Feasibility study for the measurement of the elliptic flow of electrons from beauty hadron decays in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$=2.76 TeV with ALICE

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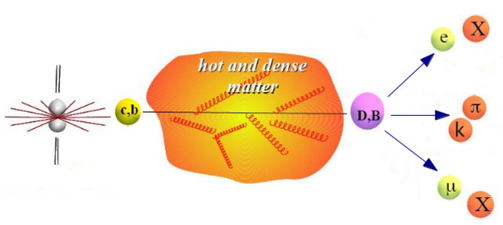
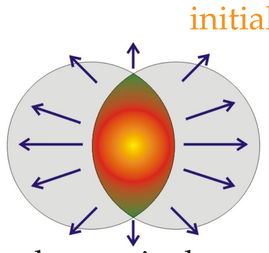
Heavy-flavour production

- Heavy quarks, charm and beauty:
– produced in the initial stage of the collision via hard parton scattering processes.
– experience the full evolution of the system.
→ well suited probe of the medium created in heavy-ion collisions at high energy (Quark-Gluon Plasma).
- Measure heavy-flavour hadrons and heavy-flavour decay leptons.



Elliptic azimuthal anisotropy (v_2)

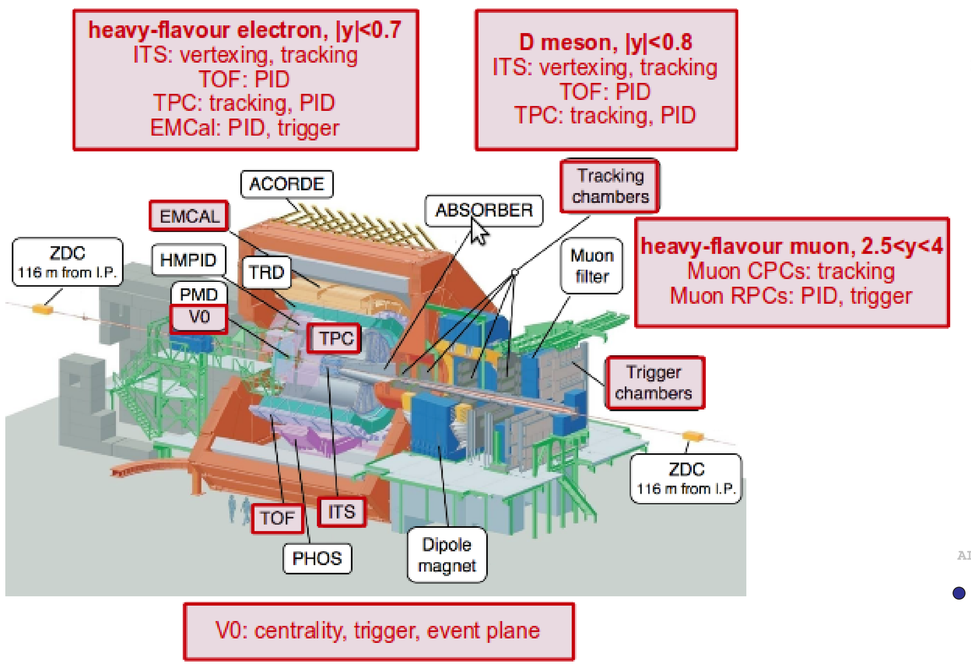
- If there is sufficient rescattering of heavy quarks with the medium:
initial spatial anisotropy → momentum space anisotropy

