ϕ Inter Calibration on Photon Energy with ATLAS Detector

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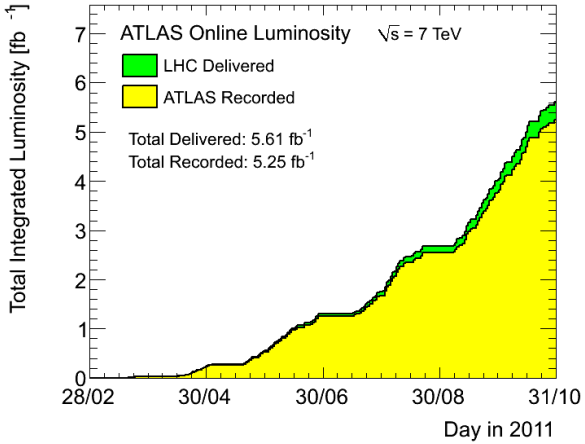
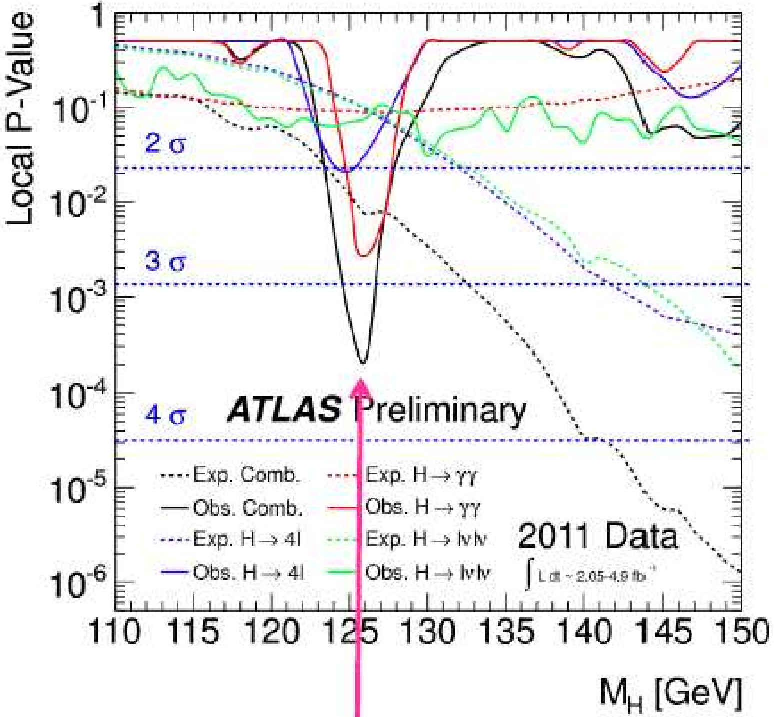
Atlas Experiment on LHC

- In the year of 2011, LHC delivered 5.61 fb-1 of data from pp collisions at √s = 7 TeV, and 5 fb-1 is recorded by ATLAS
- More than 10 million single photons and electrons could be selected respectively.
- Over a million Z candidates are used within the di-electron mass window [80,100] GeV

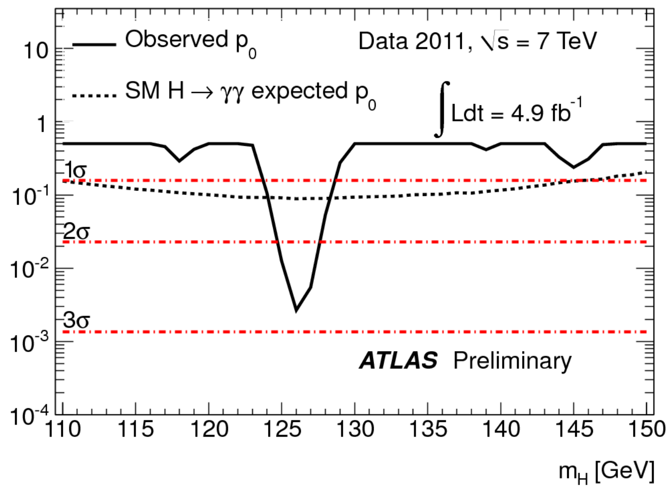


Higgs Search and recent progress

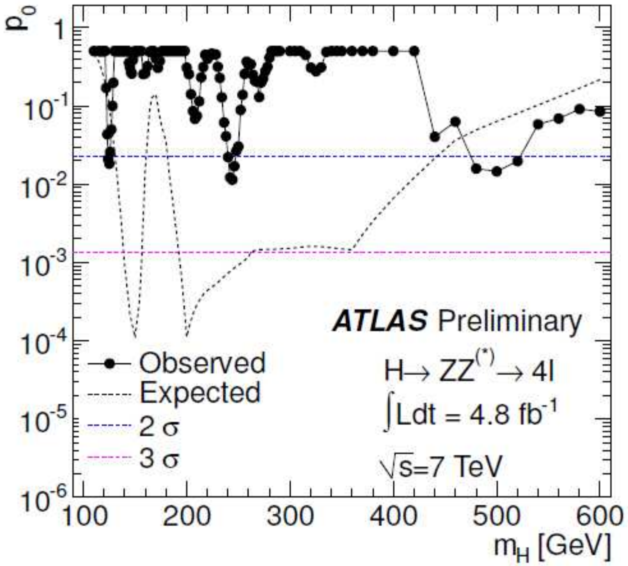


ATLAS: 3.6σ at 126 GeV

Consider Look-elsewhere effect:
2.5 σ at 126 GeV



H→γγ:
2.8σ @
126.5 GeV

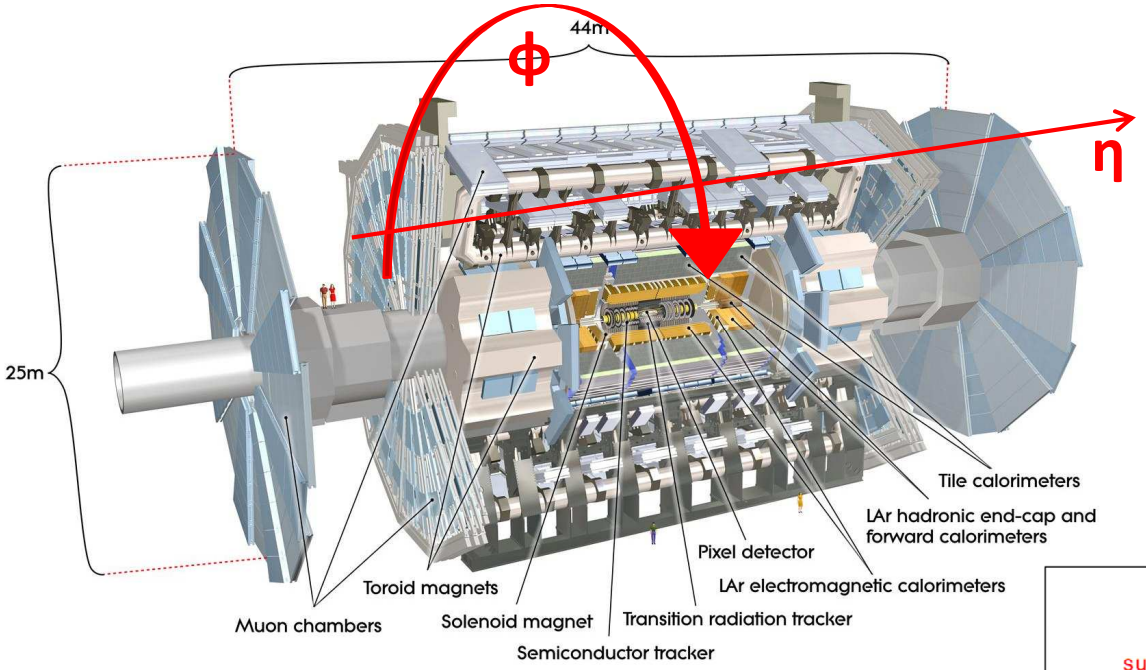


H→ZZ → 4l:
2.1σ @125 GeV
2.2σ @244 GeV
2.1σ @500 GeV

Strong motivation to improve:

