Measurement of non-prompt J/ψ contribution at midrapidity in p-Pb collisions with ALICE

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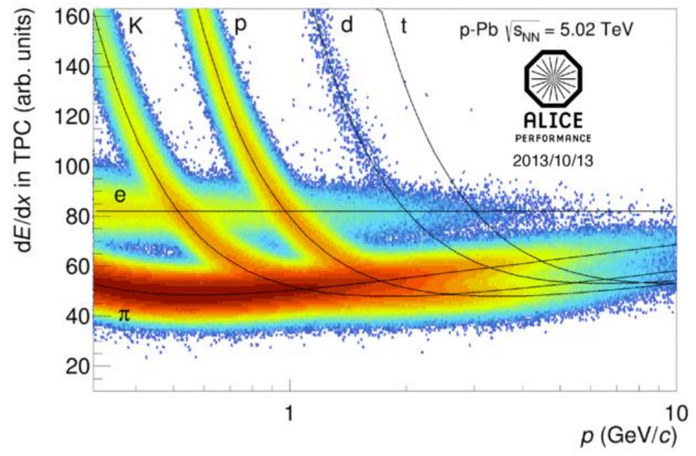
Heavy-flavour measurements in p-Pb collisions will shed light on the cold nuclear matter mechanisms such as initial state energy loss, gluon shadowing, saturation effects and nuclear absorption. These effects need to be understood such that they can be disentangled from the effects of the hot and dense matter created in heavy-ion collisions, the Quark-Gluon Plasma (QGP). The secondary J/ψ measurement is an indirect estimation of the beauty quark production, which is an important probe for the dynamics of the colliding system.

Inclusive J/ψ selection

The non-prompt component of the inclusive J/ψ sample is determined for p-Pb collisions analyzing roughly100 millions minimum-bias events collected by ALICE in 2013. The inclusive J/ψ are reconstructed in the dielectron channel J/ψ -> e^+e^- at midrapidity down to zero p_T. The dielectron pairs were selected such that both daughter tracks had a hit in the innermost layer of the ITS, $p_T^e > 1$ GeV/c, $|\eta^e| < 0.9$ and with the PID requirements $|n\sigma^{electron}| < 3$, $|n\sigma^{pion}| > 3$ and $|n\sigma^{protron}| > 3.5$ of the TPC only. On top of these selection, the J/ψ candidate for the non-prompt extraction were selected if $|y_{J/\psi}| < 0.9$ and $p_T > 1.3$ GeV/c. After all the cuts, roughly 1000 candidates of inclusive J/ψ (including background pairs) were available for the analysis.



Non-prompt J/ψ separation

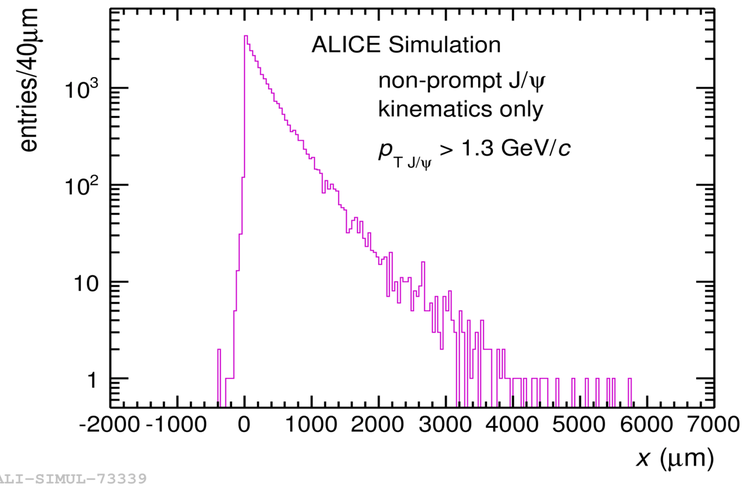
The estimate of the fraction of the J/ψ from b-hadron decays relies on the distribution of the pseudoproper decay length x. It is performed by an unbinned 2-dimensional likelihood fit by maximizing the likelihood function

$$L_{xy} = \frac{\vec{L} \times \vec{p}_T^{J/y}}{p_T^{J/y}} \qquad x = \frac{c \times L_{xy} \times m_{J/y}}{p_{T_{J/y}}}$$

