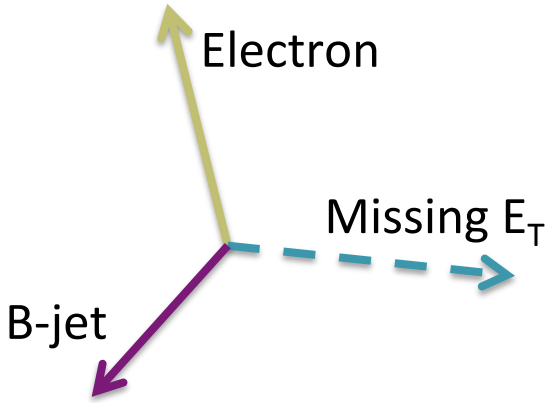
High mass Drell-Yan (e^+e^-)

An analysis of the high mass Drell-Yann has been performed in the electron channel by P. Bell, S. Gadomski, G. Pásztor, M. Goulette, K. Nikolics, X. Wu

This paper associated with this analysis is expected to be submitted for publication soon.

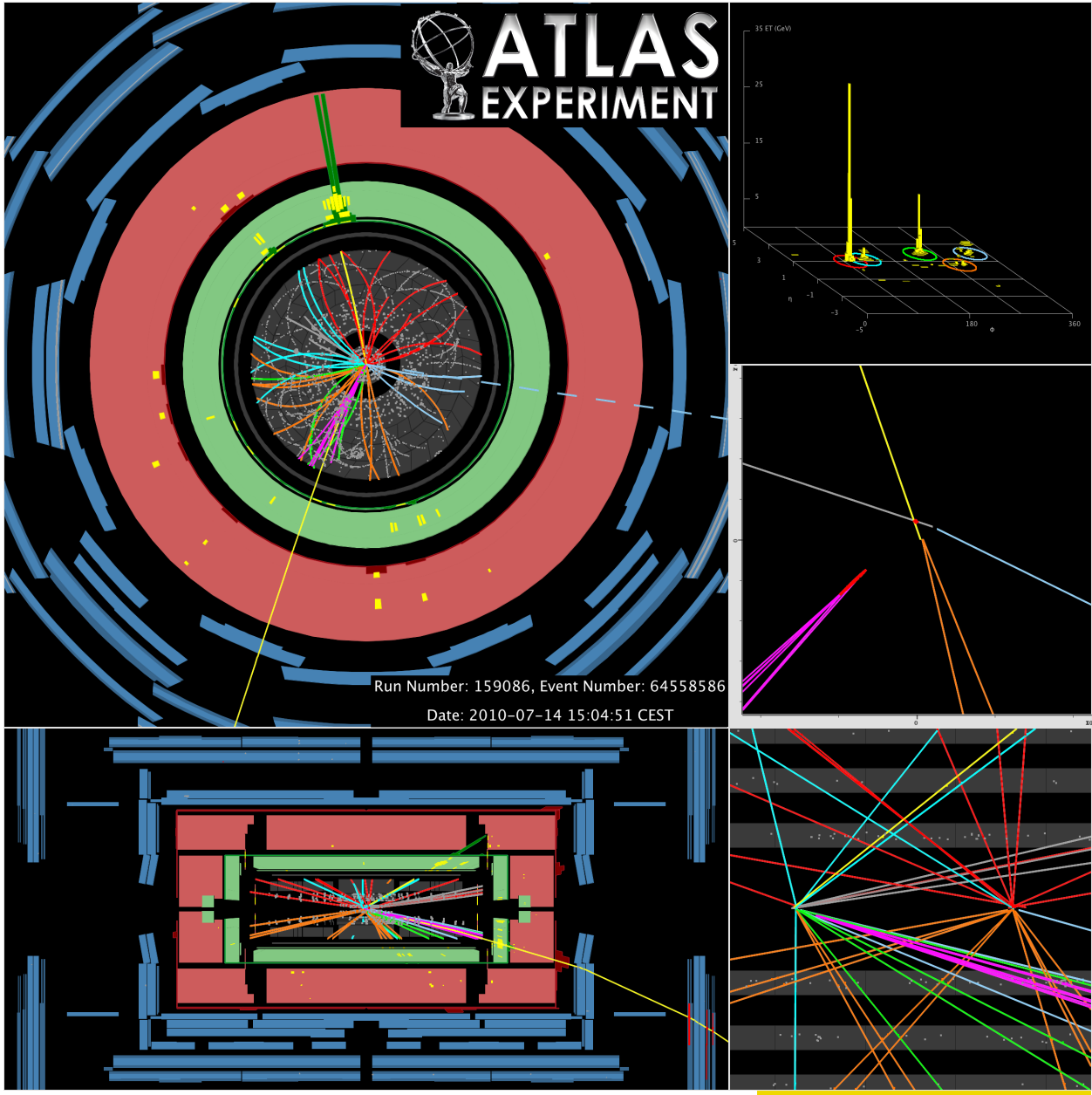


Single-lepton event selection



At least three or four jets reconstructed with the anti-k_t algorithm (0.4 radius parameter)

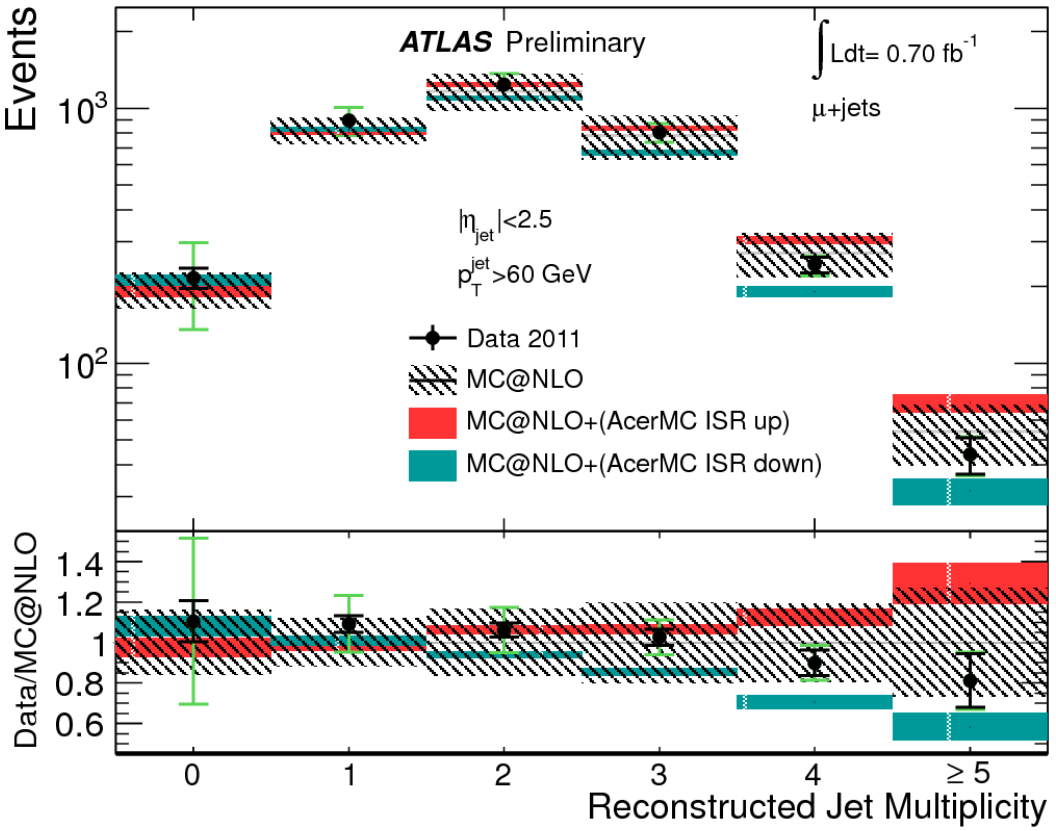
Missing energy vector from calorimeter energy deposits and muon term.



Cross-section f(jet multiplicity)

V. Dao and W. H. Bell preformed a first measurement of jet multiplicity in the single-lepton channel for several jet p_T thresholds.

W. H. Bell finishing analysis with full 2011 data set ($5fb^{-1}$), unfolded within kinematic range corresponding to acceptance of event selection.