- H→γγ -- Need for the best intercalibration of photons ($p_{t,\gamma} > 25GeV$)
- H→ZZ→ 4l -- Need for the best intercalibration of electrons ($p_{t,e} > 10GeV$)

LAr calorimeter of ATLAS detector



Barrel: |η| < 1.37
Endcap : 1.52 <|η| < 3.2

Theoretically, physics is ϕ-symmetric at a given η,
Which could be reflected by the same energy distribution of each (η_{fixed}, ϕ) bin.

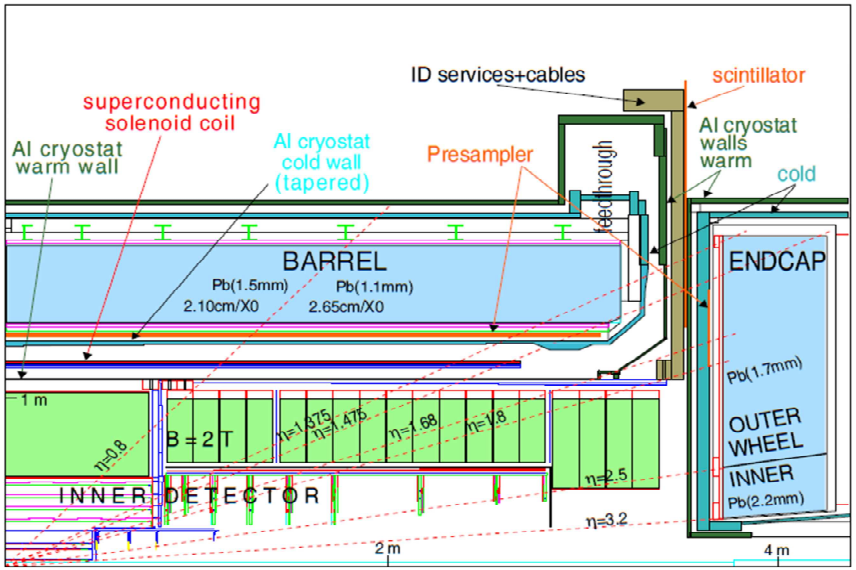
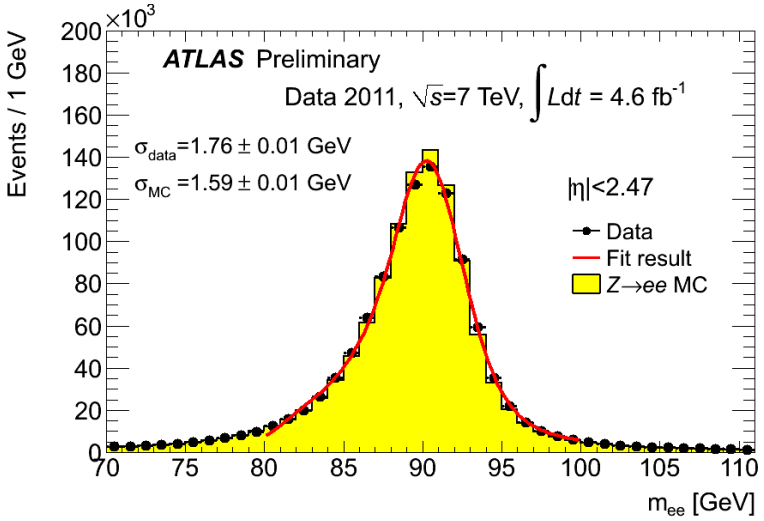
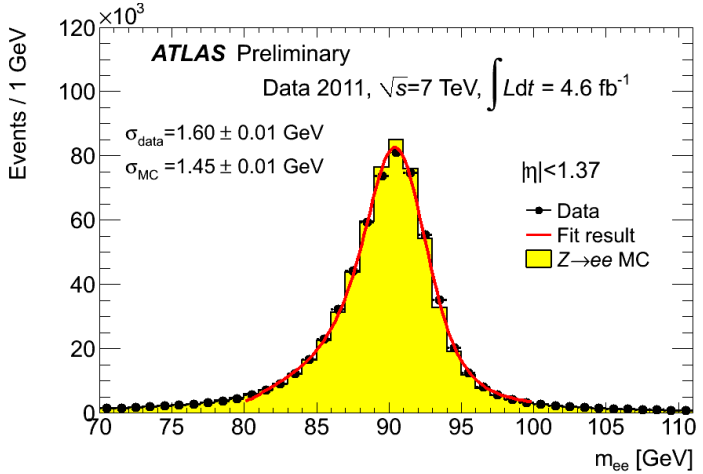


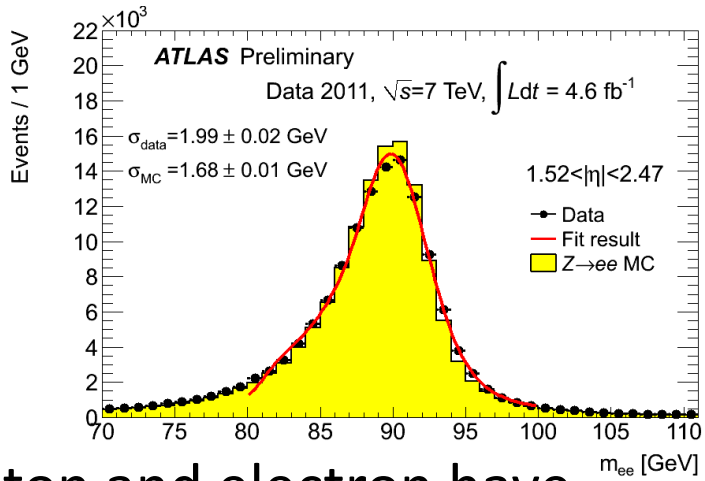
Figure 4-i Longitudinal view of a quadrant of the ATLAS EM Calorimeter.

calibration of LAr calorimeter by e/γ

- for electron calibration, particles are selected from Z→ee events, which have a high purity.







- for photon calibration, since photon and electron have similar shower shapes in calorimeter, extrapolation from Z→ee of MC is considered, with cross check with Z→llγ

Φ Inter Calibration Method (1)

- The method is based on the expectation that energy distributions of a given particle in all ϕ bins to be the same when η is given.
- It is performed by comparing:

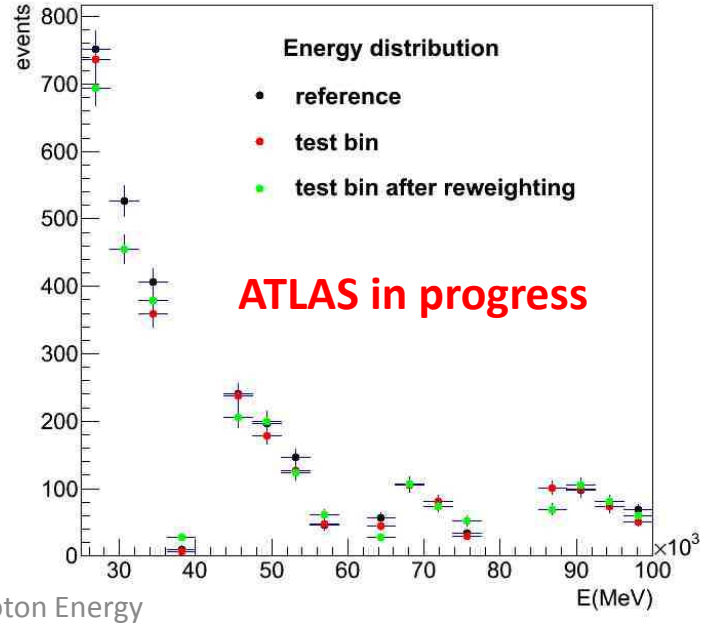
  - test: the distribution of total energy deposited in one φ bin

  the energy is reweighted by the function :

  $$E' = E/(1+\alpha)$$

  - reference: the mean distribution of total energy collected from all φ at the same η bin

