Study of γ-jets physics in the ATLAS experiment

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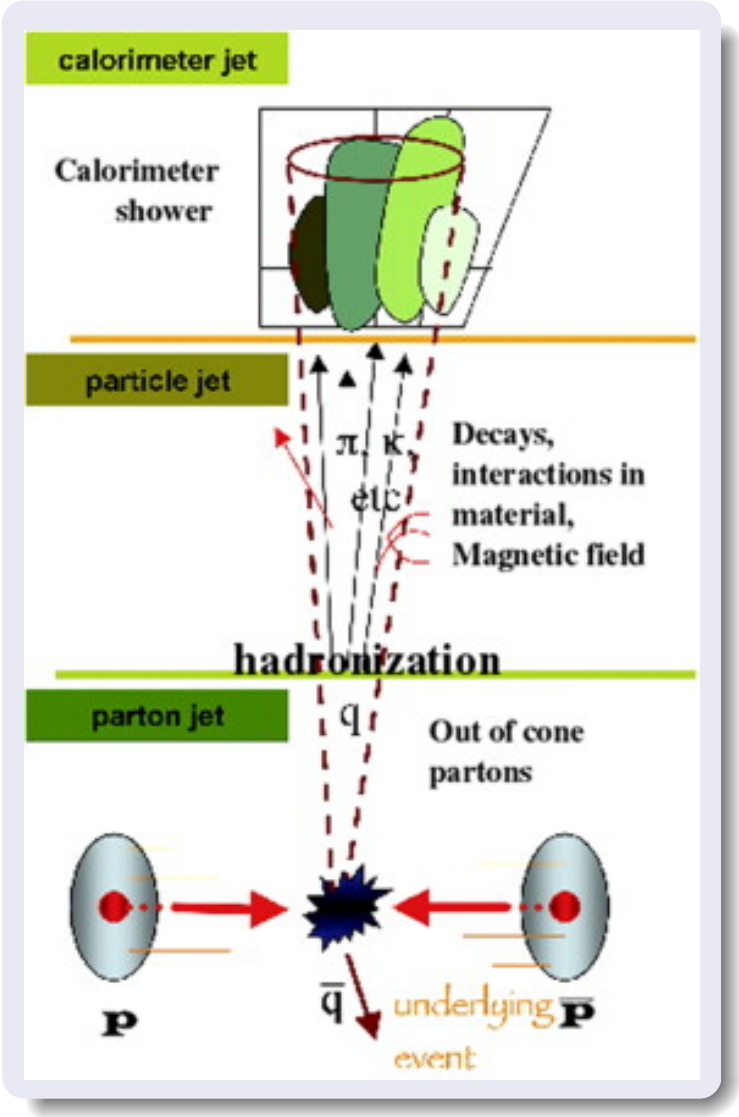
Why this study?

- Necessary for backgrounds rejection
- γ-jets events : half of the background in the H$\rightarrow \gamma\gamma$ decay's channel
- Should help us to select only the right $\gamma\gamma$ emission to find the higgs
- Promising tool for quick and dirty jet calibration

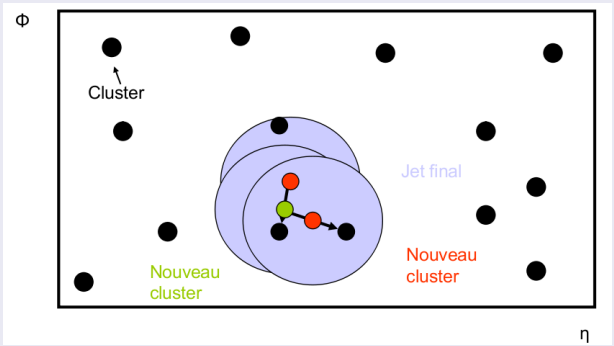
What is a jet?

- Hard scattering processes with hadrons $\Rightarrow$ outgoing partons (i.e. quarks and gluons)
- They can't remain as free partons (colour confinement)
- They will quickly 'fragment' into hadrons with a complex substructure (hadronization)
- We see only colour neutral particles (charged or not) with the same kinematics properties than the free partons
- But jets are actually meaningless without a precise definition $\Rightarrow$ jets algorithms



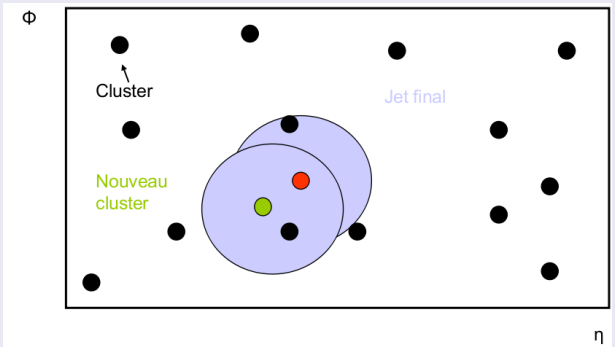
How to define a jet?

Cluster algorithm



VS

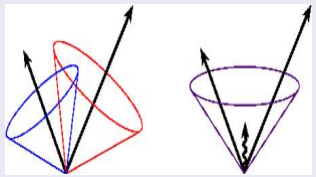
Cone algorithm



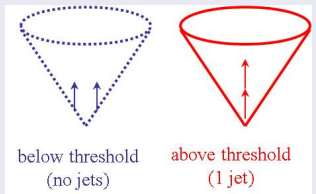
Theoretical and experimental requirements

Theoretical requirements

- Infrared safety



- Collinear safety



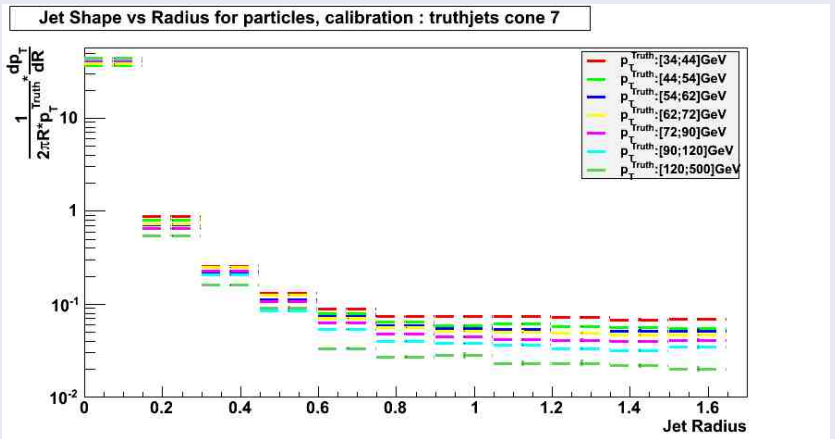
Experimental requirements

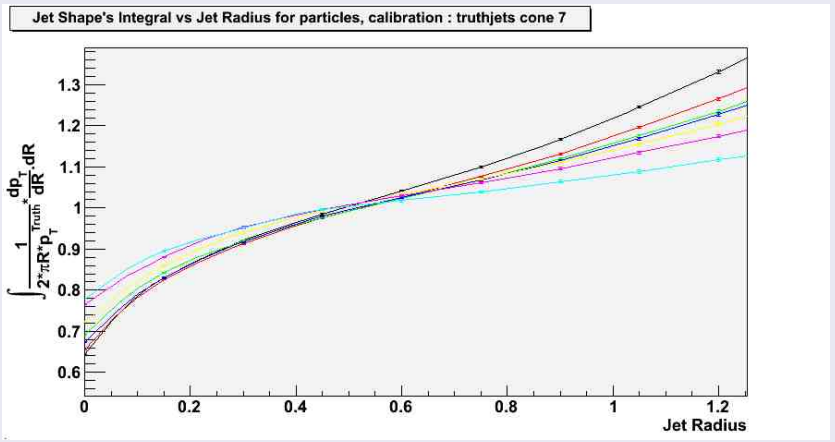
- high speed
- pile-up resistant
- small sensitivity to underlying event
- flexibility
- ability to resolve the jet's sub-structure

Jet shape analysis

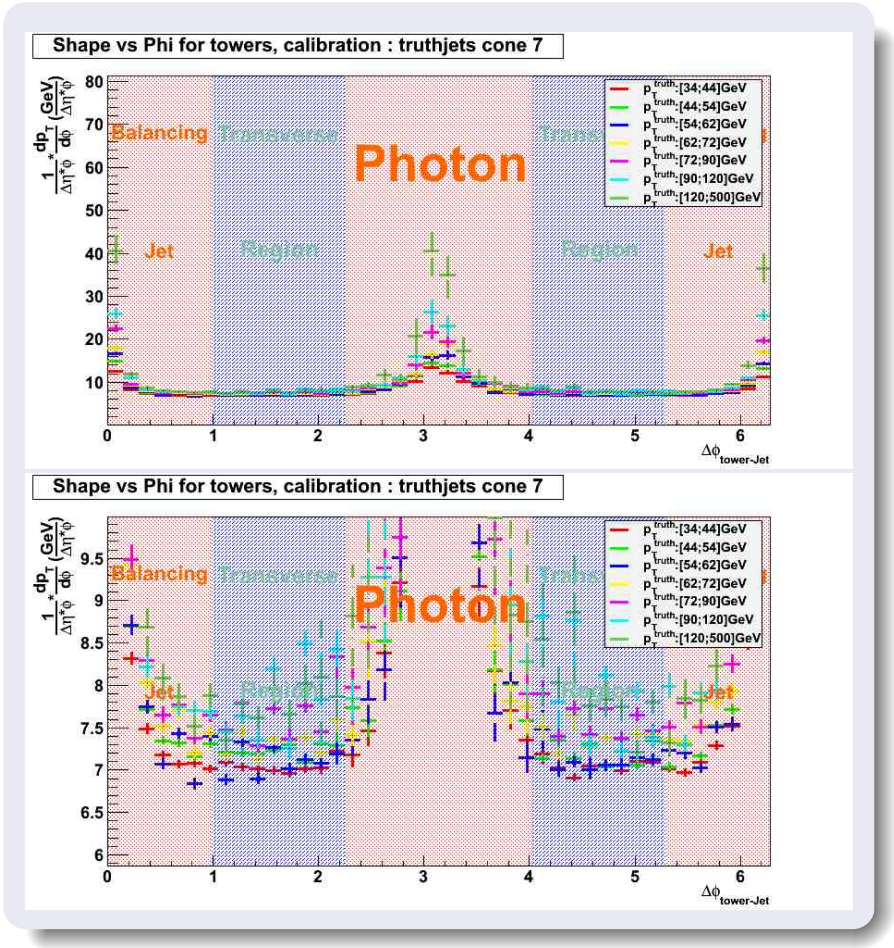
- Jet shape is a useful tool to
  - derive out of cone energy correction
  - get information about the nature of the jet
  - have soft physics under control
  - check Monte-Carlo description of datas
- the integral allows us to check
  - jet calibration
    - jet energy scale
  - algorithm performances
    - underlying event rejection

Study with the ATLAS cone algorithm (radius=0.7)





