High p_T heavy-flavour decay electron measurements in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 with the TPC and EMCal of ALICE

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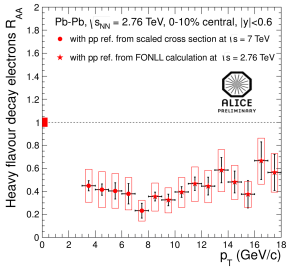
Motivation

• In heavy-ion collisions, **heavy quarks (charm and beauty) are used to study the Quark-Gluon Plasma (QGP)**, a deconfined state of strongly-interacting matter. Due to their large masses, they are produced in the early stages of the collision and experience the whole evolution of the system. Thus, they are good probes to study the properties of QGP.

• Heavy-flavour production can be studied, among others, **via semi-electronic decays: c, b->e**

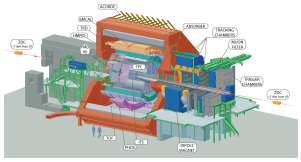
• The ALICE collaboration has measured electrons from heavy-flavour hadron decays in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV at mid-rapidity [1]. **A strong suppression of the yield of heavy-flavour decay electrons in the transverse momentum interval 3 < p_T < 18 GeV/c is observed in the 10 % most central collisions, when compared to binary-scaled pp measurements (R_{AA}).**



$$R_{AA} = \frac{1}{\langle T_{AA} \rangle} \frac{dN^{AA}/dp_T}{d\sigma^{pp}/dp_T}$$

• Measurements of heavy-flavour decay electrons and their **nuclear modification factor R_{pPb}** in the same p_T interval in p-Pb collisions are crucial to disentangle cold nuclear matter effects (shadowing, gluon saturation, energy loss, k_T broadening, multiple collisions) from hot nuclear matter effects in Pb-Pb collisions**. The EMCal trigger data extend the p_T range of a previous analysis [2, 3] in minimum bias (MB) collisions.**

ALICE detector



• TPC, TOF and EMCal detectors are used to identify electrons.

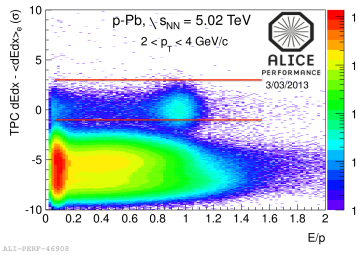
• **EMCal trigger** is used to select **electrons at high p_T**, extending measurements in MB collisions.

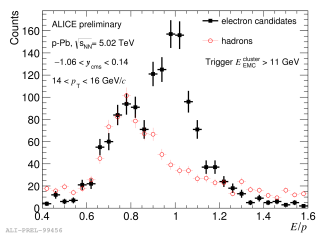
• L1 Gamma trigger: single shower trigger where the energy is summed over a sliding window of 4x4 towers.

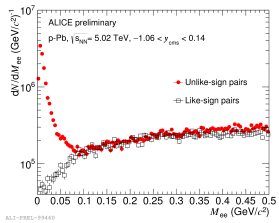
• **Two thresholds on the energy deposited in the EMCal were used in p-Pb collisions: 7 GeV and 11 GeV.**

• The integrated luminosity was 0.2 pb^{-1} and 0.5 pb^{-1} for the lower and higher thresholds, respectively.

Analysis strategy

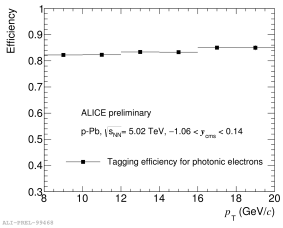






• Electrons are identified by measuring dE/dx (**-1 < (dE/dx - <dE/dx >$_e$) < 3**) in the TPC and E/p (**0.8 < E/p < 1.2**), where E is the energy measured in the EMCal and p is the momentum reconstructed with the TPC.

• **Hadron contamination** is determined using the E/p distribution after the TPC PID requirements. At low E/p values, the E/p distribution of hadrons identified with the TPC is normalized to the electron distribution and subtracted. The hadron contamination increases with p_T up to 45%.

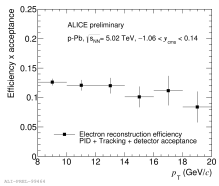


• The background (mainly from photon conversions and Dalitz decays of neutral mesons) was estimated from e$^+$e$^-$ pairs **with invariant mass smaller than 0.15 GeV/c²** (efficiency of reconstruction of pairs is around 80% at high p_T).

• The signal to background ratio is around 4 in the first p_T bin and increases with p_T.

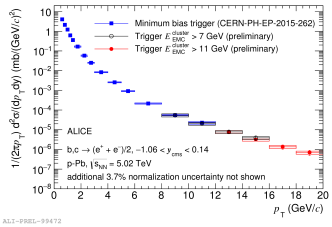
• **J/Ψ** and **W decays** are subtracted from final spectrum. The contributions are 2% and 3% in 18 < p_T < 20 GeV/c, respectively.

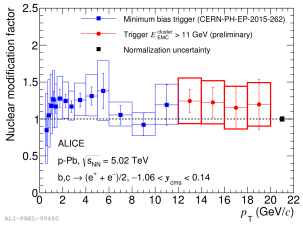
• **The final spectrum is corrected for the efficiency from track reconstruction and particle identification** (total efficiency, including the acceptance, is around 12%).



Results

The measurements of heavy-flavour decay electrons using **EMCal triggered data with the 7 and 11 GeV energy threshold are compatible** within the statistical and systematic uncertainties. **The results are also compatible with MB results [2, 3] and extend the latter to higher p_T.**





The total systematic uncertainty on the cross section is 18% and the main source of systematic uncertainty is the trigger normalization (12%).

The **pp reference** at 5.02 TeV was obtained using the **ATLAS** measurement [4] at 7 TeV scaled according to FONLL predictions. **The R_{pPb} results are consistent with unity within systematic uncertainties.**

Conclusions

The heavy-flavour decay electron cross section was measured up to 20 GeV/c using the TPC and EMCal detectors. **The R_{pPb} results are consistent with unity within systematic uncertainties.** The EMCal trigger data allowed us to extend the p_T reach of the measurements in MB collisions [2, 3]. Since there is no suppression in p-Pb collisions, **the suppression observed in central Pb-Pb collisions is due to the presence of the hot and dense medium.**

References

[1] ALICE Collaboration, Nuclear Physics A, 904, 2013, 661c-664c.
[2] CERN-PH-EP-2015-262.
[3] ALICE Collaboration, Nuclear Physics A, 931, 2014, 546c-551c.
[4] ATLAS Collaboration, Phys.Lett. B, 707,2012, 438.

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