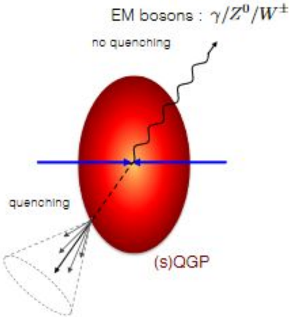
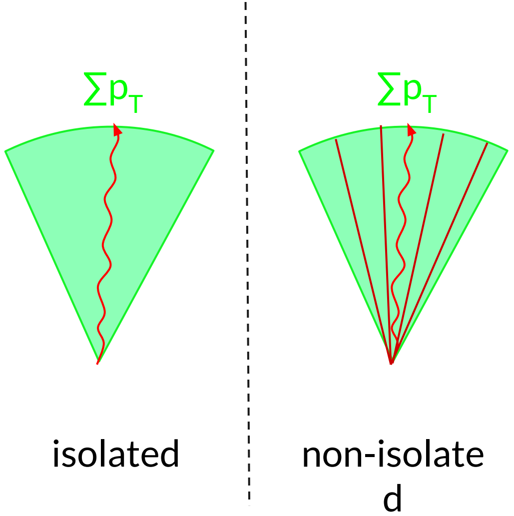
Correlation and Particles identification



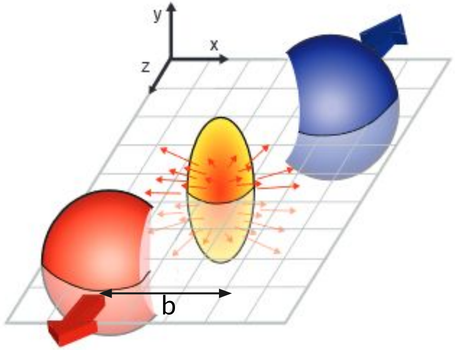
- Measure the correlation between two particles
  - Direct photons (near side)
  - Hadrons (away side)
- Direct photons are isolated
- Want to eliminate background particles
- Measure the number and energy of particles in a cone around the trigger event and compare it to a threshold

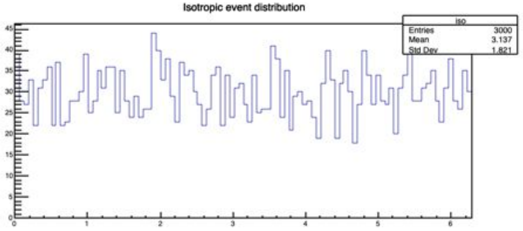


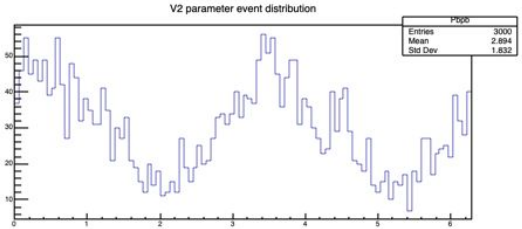
Underlying event

- Collisions generates underlying event
  - isotropic distribution (p-p,p-N, central N-N)
  - sinusoidal distribution (N-N with b ≠ 0)
- Adds background in the cone, making the identification of the trigger particles harder
- Measure the background of the UE to subtract it from our data

$$E\frac{d^3N}{d^3p} = \frac{d^2N}{2\pi p_T dp_T dy}\left(1+\sum_{n=1}^{\infty} 2v_n \cos[n(\Phi-\Psi_R)]\right)$$

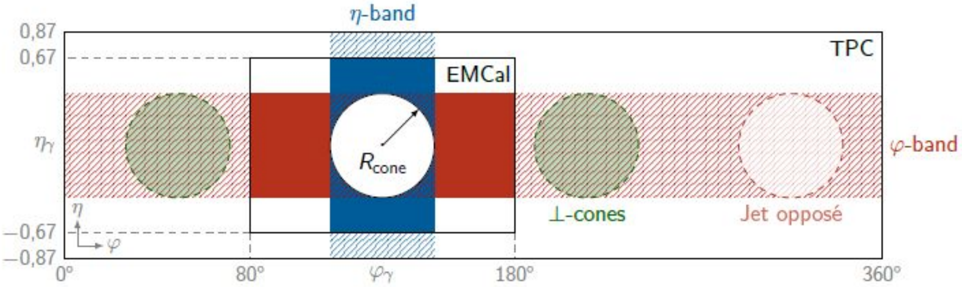






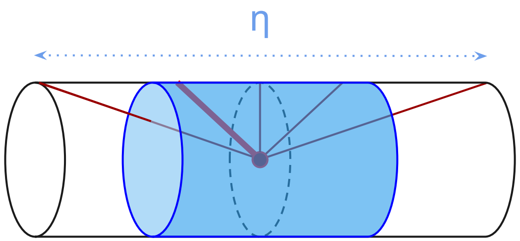
Estimation method of the UE

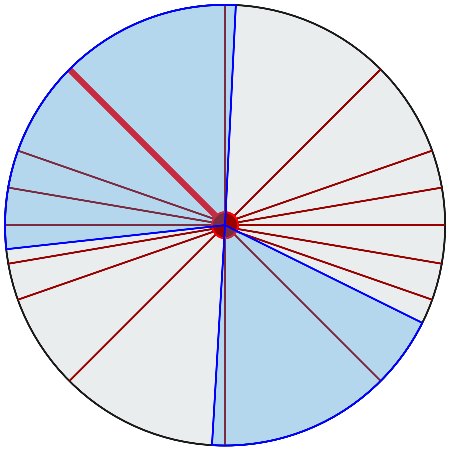
	φ-band	η-band	⊥-cones
Acceptance			
Sensitivity to the hard process			
Neutral component			
V2 parameter			



Simulation of the UE

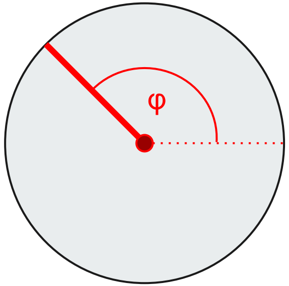
- Generates a given number of events
- Each event has a trigger particle which have a random η and φ coordinates
- Produce a random number of tracks along a Gaussian with a given mean and standard deviation.
- Distribute them in a sinusoidal distribution in the azimuthal plane

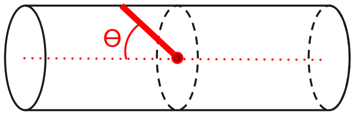


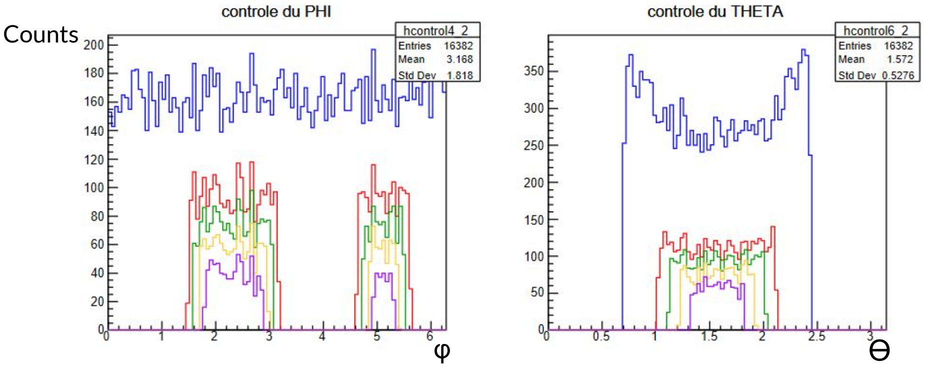


Acceptance of the detectors

- Takes into account the acceptance of EMCal and DCal
- Rejects every trigger particle that isn't inside the calorimeters acceptances



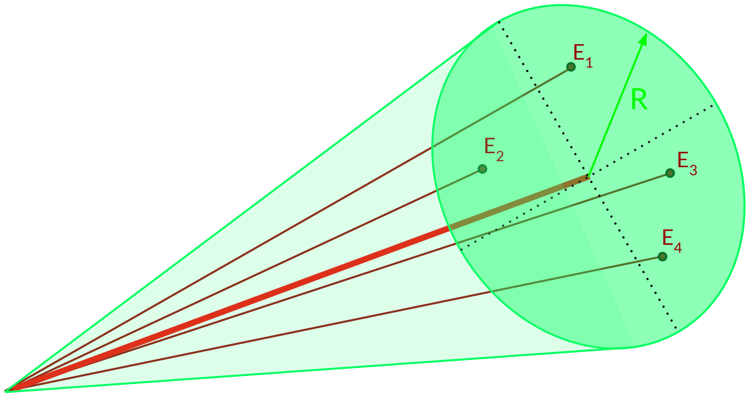




- Distribution of the event without acceptance
- Distribution of the event in EMCal or DCal acceptance with R = 0.1
- Distribution of the event with EMCal and DCal acceptance with R = 0.4

Measure of the number of tracks and energy in the cone

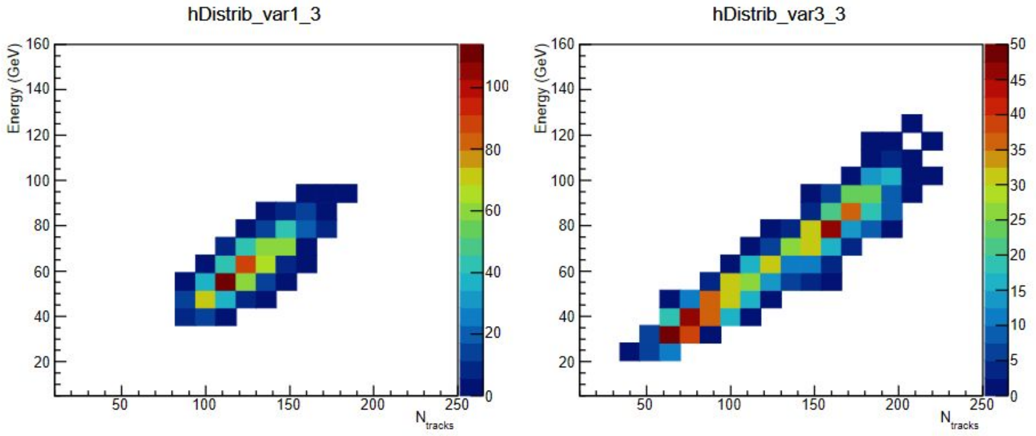
- Count the number of tracks inside a cone of radius R around the trigger particle
- Give each of these tracks a single energy and add them
- Return the number of tracks as well as the total energy inside the cone



$$N_{track}=4\ ;\ E_{cone}=E_1+E_2+E_3+E_4$$

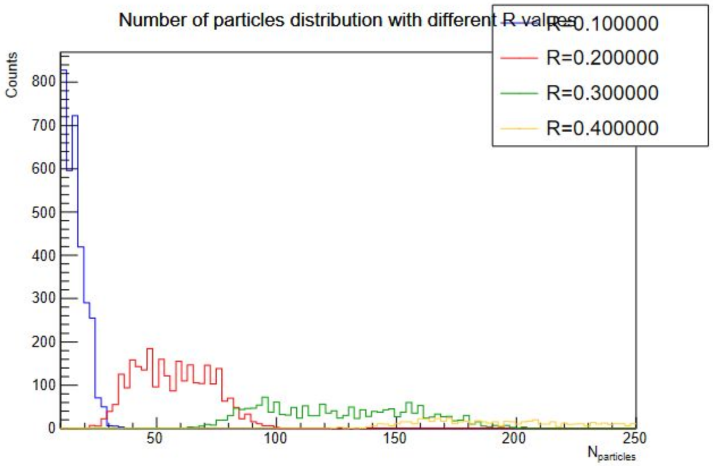
Results

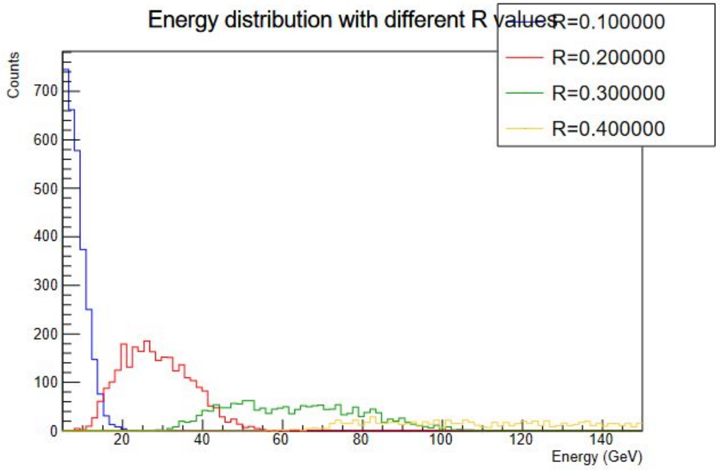
Number of tracks and energy correlation



Observation : There seem to be a strong correlation between the number of tracks in the cone and the energy inside said cone