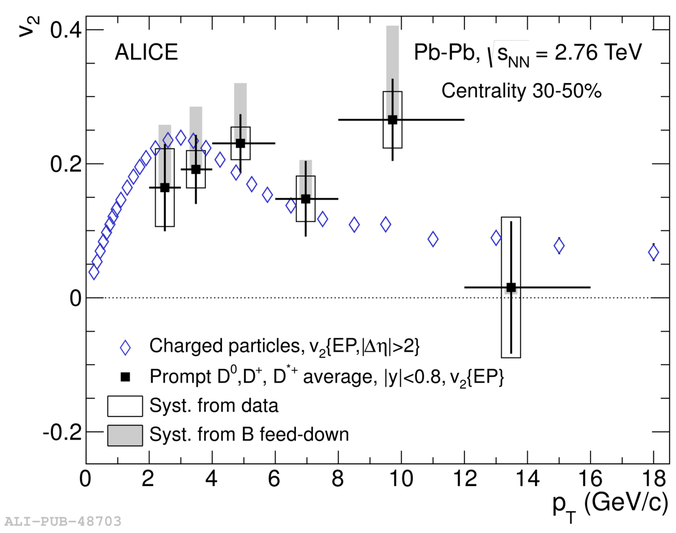


$$\frac{dN}{d(\varphi-\Psi_{\rm RP})}=\frac{1}{2\pi}\left\{1+\sum_{n=1}^{\infty}2v_n\cos\left[n(\varphi-\Psi_{\rm RP})\right]\right\}$$

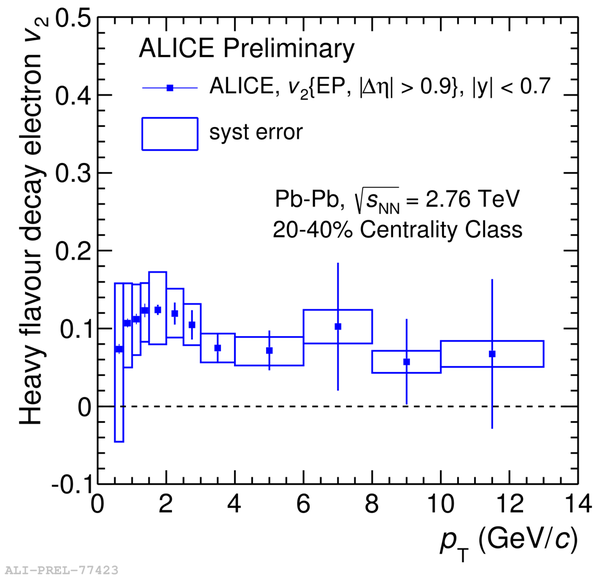
where φ is the particle azimuthal angle, $\Psi_{\rm RP}$ is the reaction-plane angle, and v_n is the azimuthal anisotropy magnitude of the n-th harmonic [1].

Heavy-flavour hadron decay v_2 with ALICE





- First hint for collective motion of charm quarks with the QGP at the LHC [2].



- Indication of collective motion of heavy quarks with the QGP at the LHC [2,3].

Feasibility study for the measurement of the beauty decay electron v_2

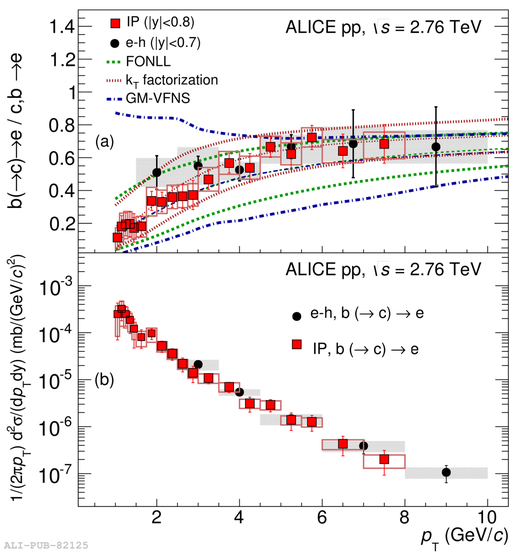
- The azimuthal distribution of heavy-flavour decay electrons is given by:

$$\frac{dN^{HFE}}{d(\varphi^{HFE}-\Psi_{\rm RP})}=\frac{dN^{e\leftarrow c}}{d(\varphi^{e\leftarrow c}-\Psi_{\rm RP})}+\frac{dN^{e\leftarrow b}}{d(\varphi^{e\leftarrow b}-\Psi_{\rm RP})}$$

