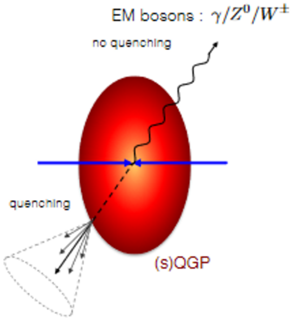
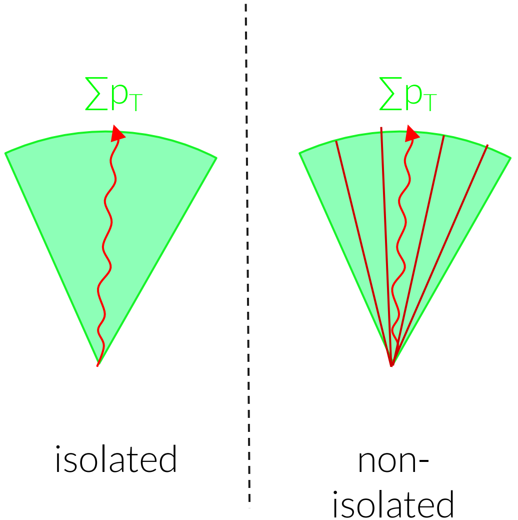
Correlation and Particles identification

- 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
- Background created by the underlying event → need to measure and substract it





isolated

non-isolated

Program

For each event :

- Generate (H, Φ) trigger particle
- Pick a random multiplicity for each charges

For each V2 value :

- Pick a reaction plane angle

For each R parameter :

For charged and neutral particles:

- Generate (η, φ) N_{charge} particles

For each track :

- Test if the particle is inside the trigger cone
- If yes, added to the distribution of energy in the trigger cone
- If not, **For each estimation method :**
  - Test if the particle is inside the area of an estimation method
    - If yes, added to the estimation histogram

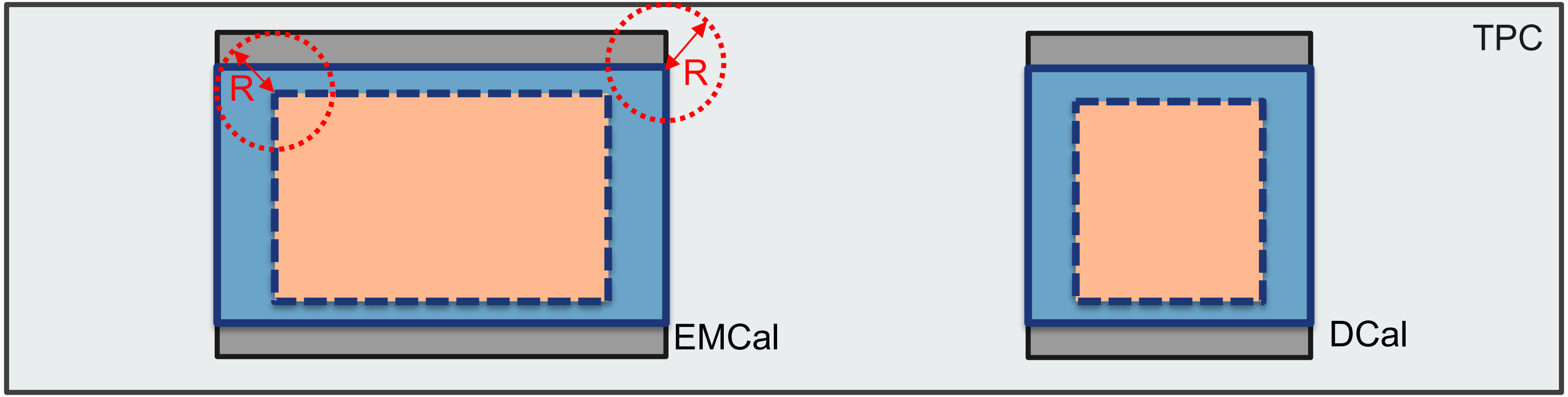
All histograms are drawn in a ~300 page document

Charged and neutral particles :

