D^+ analysis in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV at the LHC with ALICE.

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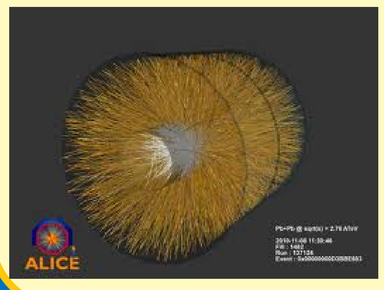
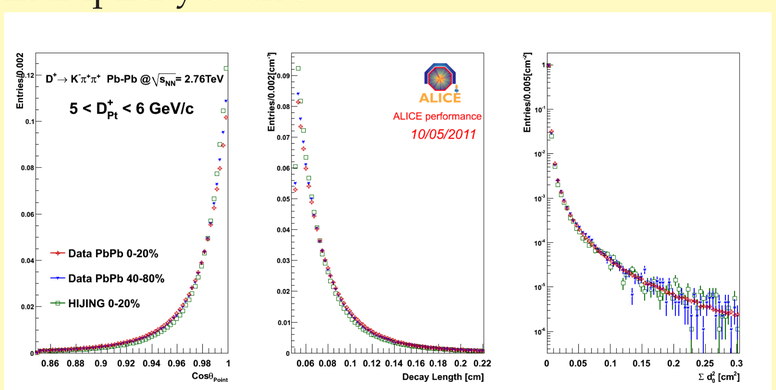
Motivations



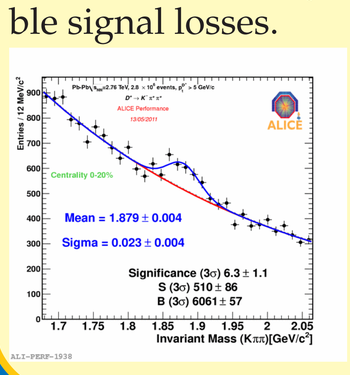
Heavy quarks are regarded as sensitive probes of the interaction dynamics between the parton and medium produced ultra relativistic heavy ion collisions, as they are produced on a very short time scale in the initial hard scattering processes and they follow all the evolution of the medium.
ALICE studies heavy flavours both in p-p and Pb-Pb collisions in order to investigate the properties of the medium

Analysis Strategy

At ALICE the D^+ meson is studied at central rapidity in its $D^+ \to K^- \pi^+ \pi^+$ decay channel (BR=9.2%). In Pb-Pb collisions we analyzed 2 centrality classes: central 0-20% and peripheral 40-80%.
The main challenge to the analyisis is represented by the huge combinatorial background originated for a 3-body decay topology in high multiplicity events.



Most important topological cuts, applied to reduce the combinatorial background, are on decay length, impact parameters and on the angle between the candidate flight line and its momentum. A good agreement between data and MC for the cut variables distribution, shown in the figure, is an important check for our strategy. PID plays an important role in improving statistical significance, and it is applied in a conservative way to avoid as much as possible signal losses.

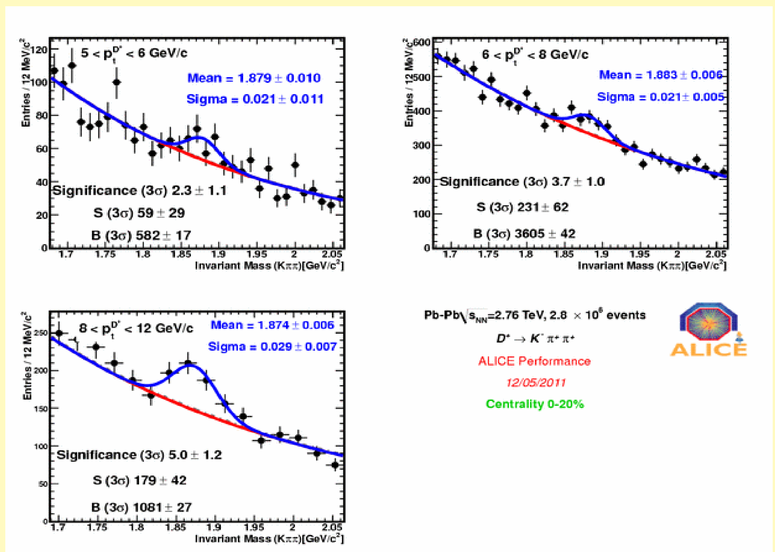


In this decay channel the kaon has always opposite sign charge with respect to the D^+. This makes PID extremely powerful for candidates selection.