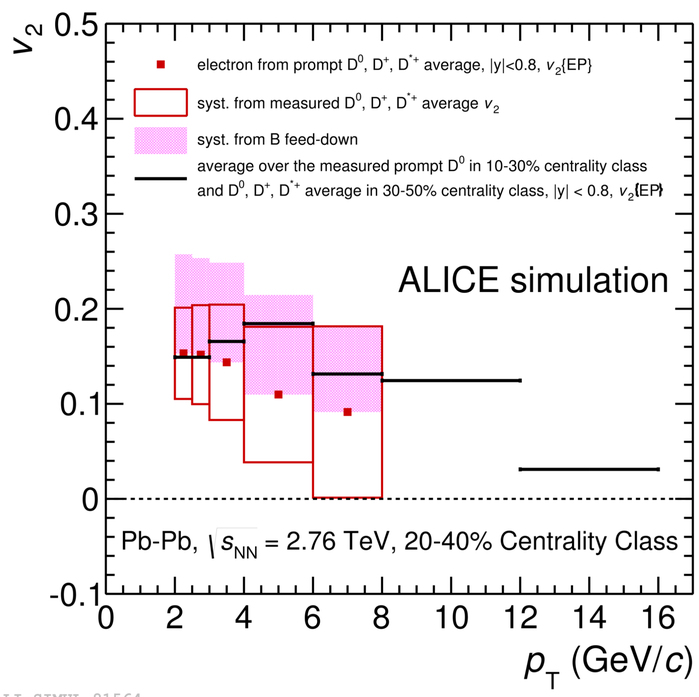
where N^{HFE} is the number of heavy-flavour decay electrons, $N^{e\leftarrow c}$ is the number of electrons from charm decays, and $N^{e\leftarrow b}$ is the number of electrons from beauty decays.
- If we assume that v_2 is the dominant term of the Fourier series, the v_2 of electrons from beauty decays is expressed as:

$$v_2^{e\leftarrow b}=\frac{v_2^{HFE}-(1-R)v_2^{e\leftarrow c}}{R}$$

where R is the ratio of electron yields from beauty-hadron decays to the electron yields from inclusive heavy-flavour hadron decays.
- The ratio of electron yields from beauty-hadron decays to the electron yields from inclusive heavy-flavour hadron decays has been measured in pp collisions at $\sqrt{s}$= 2.76 TeV by the ALICE collaboration [4]:



- The charm decay electron v_2 is evaluated with a Monte Carlo simulation taking as input:
– Measured prompt D meson average v_2 in Pb-Pb collisions at $\sqrt{s_{\rm NN}}$=2.76 TeV [2], which is represented by the black horizontal lines in the figure.
– p_T distribution of D meson in pp collisions from FONLL calculations [5] scaled to Pb-Pb collisions at $\sqrt{s_{\rm NN}}$=2.76 TeV using D meson $R_{\rm AA}$ from BAMPS model [6].
– The Pythia 6 event generator is used to decay D mesons into electrons.



- No statement possible yet, current uncertainties will be reduced with:
– Run 2: a factor 10 larger statistics compared to Run 1.
– ITS upgrade: a factor 50 smaller statistical uncertainty for the current D meson v_2 measurement [7].

Conclusions

- We presented a way to subtract the contribution of the charm decay electron v_2 from the heavy-flavour decay electron v_2.
- The significant increase of the luminosity at the LHC, as well as the ALICE detector upgrades, will increase the potential of this analysis.

References

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[2] R. Bailhache, 19/05 13:00, QM 2014
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[4] B. Abelev et. al, arxiv:1405.4144
[5] M. Cacciari et al., JHEP 9805 (1998)
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[7] S. Siddhanta, 21/05 12:30, QM 2014