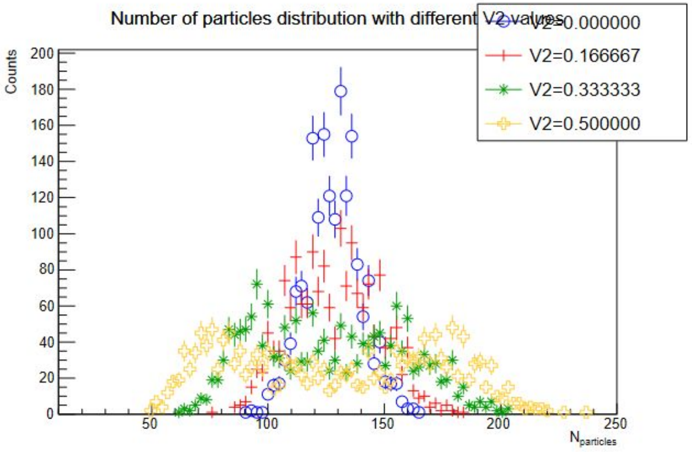
R as a parameter

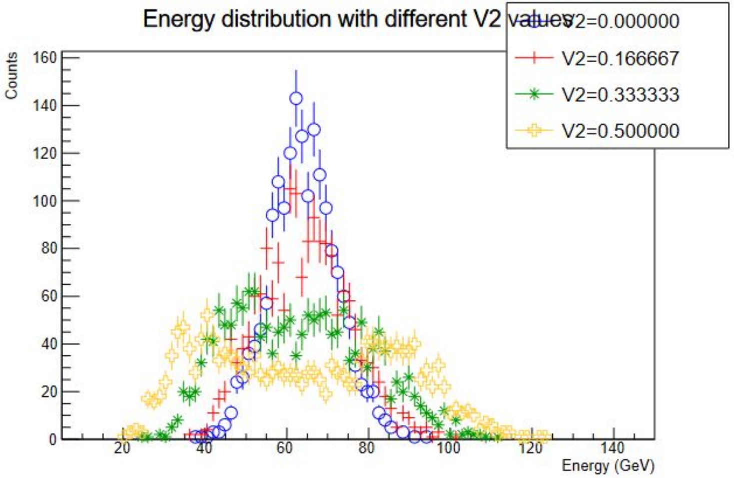




<u>Observation :</u> Widening the radius of the cone obviously increase the average number of tracks and the energy, but also flattens the distribution

V2 as a parameter

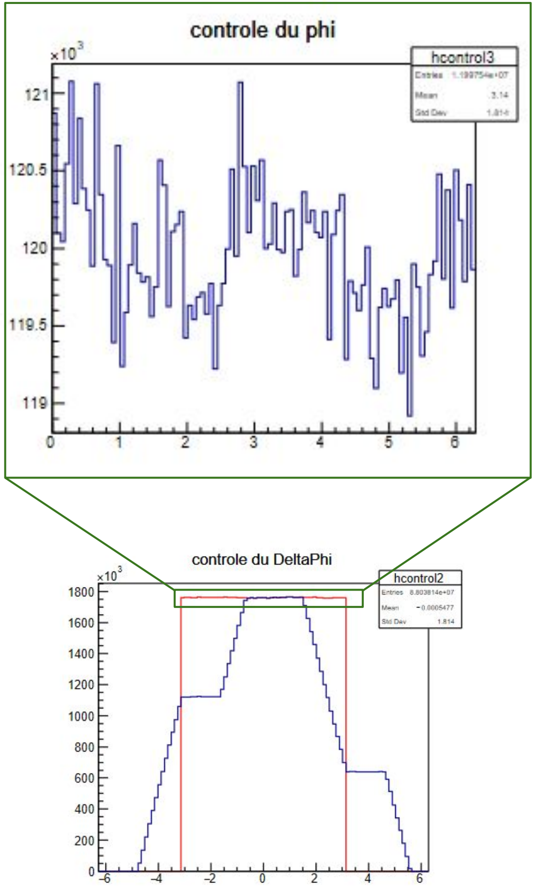




<u>Observation :</u> Increasing the V2 parameter changes the overall shape of the distribution, going from a Gaussian to two merged gaussian

Problems

- If we take the φ of all tracks from all events (or from the event with a same V2 parameter), we're expecting to see a flat line, since the multiple phase should cancel each other ; yet we still find a somewhat sinusoidal distribution at the end of the program, and we still can't explain why



Perspectives

- Add the distinction between charged particles and neutral particles
- Measure the underlying event with the methods presented in slide 3
- Generate the V2 parameter as a function of the b parameter.

Sources

Etude du plasma de quarks et de gluons au LHC, *Julien Faivre*, 2016

Mesure des corrélations photon-hadron auprès de l'expérience ALICE au LHC pour l'étude du plasma de quarks et de gluons, *Astrid Vauthier*, 2017

Mesure de la production de photons isolés dans les collisions proton-proton et proton-plomb au LHC avec l'expérience ALICE, *Erwann Masson*, 2019