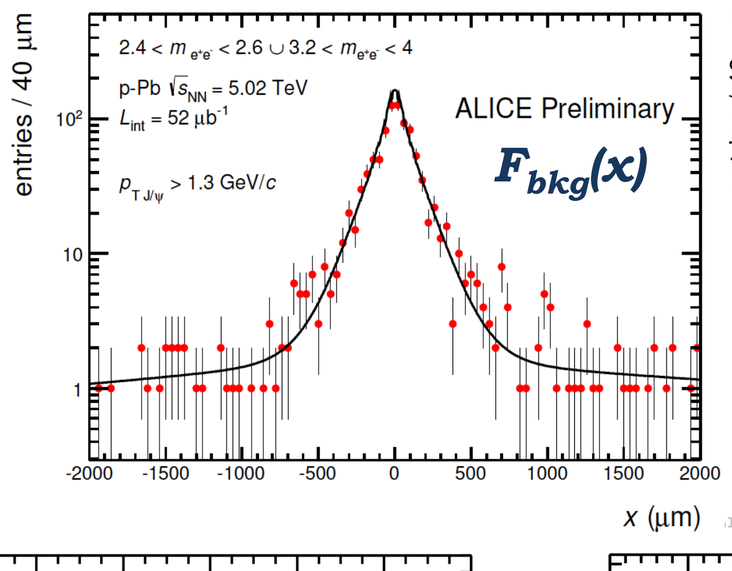
$$\ln L = \sum_{i=1}^{N} F(x^i, m^i_{e^+e^-}) \text{ where } F(x^i, m^i_{e^+e^-}) = f_{sig} \times F_{sig}(x^i) \times M_{sig}(m^i_{e^+e^-}) + (1 - f_{sig}) \times F_{bkg}(x^i) \times M_{bkg}(m^i_{e^+e^-})$$

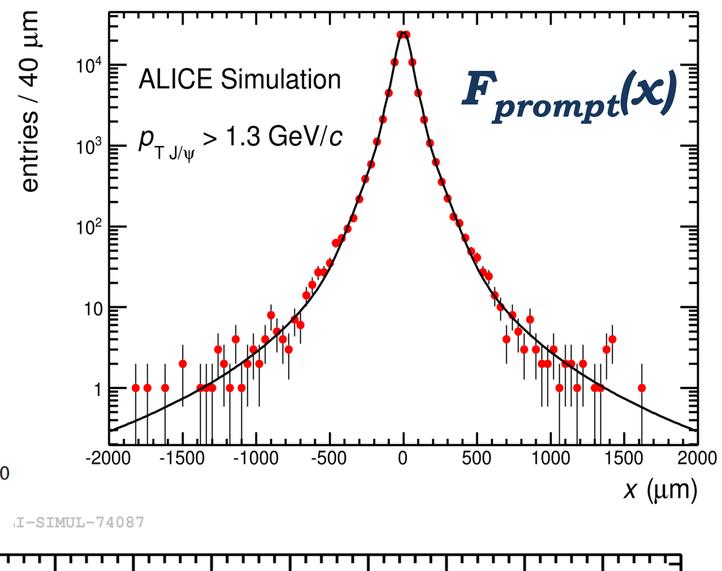
where N is the total number of candidate pairs. In particular :

- $F_{sig}(x) = f_B \times F_B(x) + (1 - f_B) \times F_{prompt}(x)$. Let the R(x) be the detector resolution. It turns out that $F_{prompt}(x) = R(x)$ and $F_B(x) = c_B(x') \ddot{A} R(x - x')$ where χ_B is the x of non-prompt J/ψ as extracted from pure kinematical variables.
- $M_{sig}(m_{ee})$ is described by a Crystal Ball function
- $M_{bkg}(m_{ee})$ is described by an exponential function
- In data $F_{bkg}(x)$ is the x distribution of the pairs whose mass values fell outside the signal region ($2.4 < m_{ee}(GeV/c^2) < 2.6$ and $3.2 < m_{ee}(GeV/c^2) < 4$)



The inclusive J/ψ, the signal, are the sum of the prompt and the non-prompt component and the f_B is the measured fraction of non-prompt J/ψ with respect to the signal yield. The F_{prompt} and F_{bkg} are shown with their parametrization as fitted on the plots themselves. The unbinned likelihood fit was performed to determine F_{sig} and $f_{B..}$ The results of the likelyhood fit are shown below as the projection of the F(x,m) function superimposed to the distributions of the invariant mass and the pseudoproper decay length of the candidates J/ψ.





Summary and Outlook

The measurement of the non-prompt J/ψ fraction f_B is being finalized. Studies on the systematic uncertainties are in progress. Sources of systematics are the shape of the resolution function (F_{prompt}), the invariant mass shape of the signal and the background, the distribution of the x of the background F_{bkg}, MC p_T distributions and the x distribution of the non-prompt J/ψ.