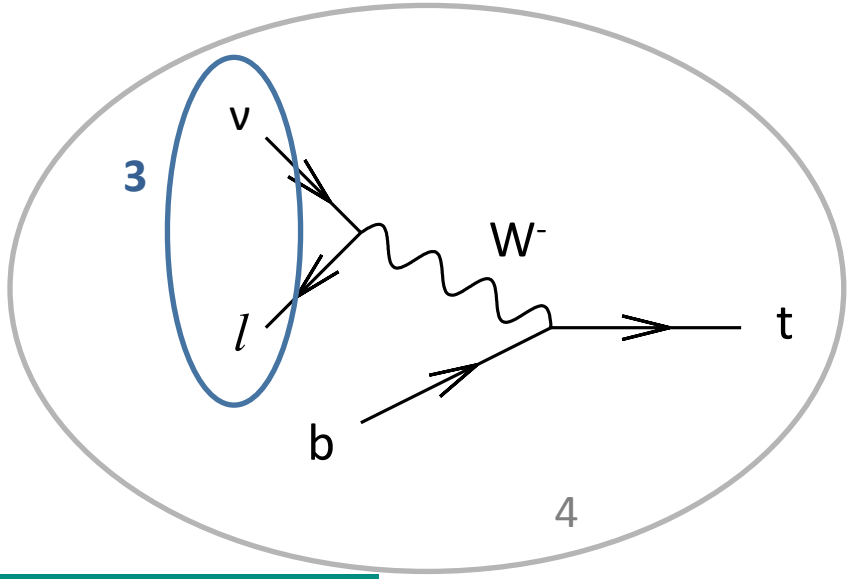


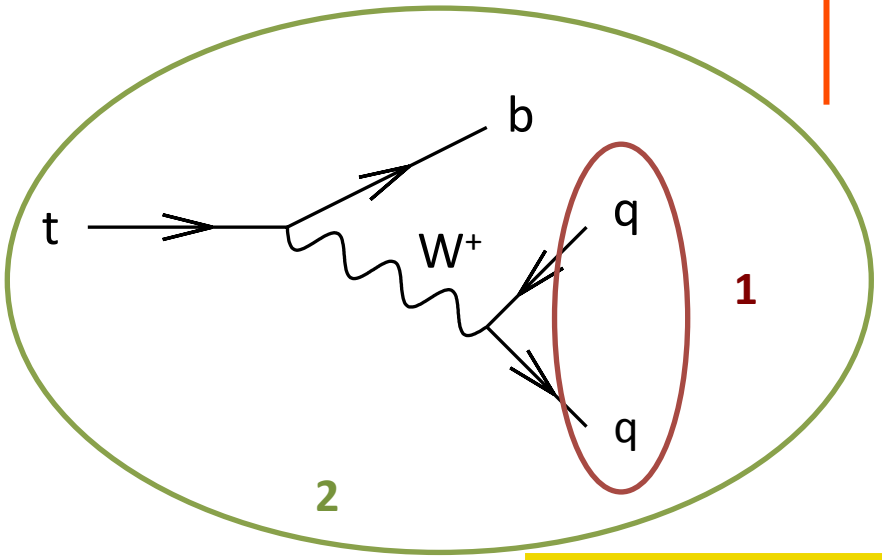
https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2011-142/

"Reconstructed jet multiplicities from the top-quark pair decays and associated jets in pp collisions at √s = 7 TeV measured with the ATLAS detector at the LHC"

Cross-section f(pseudo-top p_T)

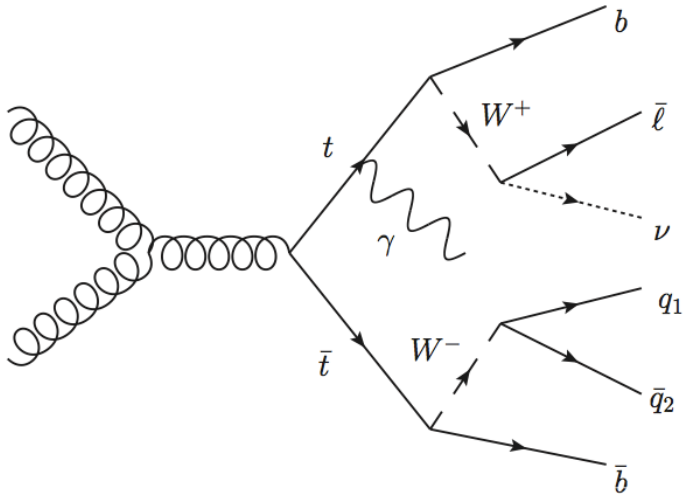
- W. H. Bell and I. Watson performing unfolded pseudo-top p_T measurement using 2011 data (5fb^{-1}).
  - Pseudo-top defined from recipe rather than kinematic fitter
    - Avoid Monte Carlo generator dependence.
    - Compare fixed order pQCD calculation with parton shower, within the kinematic range of the result.
  - Define observable with particles and reconstructed objects.
    - Unfold from reconstructed observable to particle observable.





Cross-section f(photon E_T)

- S. Gonzalez Sevilla and G. Barone are performing a cross-section measurement for top anti-top events which contain additional photon.
  - Constrain top charge and test SM using ttbar+gamma/ttbar.
  - Analysis is being performed using 2011 data set (5fb^{-1})
  - Plan to perform a differential analysis with 2012 data.



- G. Pásztor editorial board member for this analysis and ttZ production.
  - Improvements to ttZ analysis, signal and background selection.

Conclusions & Outlook

- Contributed to the ATLAS Higgs discovery analysis.
- Performed a high mass Dell-Yan cross-section analysis
- Finishing a range of differential ttbar analyses.
- Contributed to several analyses by involvement in editorial boards.