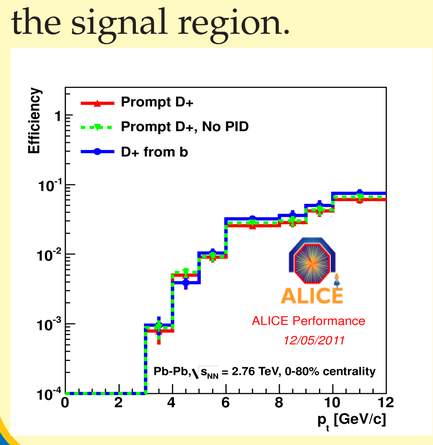
D^+ elliptic flow analysis

One important signature of the creation of a thermalized medium is the elliptic flow, a second armonic azimuthal asimmetry (v_2).
The measurement of open charm meson elliptic flow can probe if the charm quarks were thermalized in the medium and to which extent.
The simplest strategy to measure the charm elliptic flow is to perform signal extraction in several bins of azimuthal angle (with respect to the estimated event plane) and p_T. Then from the observed asimmetries in azimuthal distribution extract v_2.
A large statistics is mandatory to perform such analysis.

Signal extraction

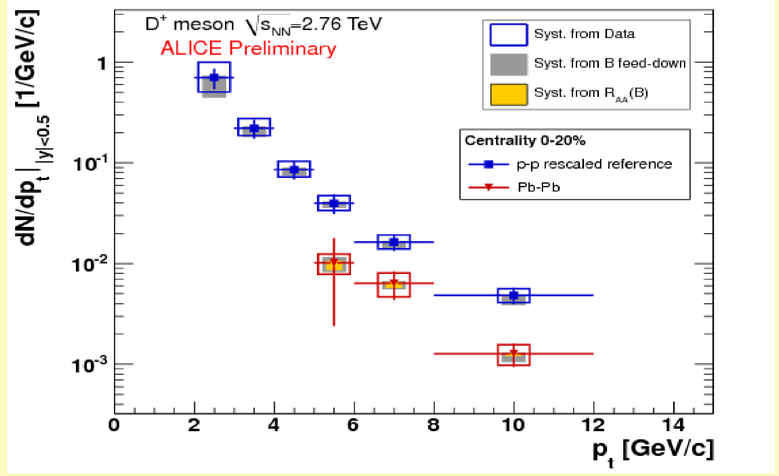


A fit of the invariant mass distribution in the side bands region is used to estimate the background. Then the signal is estimated adding to the background distribution a gaussian fit in the signal region.

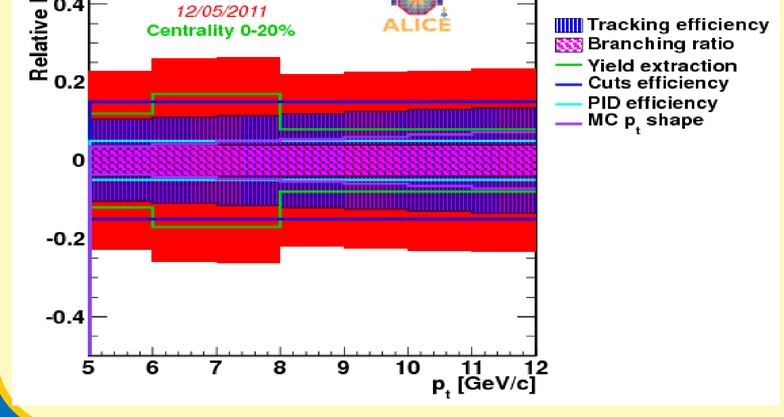


Efficiencies are calculated for prompt and secondary D^+ using MC simulations tuned to reproduce experimental conditions.