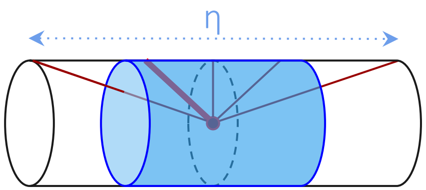
Acceptance of the trigger particle :

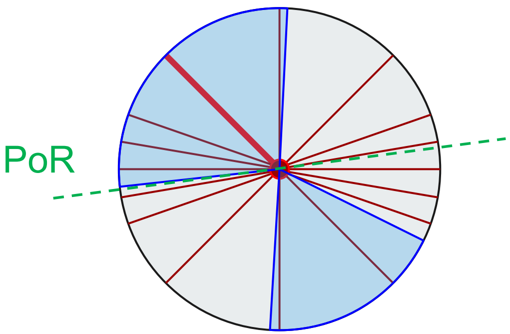
Charged particles

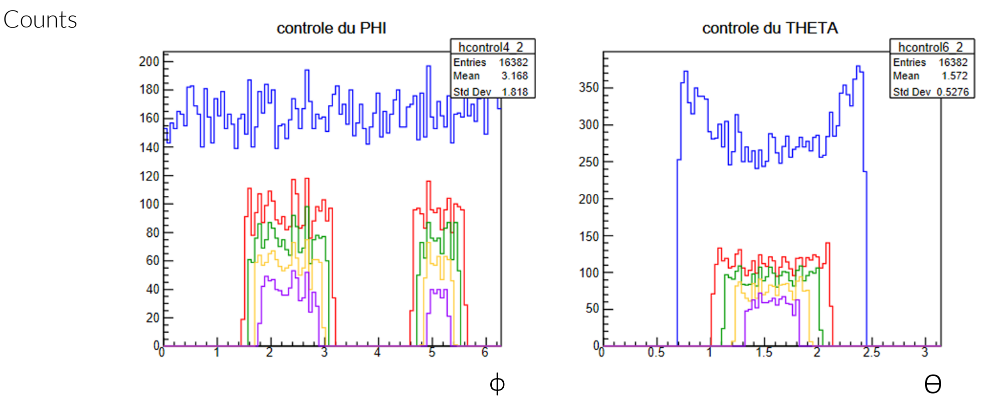
Charged + neutral particles



Acceptance of the detectors



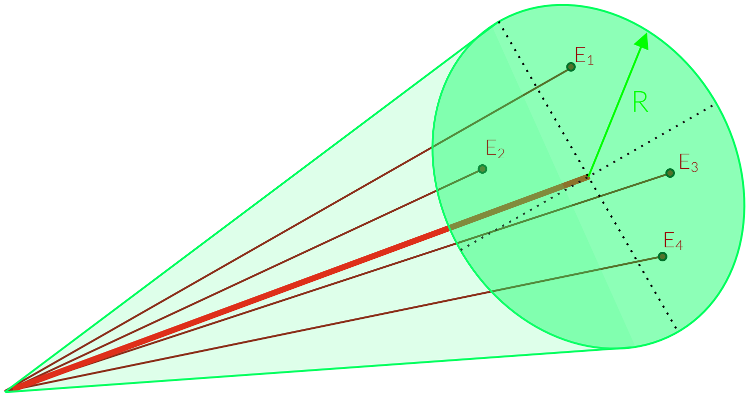




- Distribution of the trigger particles without acceptance
- Distribution of the trigger particles in EMCal or DCal acceptance with R = 0.1
- Distribution of the trigger particles with EMCal and DCal acceptance with R = 0.4

