Identified Particle Flow Methods in ALICE at the LHC

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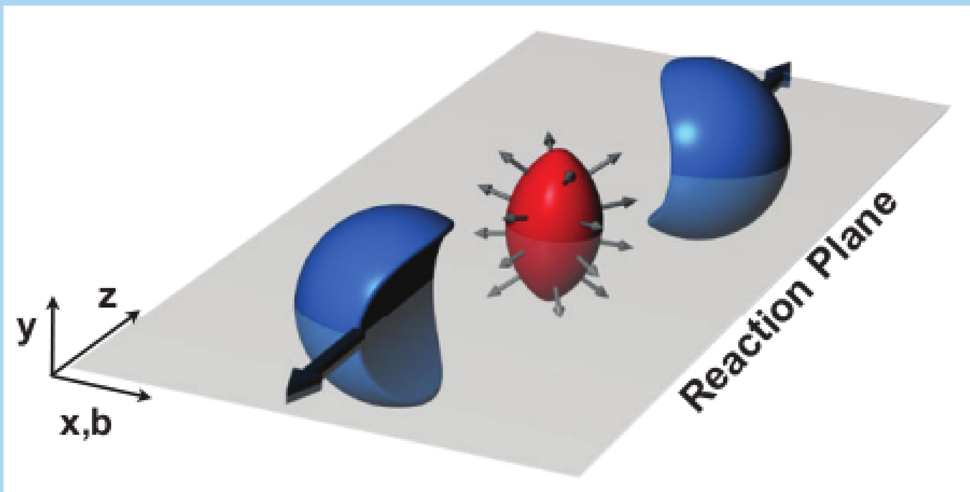
Collective behavior develops due to hydrodynamic expansion



Fourier expansion of angular distribution around the reaction plane (RP) angle

$$\rho(\phi^{rp}) = \frac{1}{2\pi} + \frac{1}{\pi}\sum_{n}^{\infty} v_n \cos n\phi^{rp}$$

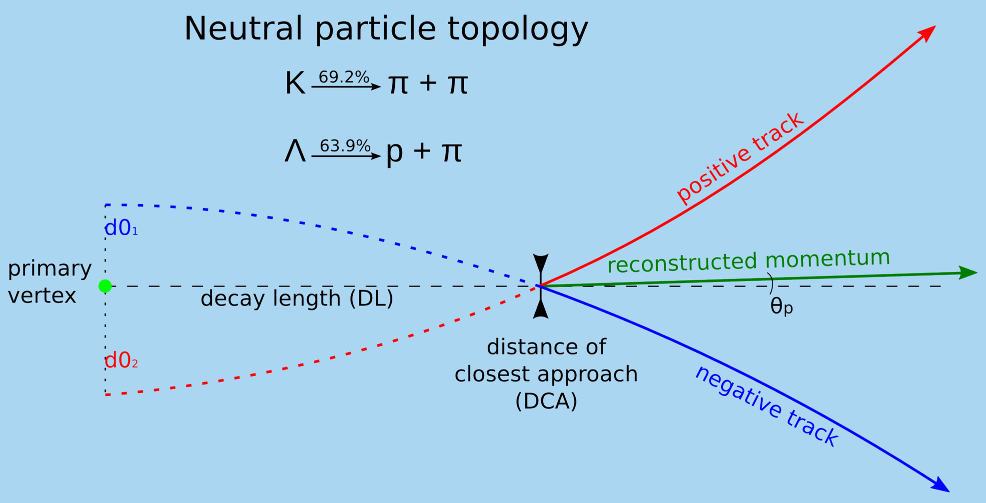
v_1: directed v_2: elliptic
v_3: triangular v_4: quadrangular

Fourier coefficients estimated by several correlation methods[1]:

- Scalar Product (SP)
- Q-Cumulants
- GF-Cumulants
- Lee-Yang Zeroes

[1] arxiv: 0809.2949v2

Particle detection by decay topology

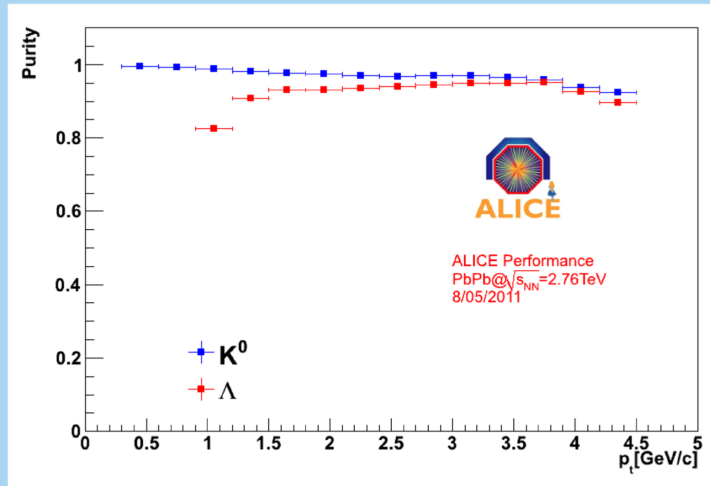


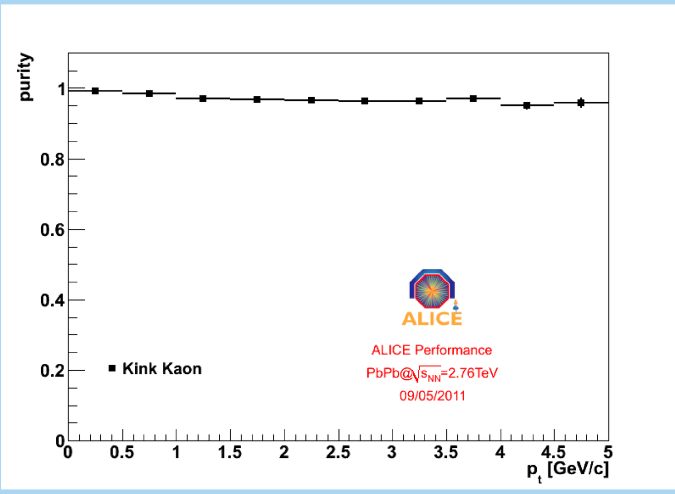
K^0_s and Λ	
DCA max [cm]	0.500
$\cos\theta_p$ min	0.998
DL min [cm]	0.500
d_0 min [cm]	0.100
$d_0 \times d_0$ max [cm^2]	0.000
q_t^* min [GeV/c]	0.105

$*$ to remove Λ background in K^0_S selection.

With a few cuts on the topology of the decay (see table on the left) the K^0_s and Λ are selected efficiently and with high purity.

The remaining background can be subtracted with the method described below.



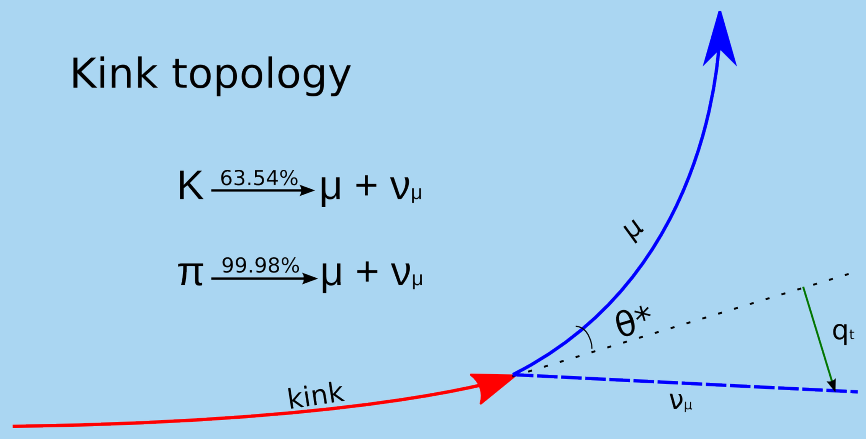


Although one of the decay products of the charged Kaons is neutral and cannot be detected, the characteristic "kink" topology for the reconstructed track allows selection of a high purity sample.

No background subtraction needed.

Kinks	
Active volume [cm]	120 – 200
Decay angle [rad]	K comp*
Invariant mass [GeV/c^2]	0.40 – 0.55
q_t [GeV/c]	0.16 – 0.24
dE/dx TPC-PID cut	$3.5\,\sigma$

$*$ Constrain coming from kinematics



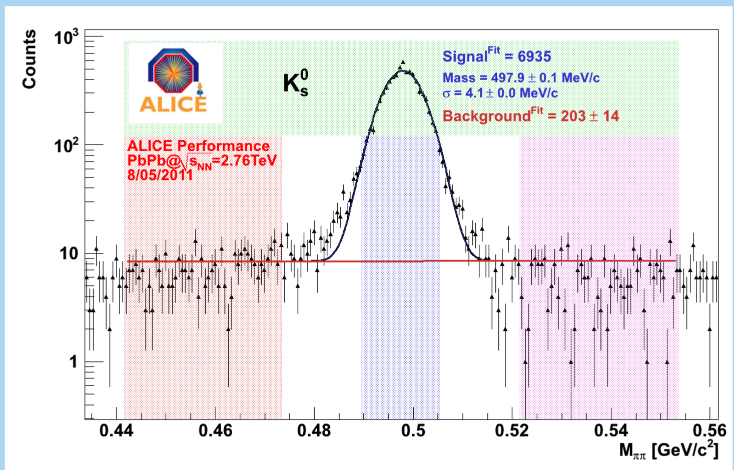
v_2 extraction method

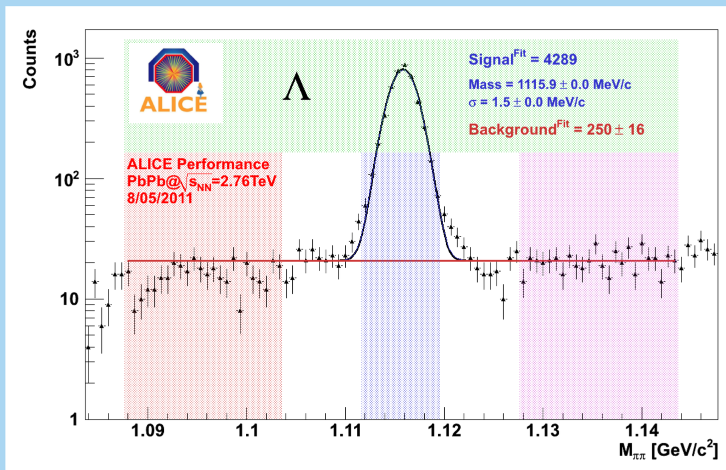
Strange particles are reconstructed via their weak decay daughters tracked in the volume of TPC:

- Topological and particle identification cuts applied to select a sample of K^0_s and Λ candidates
- For the elliptic flow measurement the K^0_s and Λ candidates are selected within an invariant mass window of $\pm 2\sigma$ from the PDG mass of the strange particle.

Elliptic flow of the background is estimated from the bands on each side of the invariant mass peak and subtracted from the candidate's flow in the signal region: $v_2^{sgn} = \frac{N^{tot}}{N^{sgn}} v_2^{tot} - \frac{N^{bkg}}{N^{sgn}} v_2^{bkg}$

N^{tot}: candidate's yield in $\pm 2\sigma$ invariant mass window for a given transverse momentum (p_t) bin.
N^{sgn} (N^{bkg}): signal (background) yield extracted from the Gaussian plus power law fits to the invariant mass distribution for a given p_t bin.

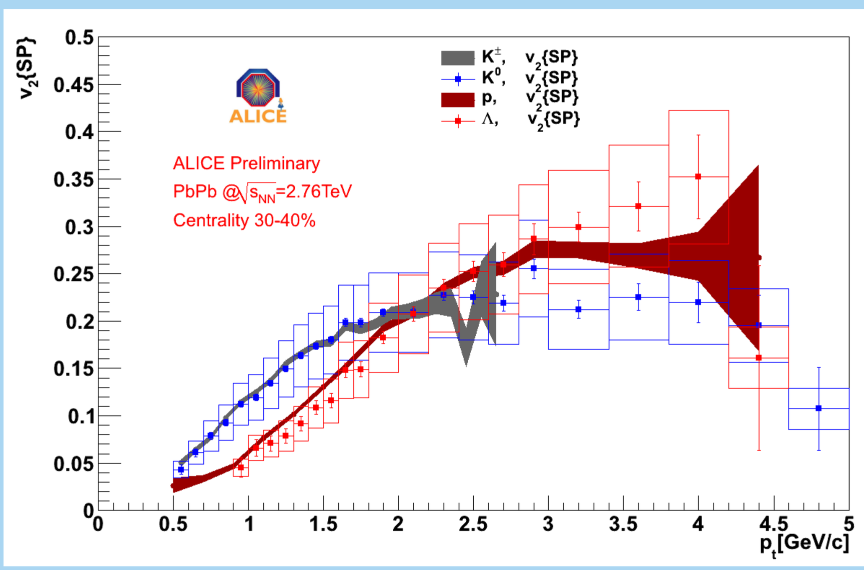


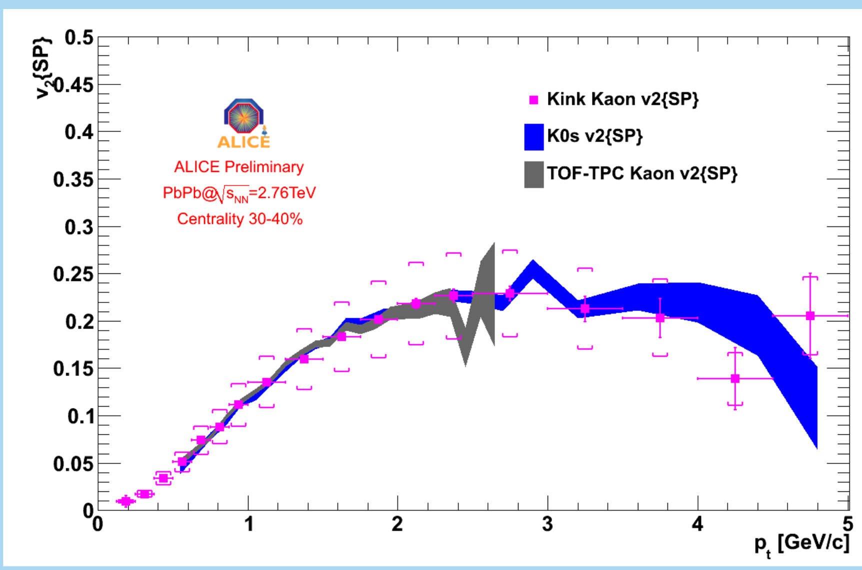


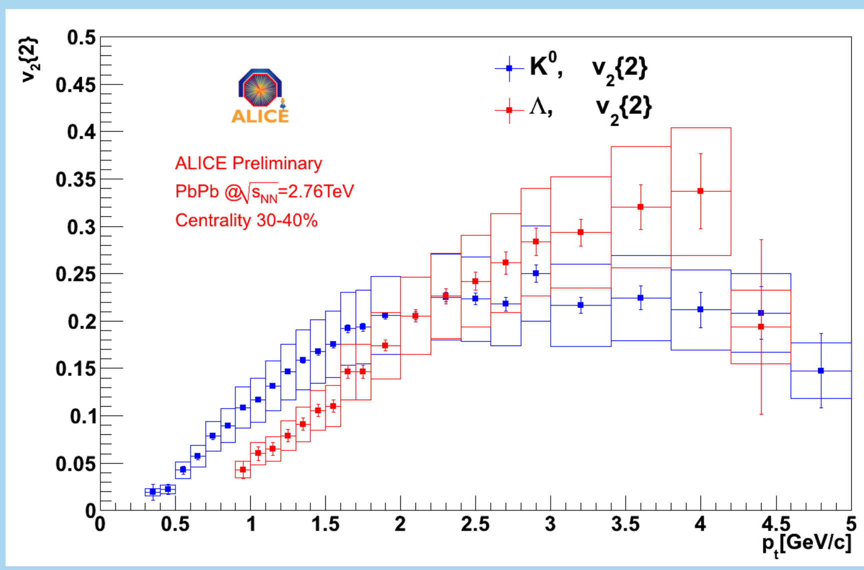
K^0_s and Λ in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV

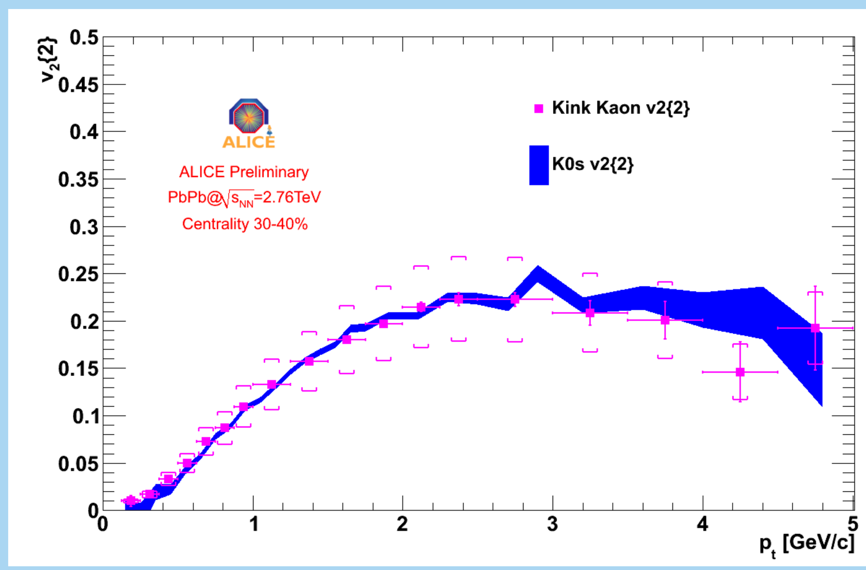
Elliptic flow measurements, using SP and QC{2}, for charged kaons (via TOF+TPC particle identification and via Kink method identification) and K^0_s (via topological method) show consistent results, while Λs obey mass ordering. We suppress non-flow by using gap in pseudorapidity ($|\Delta\eta| > 1$) for the SP method.

The systematic errors due to cut variation and event centrality uncertainties are within a few percent. The total systematic error is dominated by efficiency variation as a function of local track density.









Outlook

The background subtraction was applied to K^0_s and Λ. This technique can be applied to any reconstructed decay (such as D^0, D^+, D^* ...) provided the flow of the background can be determined.

The measurement of v_2 for the K^0_s, charged kaons and Λ is well advanced. The elliptic flow for charged kaons (via TOF+TPC particle identification and via Kink method identification) and K^0_s (via topological method) shows the same trend.

A detailed study of the systematic errors is ongoing.