ALICE Offline
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Physical observables with the Silicon Pixel Detector

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Aim of this work: study of physical observables which can be measured by the Silicon Pixel Detector standalone.

- Multiplicity

- Pseudorapidity distribution

- Azimuthal anisotropy

- What next

General considerations

- All the simulations are performed with slow-digitization, in standard conditions;

- All the reconstruction programs require the primary vertex coordinates; They can be obtained from the two layers of the pixel detector; in this work they are assumed to be known.

- The L3 magnetic field is switched off in most of the simulations, as this configuration offers the best resolution for all the measurement.

Multiplicity measurement

a) Cluster counting

The simplest way to determine the multiplicity is just to count the clusters (rec points).

$\Rightarrow$ N. of Clusters = const$\times dN/d\eta$;

The constants depend on the considered η range; let's call them:

K for $|\eta| < 0.5$ (both layers) and H for $|\eta| < 2$ (layer 1) and $|\eta| < 1.4$ (layer 2)

$\Rightarrow$ The constants K and H depend on the vertex position;

Note: K1, H1 $\simeq$1, K2, H2 >1 due to secondary interactions in layer 1 and to the turbo geometry.

b) Tracklets counting

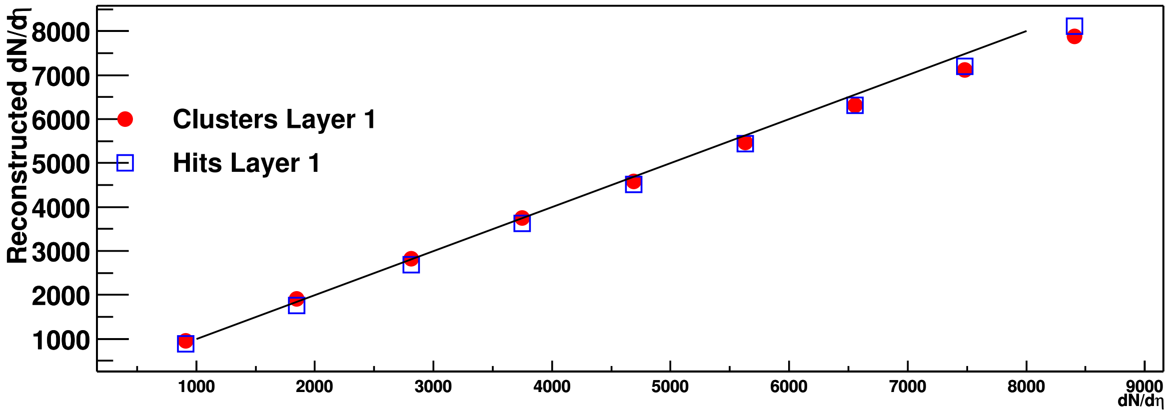
Starting from the first (second) layer, extrapolate (interpolate) the point on the second (first) layer with a straight line.

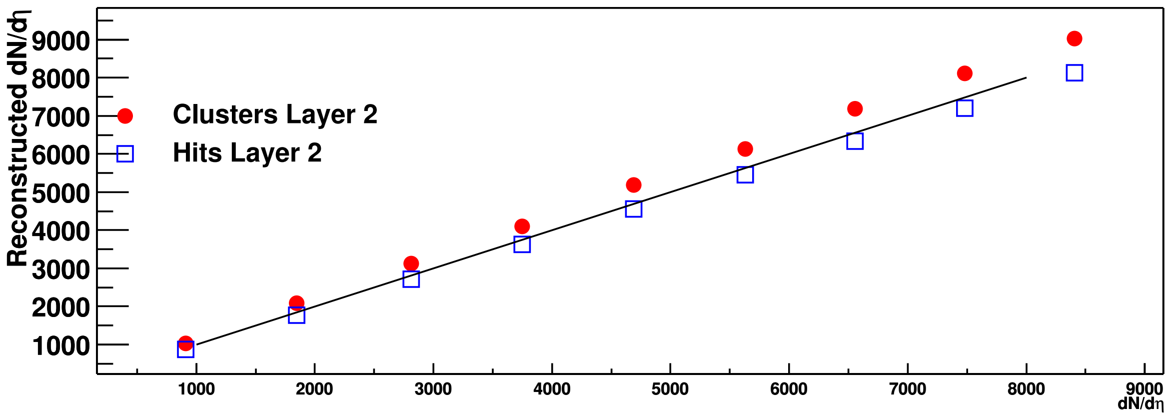
$\Rightarrow$ Cut on the distances z and r; look for the closest rec point.

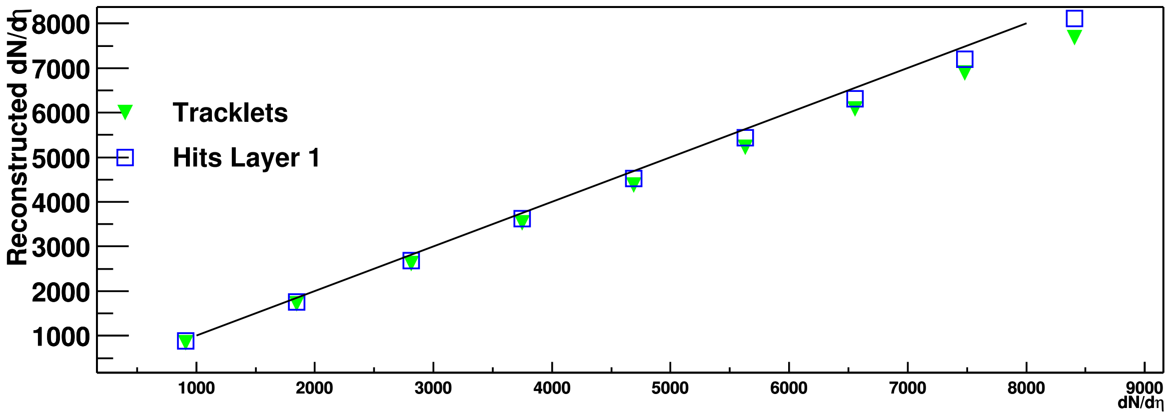
$\Rightarrow$ N. of tracklets = const$\times dN/d\eta$;

As in the previous case the constant depends on vertex position.

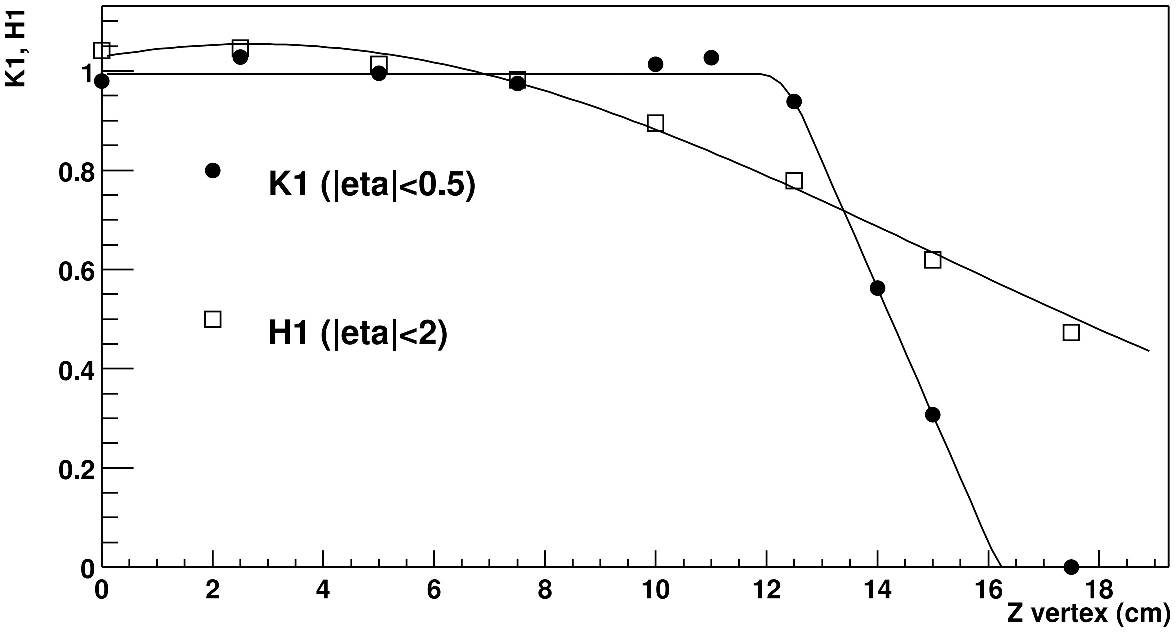
Multiplicity determination (Zvertex=0, B=0)

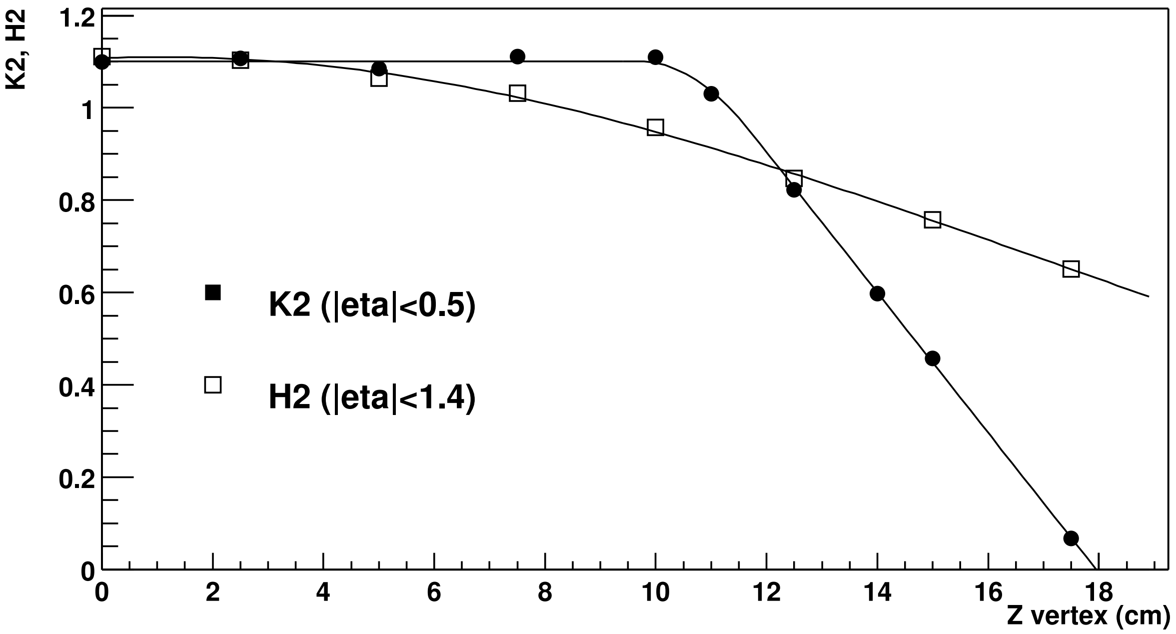






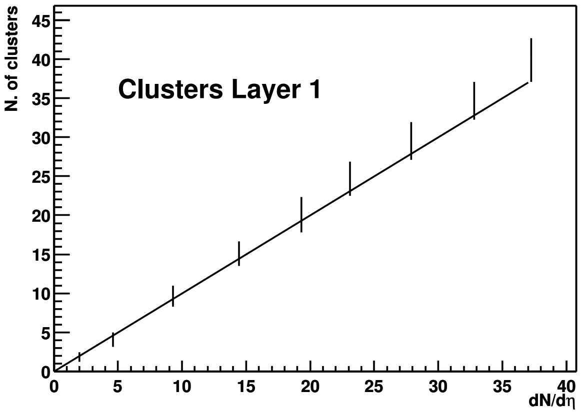
Acceptance (B=0)

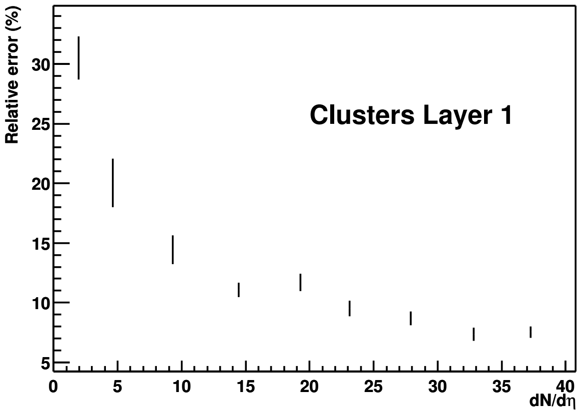


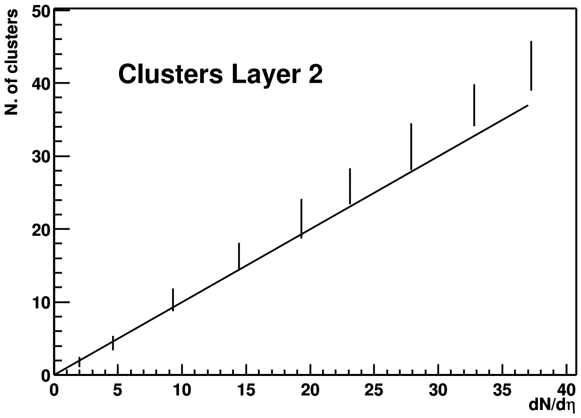


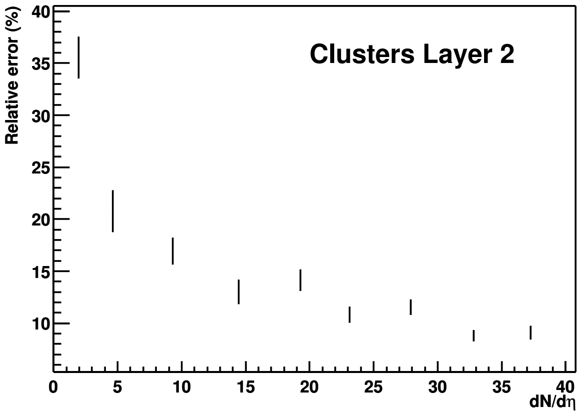
Multiplicity: experimental resolution

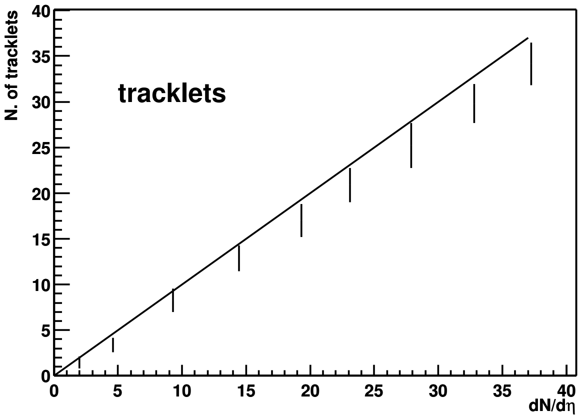
200 events were generated for each bin of dN/dη; the relative error is evaluated by σ/dN/dη where σ is the standard deviation of the gaussian fit to the distribution of the difference $(dN/d\eta_{generated} - dN/d\eta_{reconstr})$.

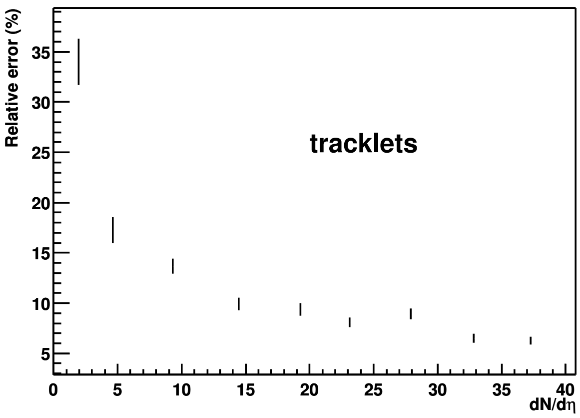






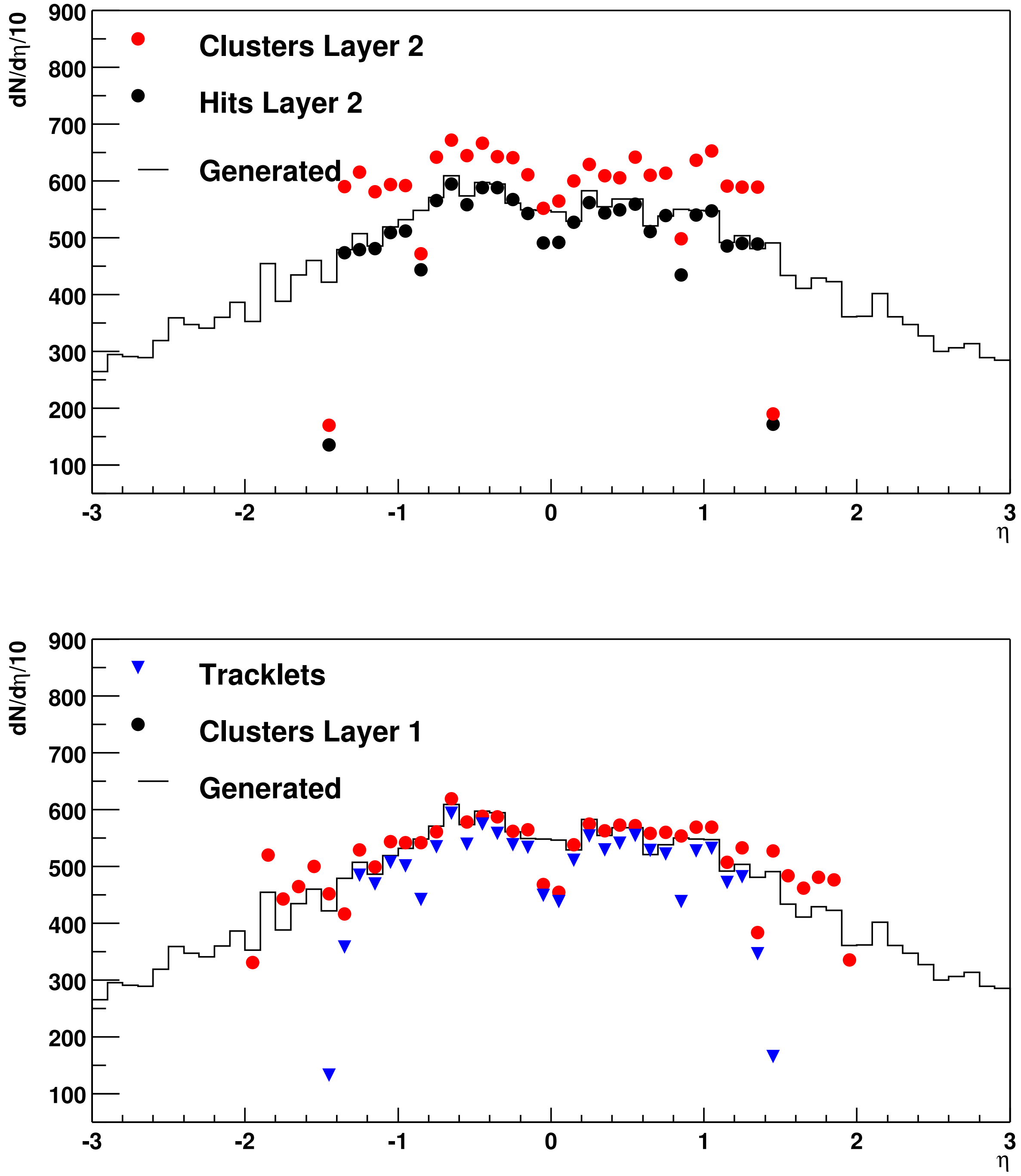




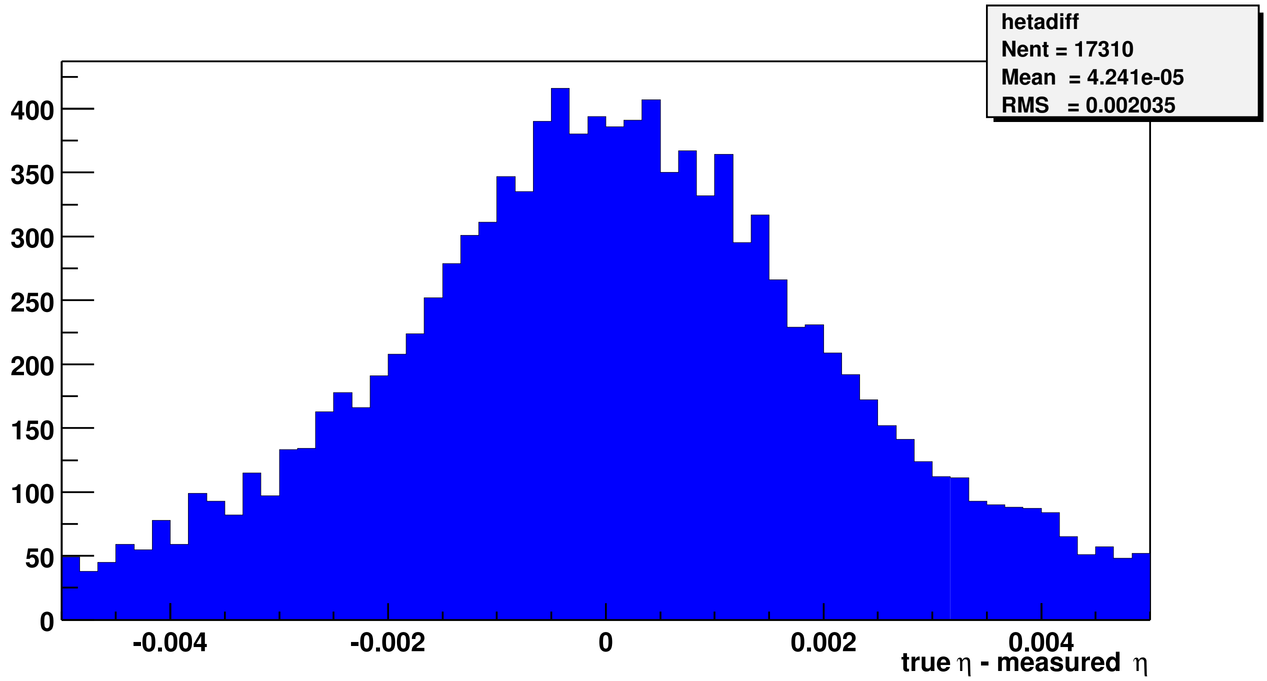


$dN/d\eta$ reconstruction (Zvertex=0, B=0)

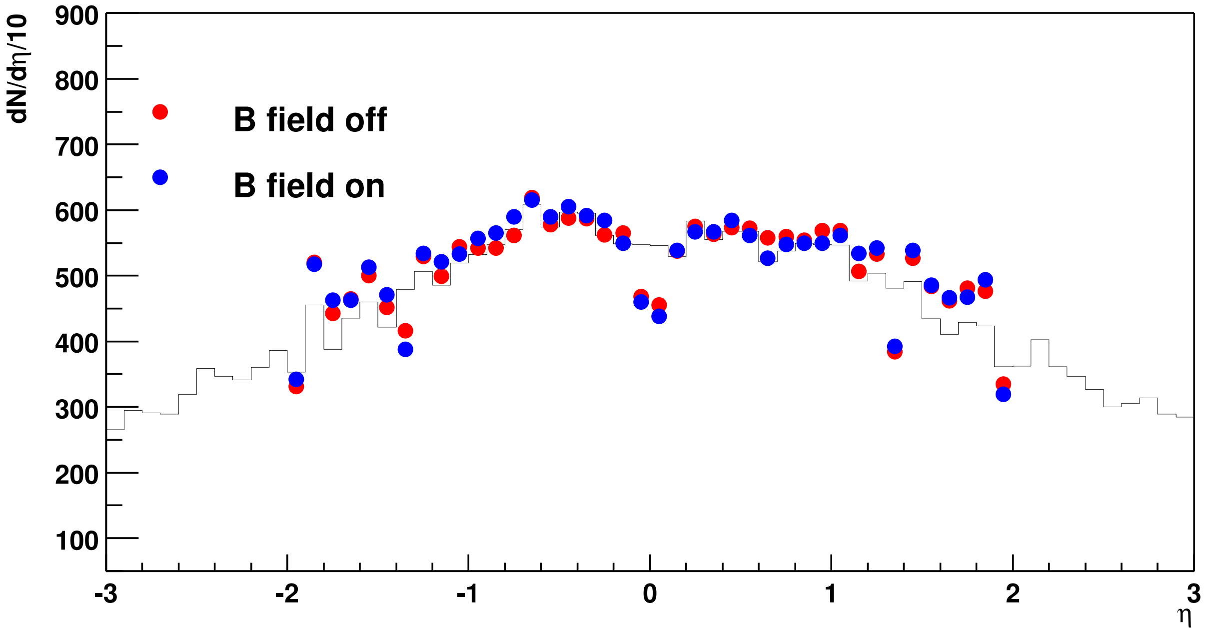
The pseudorapidity can be obtained considering a straight-line to the vertex.



Resolution



Magnetic field effect



The effect of magnetic field is negligible on clusters.

Azimuthal anisotropy

The azimuthal angle ϕ is determined with good precision by the SPD. (The pixel size is 50 μm along ϕ.)

$\Rightarrow$ good reconstruction of dN/dϕ.

Study of the resolution: generate a non flat ϕ distribution and then look at the reconstructed dN/dϕ.

First step: the AliGenBox routine was modified in order to produce a non flat ϕ distribution:

$$dN/d\phi \propto (1/2\pi) + 2v_2 \cdot \cos(2(\phi - \Psi_2))$$

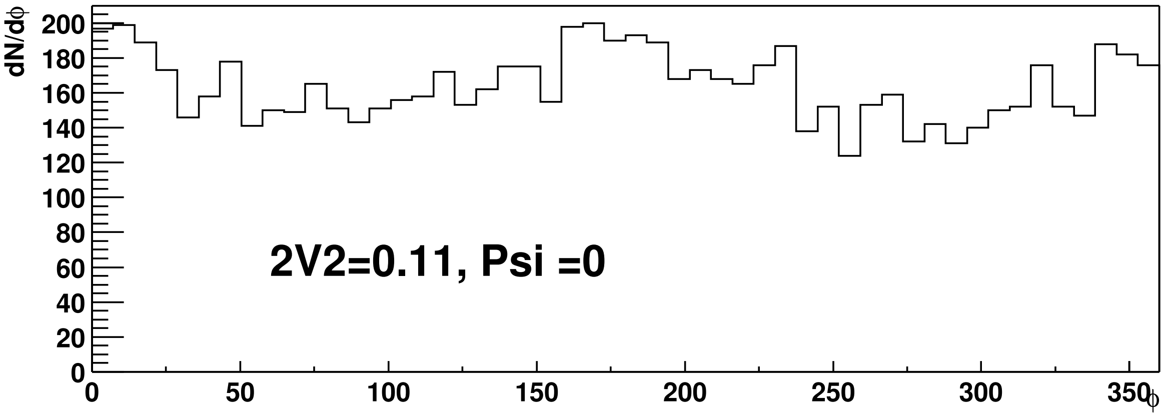
(Here I considered the elliptic flow only; the direct flow can be studied as well.)

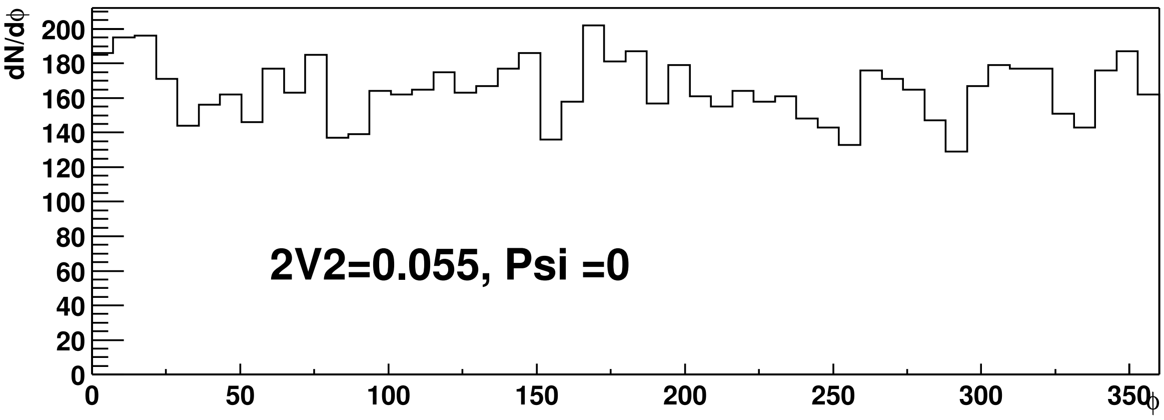
The parameters v_2 and Ψ_2 now take the place of ϕ_{min} and ϕ_{max} parameters in the routine.

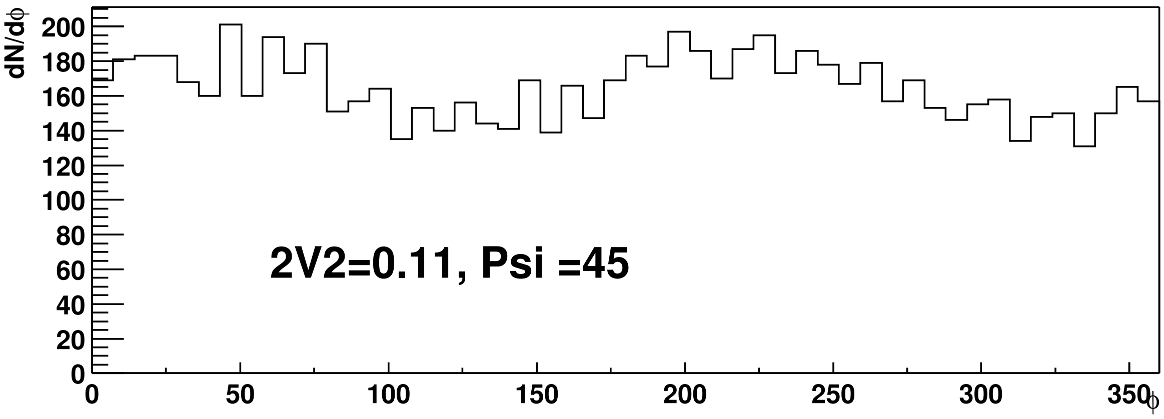
The multiplicity was (preliminary) set to

dN/dη = 3000.