An example from one (η, φ) bin:
The energy distribution of reference, test bin and the one after reweighting

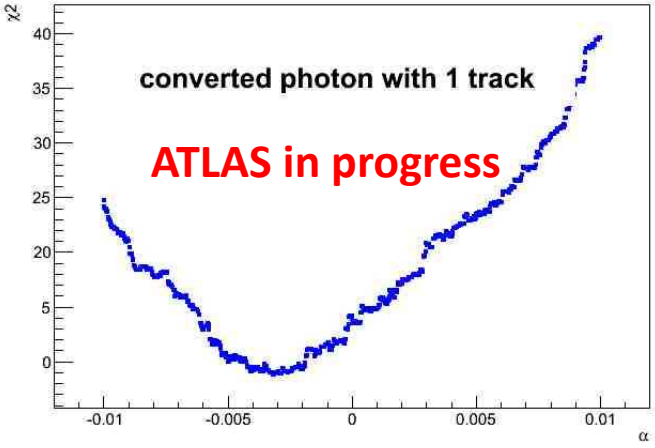


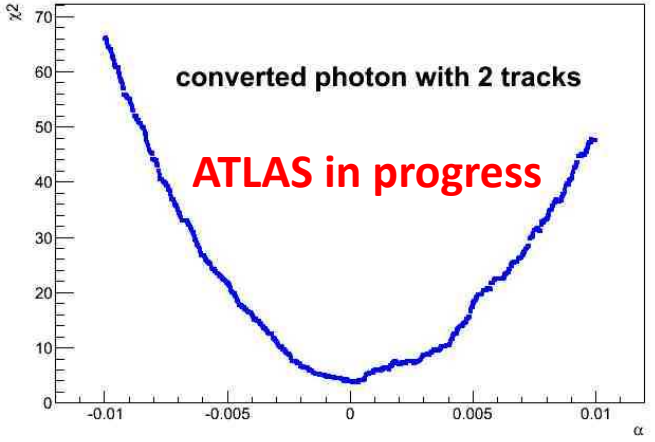
Φ Inter Calibration Method (2)

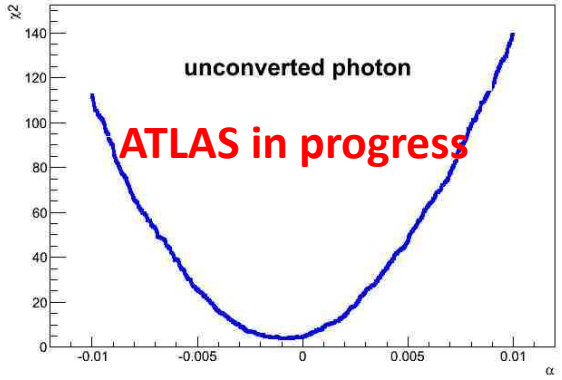
- the best α is chosen by looking at the χ2 distribution obtained from the comparison of the two spectra

$$\chi^2 = \sum_{i}^{Nbins} \frac{(N_{test,i} - N_{ref,i})^2}{\sigma_{test,i}^2 + \sigma_{ref,i}^2}$$

$N_{test,i}$: γ,e number in ith bin of the energy distribution histogram at given ϕ bin at fixed η bin
$N_{ref,i}$: γ,e number in ith bin of the energy distribution histogram at fixed η bin with global ϕ
$\sigma_{test,i}$: the error of $N_{test,i}$
$\sigma_{ref,i}$: the error of $N_{ref,i}$







An example of χ2(α) in one (η, φ) bin from three kinds of photons

conclusion

- calibration of photons and electrons is very important for the final physics results expected this summer.
- The work done in ATLAS calibration group during spring will be public in a few weeks .
- The inter calibration method that we have developed also applies to electrons and should improve the electron in situ calibration used in coordination with the usual Z->ee peak calibration. This will improve the EM scale global uncertainty.

Let's wait for summer result
(∩_∩)