D-meson $v_2$ measurement in Pb-Pb collisions at 5.02 TeV with ALICE

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Physics motivations
In non-central heavy-ion collisions the overlap region features a geometric anisotropy. Multiple interactions during the expansion of the system convert it into an azimuthally anisotropic distribution in momentum space of the produced particles:

$$\frac{dN}{d\varphi} = \frac{N_0}{2\pi} + \frac{N_0}{\pi} \sum_{n=1}^{\infty} v_n \cos(n(\varphi - \psi_n))$$

$\psi_n$: n-th order symmetry plane; $v_n$: elliptic flow parameter.

The measurement of open charm $\psi$ $D$ mesons are reconstructed in the central rapidity region from the hadronic decay channels $D^{*-}\rightarrow K^+\pi^-$ (BR = 3.93 ± 0.04%, $ct$ = 123 μm)

- The $D^0$, $D^+$, $D_s^+$-meson decay vertex are reconstructed and signal candidates are identified selecting vertices with displaced topology. The combinatoric background is suppressed by applying topological selections and particle identification with TPC and TOF.

Pairs of $D^0$ and pion candidates are built to measure the $D^+$ decay signal.

- The elliptic flow parameter $v_2$ is calculated with the Event-Plane method [3].

- The reaction plane angle of the collision is estimated by measuring the event plane angle $\psi_2$ with the V0 detector.

- The resolution on the event plane $R_2$ is estimated with the three sub-event method (using the V0 detector and the positive and negative $v_2$ parameter).

- D-meson yields evaluated independently in the in-plane and out-of-plane azimuthal quadrants.

Analysis method

- Non-strange D-meson average $v_2$ larger than 0 in $2 < p_T < 10$ GeV/c in the 30-50% centrality class.

- $D$-meson $v_2$ is comparable in magnitude to that of non-strange D mesons and positive with a significance of 2.6σ in $2 < p_T < 6$ GeV/c.

Results

- $D_s^+$-meson $v_2$ in 30-50% centrality class is compatible with that of non-strange D mesons and positive with a significance of 2.6σ in $2 < p_T < 8$ GeV/c.

- Model calculations that provide a fair description of the measurement (LBT, MC@SHO, PHSD, POWLANG) use values of the heavy quark spatial diffusion coefficient in the range $2 \pi T D_v$=1.5-7 at the critical temperature $T_c$≈155 MeV.

- Thermalization time for charm quarks is $\tau_D(m_c/T) \approx$3-14 fm/c with $T_c=155$ MeV.

References: