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# D* mesons in jets analysis in proton-proton collisions at $\sqrt{s}$ = 10 TeV using the ALICE detector at CERN-LHC

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Charm and bottom quarks have been proposed as probes to study partonic matter produced in high-energy heavy-ion collisions. The detailed understanding of the production mechanisms in such collisions is of considerable interest. Measurements of the D* yield in jets probe the production processes in which the observed D* mesons are formed primarily from gluon splitting into $c\bar{c}$ or $b\bar{b}$ pairs. The charm content in jets is calculable in perturbative QCD, and the leading non-perturbative correction is expected to be significant at LHC energies. In this contribution we present the first results on performance studies of the reconstruction of charged D* mesons in jets in proton-proton collisions at $\sqrt{s}$ = 10 TeV using the ALICE central detector. $D^{*\pm}$ mesons are reconstructed through the decay sequence $D^{*+} \rightarrow D^0\pi^+$ and $D^0 \rightarrow K^-\pi^+$ (and its charge conjugate channel). The results are compared for different jet transverse momenta, and topological cut effects are discussed.

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## 1. Introduction

The study of charm and bottom production mechanisms is of valuable interest since heavy quarks can be used as hard probes of hot and dense QCD medium produced in heavy-ion collisions. At LHC energies a large contribution from Next-to-Leading-Order processes as gluon splitting to the total production cross section is expected. This paper we present the feasibility of a measurement of the gluon splitting rate in charm pair by investigating the $D^*$ content in jets and studying their correlation to the jet direction.

## 2. Gluon splitting in charm pairs

The ratio of gluon splitting is calculable in perturbative QCD (pQCD). At the energies available at Tevatron and RHIC its contribution to the total cross section is expected to be small [1][2]. This production mechanism can be investigated studying the D* content in jets and using the different fragmentation characteristic with respect to pair creation. Several attempts has been made to measure the $D^*$ content in jets. In proton-proton collisions at $\sqrt{s}$ = 630 GeV the UA1 collaboration has observed $D^{*\pm}$ in jets with transverse momenta over 40 GeV [3]. Nevertheless their fractional momenta, found smaller, are consistent with a production mechanism different from pair creation, in which the D* originate from gluon splitting in $c\bar{c}$ ($g \to c\bar{c}$). The same result is found by CDF collaboration at $\sqrt{s}$ = 1.8 TeV [4]. A recent paper from the STAR collaboration at RHIC [5] shows that the contribution at is non zero and in accordance within the experimental errors with the pQCD predictions.

## 3. Analysis setup

The event sample used to produce the preliminary results presented in this paper is made of $3.5 \times 10^6$ events of the ALICE charm forced production which means that each event contains a $c\bar{c}$ pair. Taking into account that at the center of mass energy of 14 TeV we can expect 0.16 charm pair per event [6] it is clear that the used simulation datasample overestimates (underestimates) the signal (background) by a factor $8-10$.

## 4. $D^*$ - leading particle azimuthal correlation

The key task to prove the feasibility of the analysis is to evidence the ability of the detector to clearly record the correlation of the $D^*$ and jet axis since in the case of gluon splitting the whole contribution is expected to come from the near-side correlation. A second step will be a selection of the near-side region to investigate the fragmentation characteristic of the events. The $D^*$ reconstruction is performed throught the channel $D^{*\pm} \to K\pi + \pi_s^{\pm}$. In a first step a $K\pi$ invariant mass region of $3\sigma$ invariant mass resolution around the expected $D^0$ mass is selected. In a second step the soft pion ($\pi_s$) is added. The combinatorial background for the $D^*$ reconstruction is estimated using the side-band method. The side-band-background is evaluated, during $D^*$ reconstruction, selecting instead a the central band of $3\sigma$ around the expected $D^0$ mass two side bands, on the left and right, $6\sigma$ away from the expected $D^0$ mass. As first approximation of the jet axis direction is chosen the

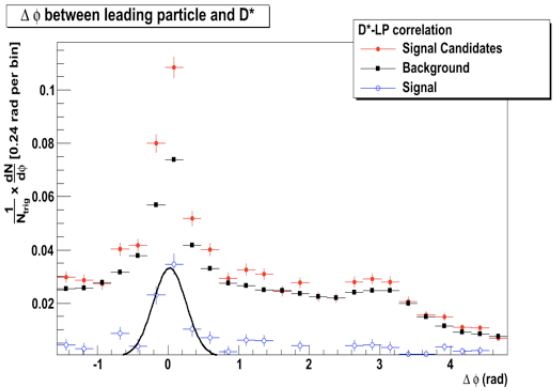


**Figure 1:** (color online) Azimuthal angular ($\Delta\phi$) correlation between LP and $D^*$. The solid line is a gaussian fit to the near side peak.

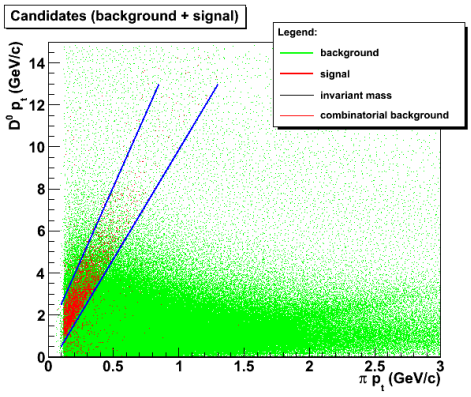


**Figure 2:** (color online) Transverse momentum correlation between $D^*$ and $\pi_s$ for signal (red) and background (green).

leading particle (LP) direction and only events with LP $p_t > 5$ GeV/c are considered. In fig. 1 where the D$^*$-LP azimuthal angular correlation is shown, after side-band subtraction, the near side peak is clearly visible. With an unbiased sample some selection criteria must be developed in order to enhance the signal. Two strategies are under study. The first is to apply the $D^0$ reconstruction cuts already developed for $D^0$ analysis. The second is to implement a cut on the $D^0\pi_s$ pt phase space as clear from fig. 2.

## 5. Conclusions

The analysis of the $D^*$ content in jets is of great interest at LHC energies. It allow to access to the gluon splitting production rate in an energy domain never investigated before. Since the production rate is evaluable in pQCD the analysis is a powerful QCD test tool. In this paper a preliminary study is presented showing the feasibility of the analysis.

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