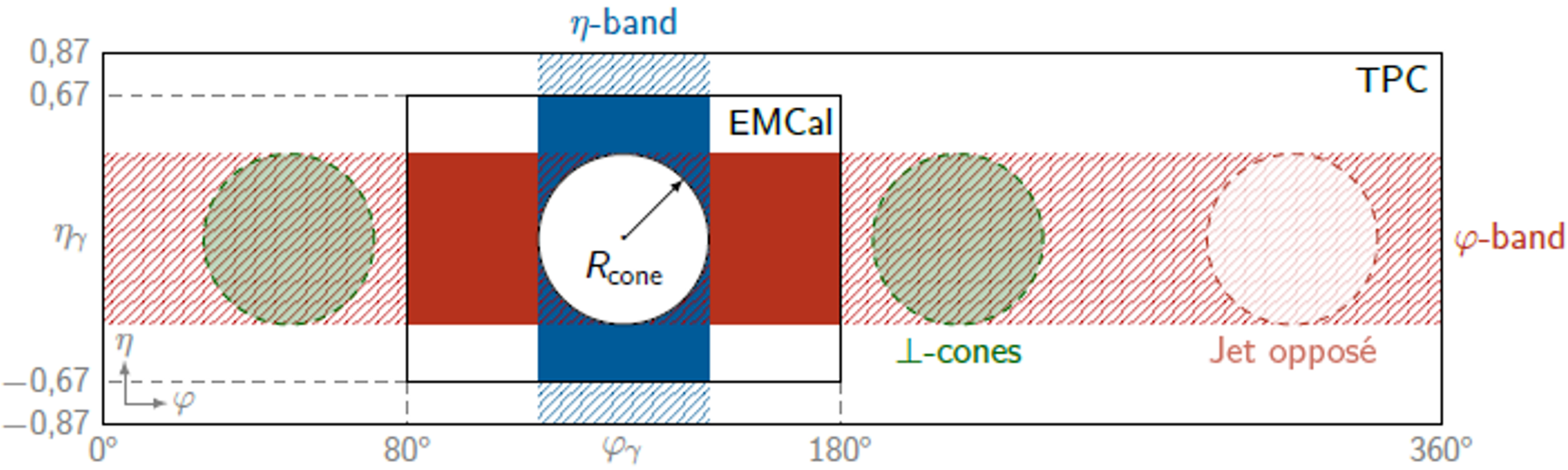
Measure of the number of tracks and energy in the cone

- 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



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

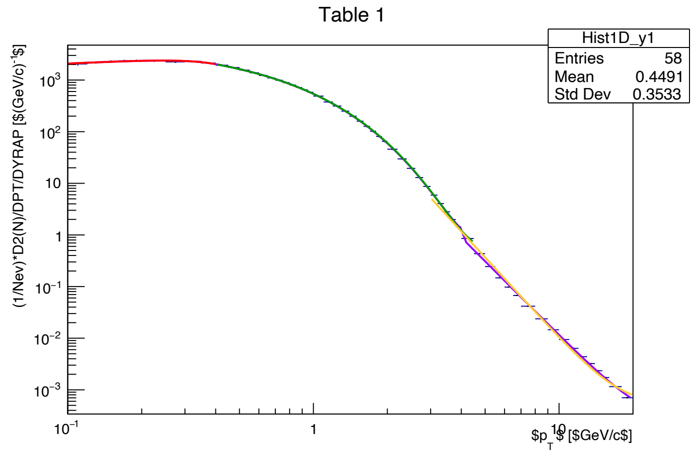
Different methods of estimation of the UE

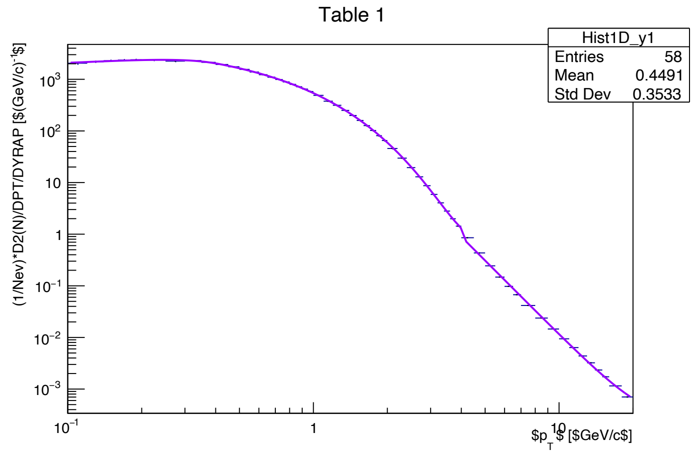


Results

Energy parametrisation

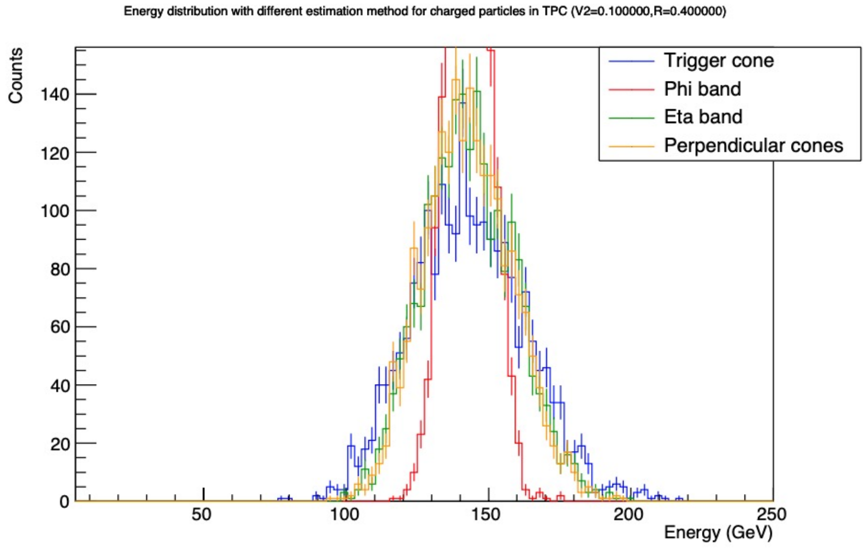
- Used [4] to implement a realistic energy distribution for each particle created by the underlying event
- Real distribution was too complicated to compute ; instead, we used 3 simpler functions :
    - (p_T<0.4 GeV) : dN∝ $p_T^2+p_T+C$
    - (0.4<p_T<4 GeV) : dN ∝ exp(p_T)
    - (p_T> 4 GeV) : dN ∝ p_T





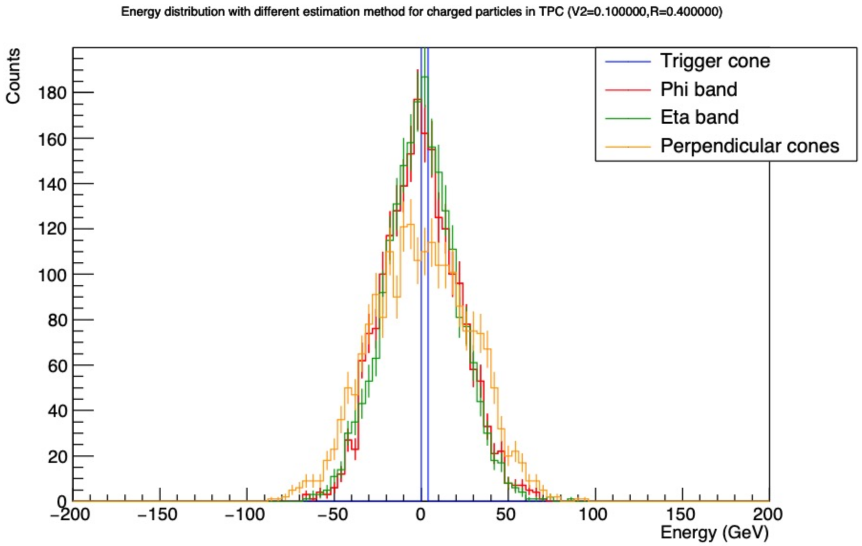
Comparison of estimation methods

- Normed histogram for low V2 value
- All distribution are centered around the same mean
- The distribution are more peaked as their acceptance increase



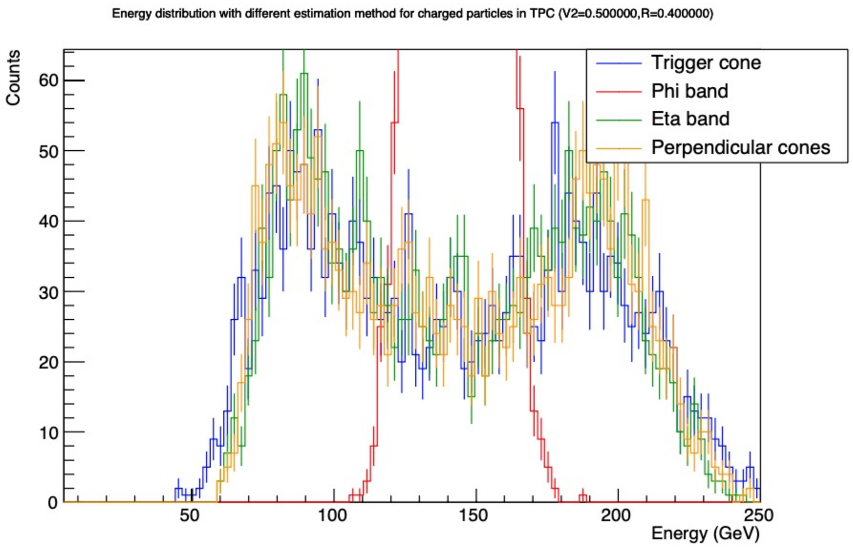
Comparison of estimation methods

- Subtracted histogram for low V2 value
- All distribution are centered around 0
- The peakness of each distribution does not depend entirely on the method's acceptance



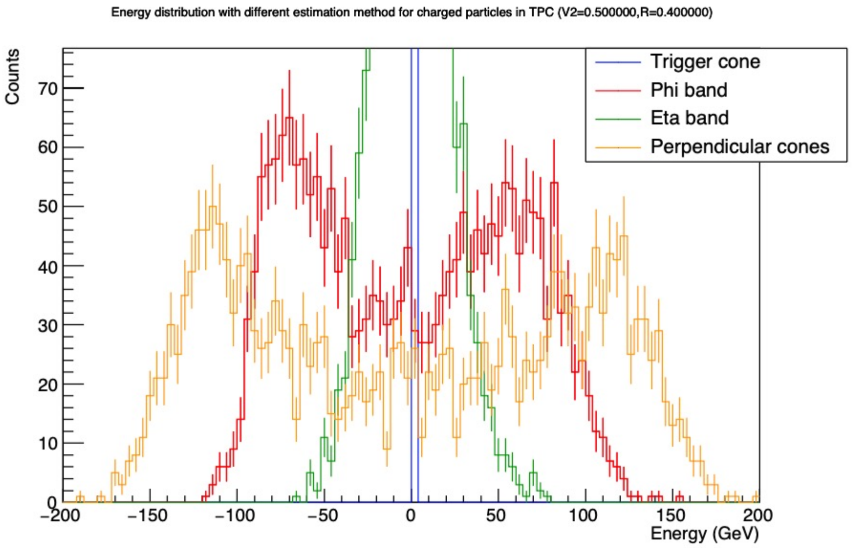
Comparison of estimation methods

- Normed histogram for high V2 value
- Very high V2 value, only to study the effect of the V2 on the distribution for extreme values
- All distribution are centered around the same mean
- All distribution are similarly sensible to the V2, except for the phi band (expected since we take a 2π acceptance)



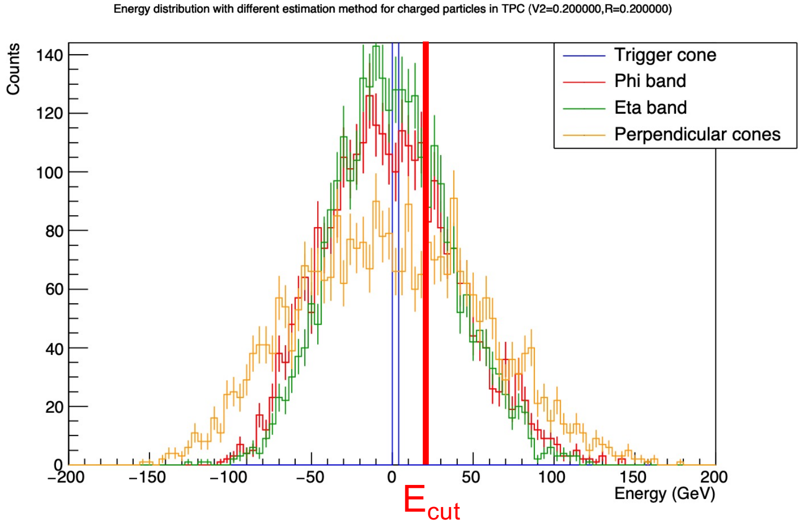
Comparison of estimation methods

- Subtracted histogram for high V2 value
- All distribution are centered around 0
- Phi-band is no longer unaffected by the V2
- Perp cones is very affected by the V2 because of the $\pi/2$ phase between the trigger cone and the perpendicular cones
- Eta-band is very peaked since it has the same V2 as the trigger cone



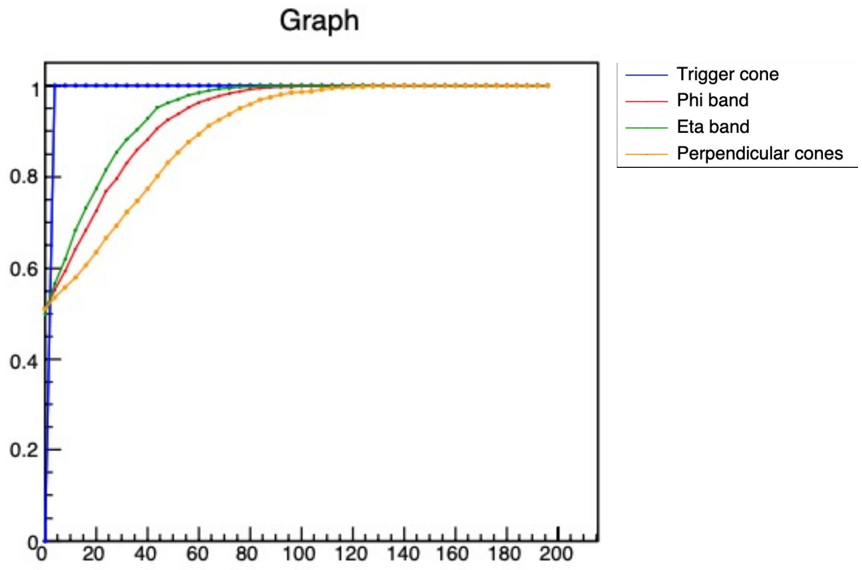
Comparison of estimation methods

- More practical method of comparison
- Compare the number of event with an energy under a given energy cut to the total number of events



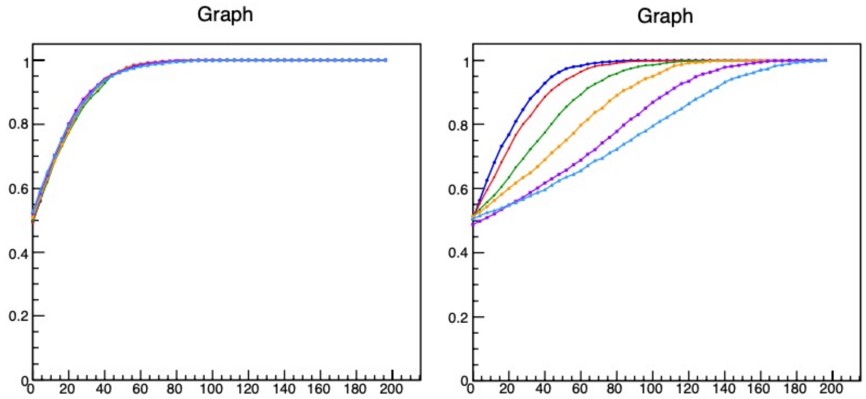
Comparison of estimation methods

- Compare the part of number under the cut according the energy cut value for different methods of estimation



Comparison of estimation methods

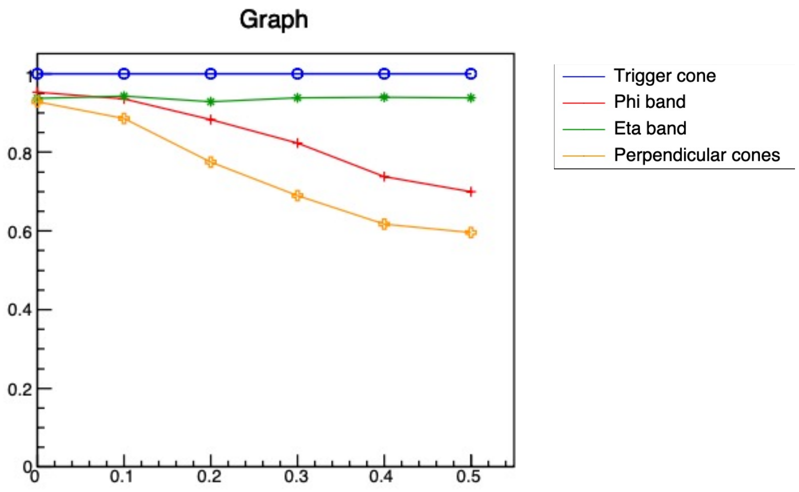
- Compare the part of number under the cut according the energy cut value for V2 values
- On the left, for the eta band : the V2 parameter as little to no effect on the cut
- On the right, for the perpendicular cones : the V2 parameter has a huge effect on the energy cut



V2 = 0.1
V2 = 0.2
V2 = 0.3
V2 = 0.4
V2 = 0.5
V2 = 0.6

Comparison of estimation methods

- Compare the part of number under the cut according to the V2 value for different methods
- Once again, we see that the eta band is the least sensible to the V2



Perspectives

- Realistic V2 values
- Change some method area
- Link the V2 to the centrality
- Add the distribution of V2 according to p_T

Sources

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

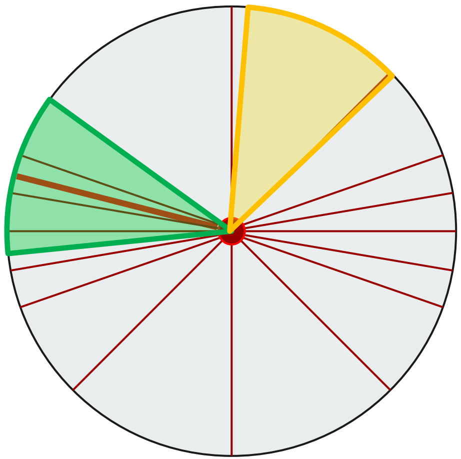
[2] Mesure des corrélations photon-hadron auprès de l'expérience ALICE au LHC pour l'étude du plasma de quarks et de gluons, *Astrid Vauthier*, 2017

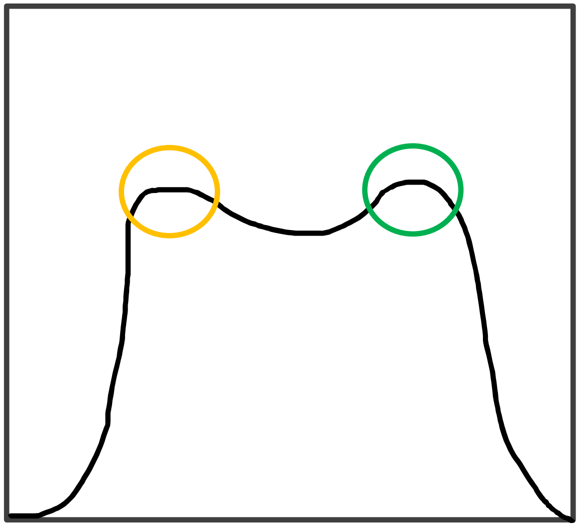
[3] Mesure de la production de photons isolés dans les collisions proton-proton et proton-plomb au LHC avec l'expérience ALICE, *Erwann Masson*, 2019

[4] **Production of charged pions, kaons and (anti-)protons inPb−Pbandinelastic pp collisions at $\sqrt{s_{NN}}$= 5.02 TeV,** *Alice Collaboration,* 2020

Backup

Affect of V2 on the perpendicular cones





Estimation method of the UE

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