Yield extraction

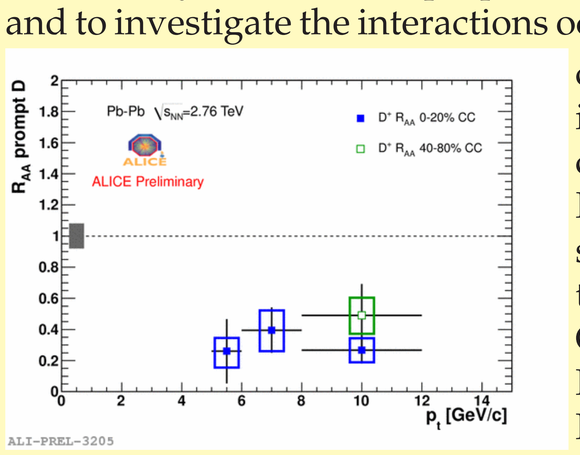


The invariant yield measured from 2.8×10^6 central Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV is shown in the upper figure. It is compared to the reference spectrum obtained by the D^+ invariant yield measured by ALICE in pp collisions at 7 TeV, scaled down to 2.76 TeV with FONLL and multiplied by the nuclear overlap function calculated with the Glauber model.
The energy loss of particles coming from B decay is an important source of systematic uncertainty. It is obtained by varying the ratio between the energy loss of the prompt and secondary D and represented by the yellow band.

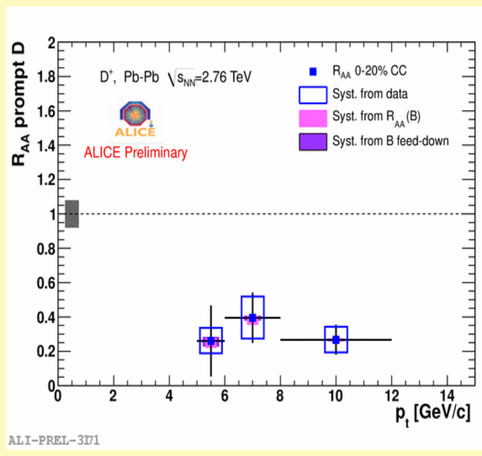


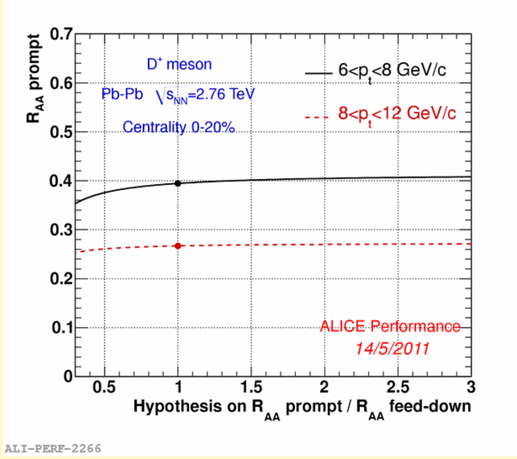
D^+ energy loss

The energy loss of the charm quarks due to their interaction with the medium can be of wide interest to study the medium properties. Energy loss can be used to estimate the transport coefficient and to investigate the interactions occuring in the medium with respect to different masses and color charges of the partons. Figure on the left shows the nuclear modification factor (R_{AA}) of D^+ in different p_T bins for the 20% most central event and for peripheral events.
R_{AA} is obtained by computing the ratio between the yield measured in central Pb-Pb events and the spectra obtained by multiplying by the nuclear overlap function (calculated with the Glauber model) the D meson cross-section measured by ALICE in pp collisions at 7 TeV and scaled down to 2.76 TeV with FONLL.



The prompt D^+ R_{AA} is obtained assuming the beauty loosing as much energy as charm. Different hypothesis for the R_{AA} from beauty (right plot) have been tested to estimate the systematics arising from this assumption.
A very strong suppression of D^+, up to a factor 5, is visible in Pb-Pb collisions for $p_T > 5$ GeV/c.





Conclusions

D^+ has been observed at ALICE in 3 p_T bins in the range $5 < p_T < 12$ GeV/c and 2 centrality classes (0-20% and 40-80%) so far. The D^+ invariant yield has been obtained and a strong suppression with respect to pp data has been observed in Pb-Pb collisions at ALICE in the p_T range under investigation.
The measurement of the elliptic flow is progressing.
Data analysis to extend the p_T range of the measurements is ongoing.