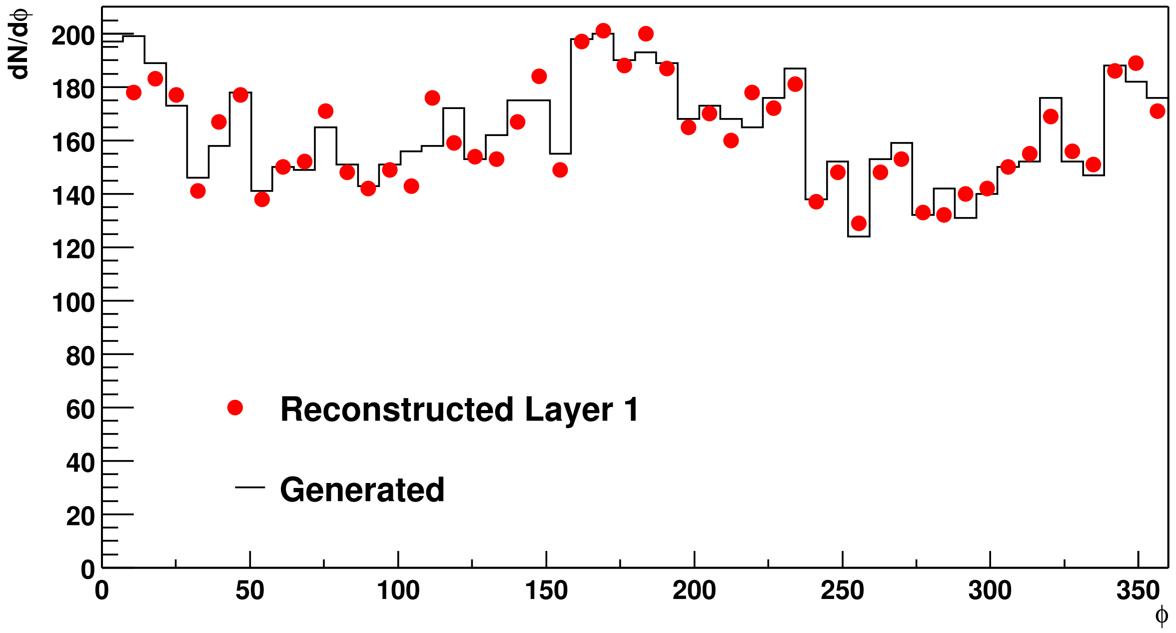
Example of generated dN/dϕ distributions

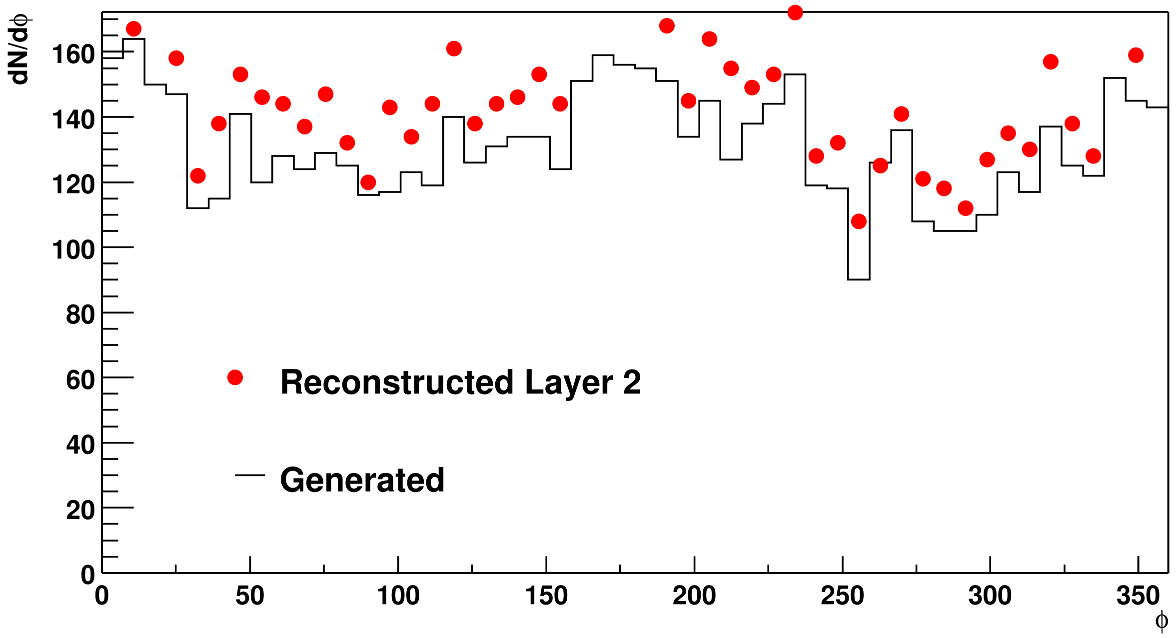






Example of reconstruction of dN/dϕ
$2v_2$=**0.11**, Ψ2=**0**





Azimuthal anisotropy analysis

Two different methods are investigated:

1. **Fit of the ϕ distribution** (see plot);

   In this case the fit gives directly the parameters v_2 and Ψ_2;

2. **Diagonalization of the transverse sphericity tensor**:

$$S_{ij} = \sum_k \cos(\phi_{k,i}) \cos(\phi_{k,j})$$

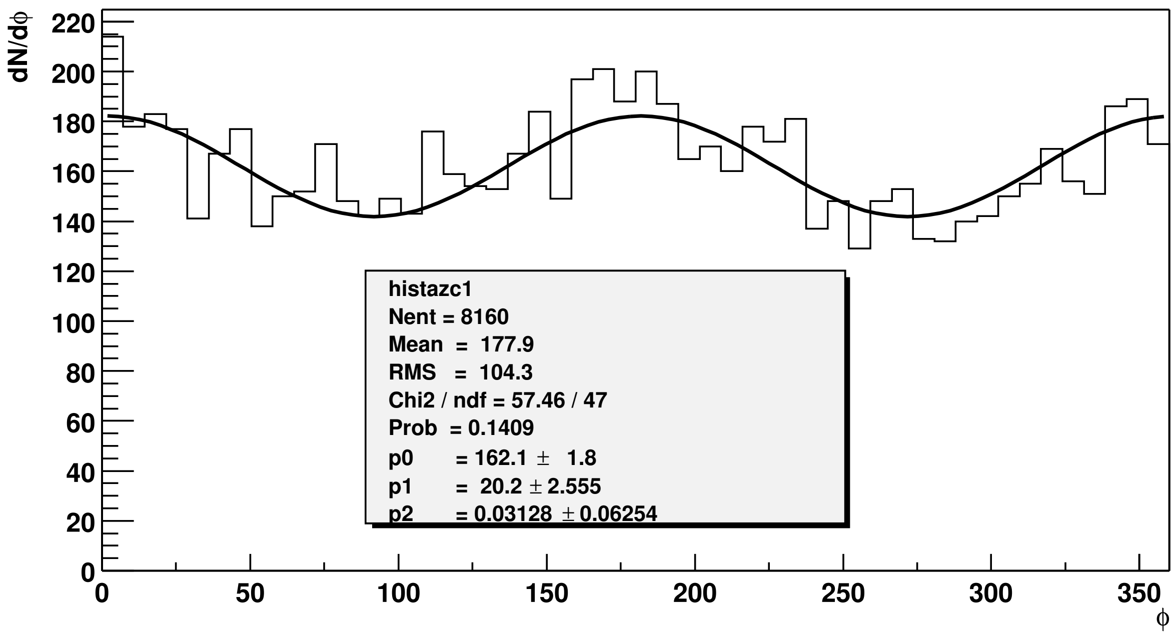
   (k= particle index, i and j= axes index).

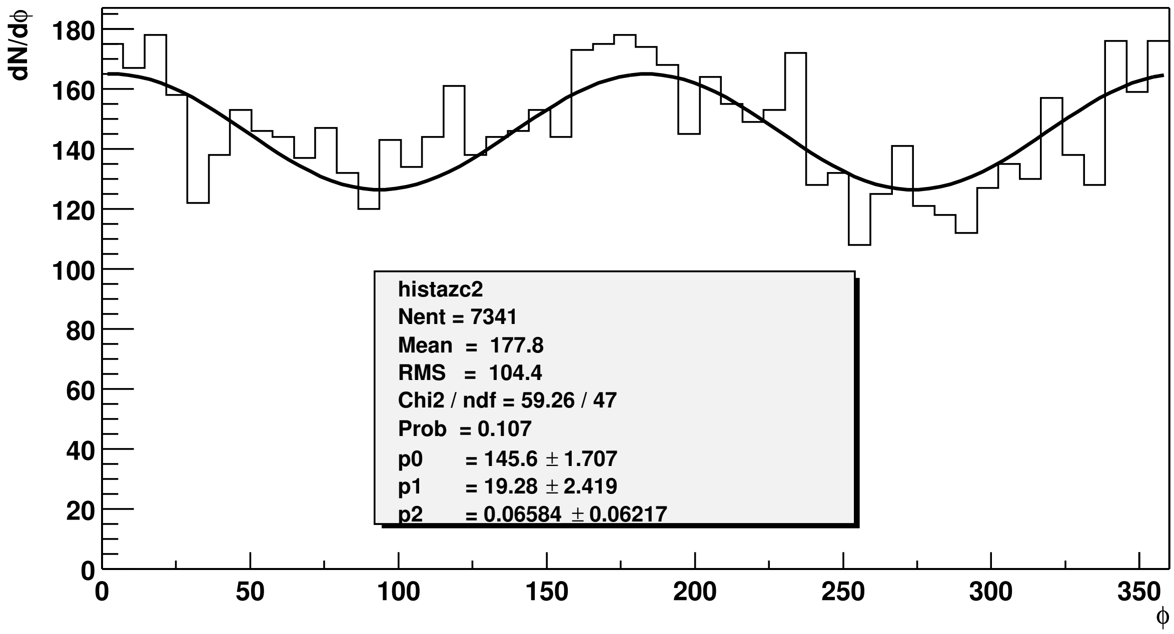
   In this case the ratio $\epsilon = (f_2 - f_1)/(f_2 + f_1)$ between the two eigenvalues is equal to v_2 ($f_2 > f_1$), and the rotation of the reference system gives Ψ_2.

A more refined analysis is required at low multiplicity, in order to handle the statistical fluctuations $\Rightarrow$ divide the event into two different subevents.

Example of fits

$2v_2$**=0.11,** $\Psi 2$**=0**





Fit function: $P0 + P1 \cdot \cos(2(\phi - P2))$

Preliminary results

Results from the fit method

Generated		Fit Layer 1		Fit Layer 2	
$2v_2$	Ψ_2	$2v_2$	Ψ_2	$2v_2$	Ψ_2
0.11	0^o	0.12±0.02	1.8 ± 3^o	0.13±0.02	3.8 ± 4^o
0.055	0^o	0.049±0.016	-11 ± 9^o	0.043±0.017	-16 ± 10^o
0.11	45^o	0.11±0.02	44 ± 4^o	0.10±0.02	43 ± 5^o

Results from the analytical method

Generated		Spher. Layer 1		Spher. Layer 2	
$2v_2$	Ψ_2	$2v_2$	Ψ_2	$2v_2$	Ψ_2
0.11	0^o	0.13	3.5^o	0.13	7^o
0.055	0^o	0.051	-13^o	0.039	-15^o
0.11	45^o	0.11	44^o	0.09	44^o

(Errors not estimated yet)

What Next

- **Multiplicity and dN/dη**: study of the magnetic field effect on tracklets, for different field values.

- **Azimuthal anisotropy**: systematic study of the resolution as a function of the multiplicity and of the effect itself; study of the magnetic field effect.