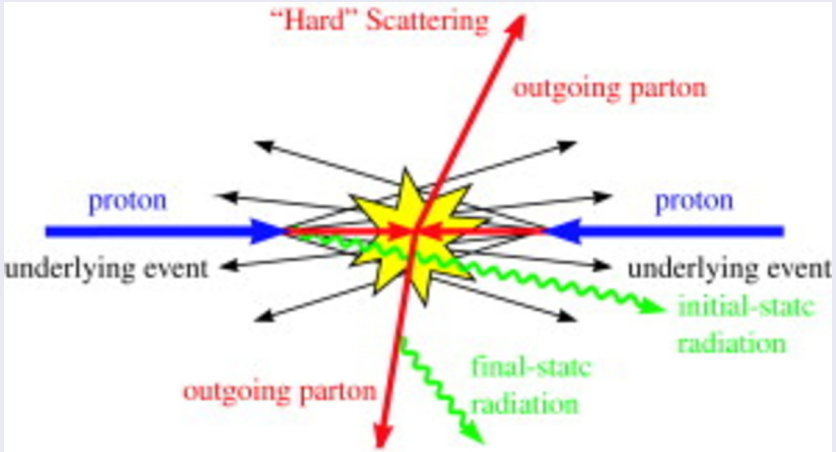
Jet shape analysis



- We can estimate the contribution of the underlying event, looking at the transverse region
- This distribution should be better understood and we have to focus to the underlying event to do the correct estimation.

Underlying event analysis

What is the underlying event?



What do we get?

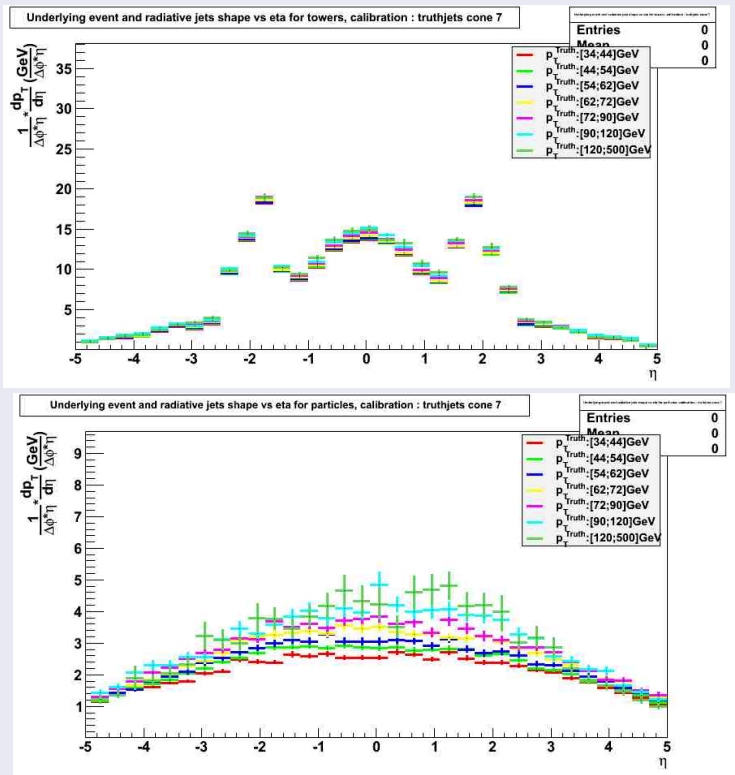
- Jets
  - Hard scattered partons
  - Final state radiation
  - + hadronization
- Underlying event
  - Initial state radiation
  - Beam-beam remnants
  - Multiple partons interaction
  - + hadronization

Underlying event analysis

What do we see?

- Underlying event distribution in $\eta = -\ln(\tan(\frac{\theta}{2}))$
  - at detector level
  - This curve is a useful tool to get an accurate estimation of the calorimeters response
  - We have an estimation of the underlying event that we can use to calibrate jets at detector level
  - at particle level
  - We need to use this curve with those above to get the calorimeter response
  - We have an estimation of UE at particle level useful to get the right jet energy scale

Underlying event's shapes



What's next?

- We are waiting for the first LHC datas
- The measure of the underlying event will be the first measurement which will be proceed
- We will have to compare this results with the real one to check the validity of models
- We are expecting surprises (soft physics can become hard at LHC)