
# Cold Nuclear Matter effects on Quarkonium production with extrinsic transverse momentum

Content :

We study the Cold Nuclear Matter (CNM) effects on $J/\psi$ and $\Upsilon$ production, whose understanding is fundamental to evaluate the Quark Gluon Plasma or Hot Nuclear Matter effects. Two CNM effects are of particular importance: the modifications (here, shadowing or EMC effect) of the initial parton distributions (PDF) and the nuclear absorption of the $c\bar{c}$ (or $b\bar{b}$)-pair. Recent theoretical works~\cite{CSM-upgrade,Upsilon-LHC,next-paper-JPhi} have emphasized that the $J/\psi$ production at low and mid-$p_T$ proceeds {\it via} a $2 \to 2$ process, such as $g+g \to J/\psi + g$, instead of a $2 \to 1$ process, as assumed in the usual studies of CNM effects. So one has to modify accordingly the way to compute the nuclear shadowing. When taking into account the exact kinematics for the $2 \to 2$ process, visible differences~\cite{first-extrinsic-paper} appear in the obtained shadowing corrections, irrespective of which shadowing parametrization is used~\cite {second-extrinsic-paper}. This naturally induces changes in the absorption cross-section fit to the data, and hence to the deduced rapidity dependence~\cite{second-extrinsic-paper}. We will present our results in $dA$ and $AA$ collisions at RHIC energy, using several parametrizations of the nuclear PDF, and including the $p_T$-dependence of CNM effects up to mid-values of $p_T$, which are not accessible with the usual simplified kinematics. We extend our study to the $\Upsilon$ case, where the first experimental results in $dA$ at RHIC energy are available. At low~$p_t$ i.e. for the bulk of the production cross-section, the leading production mechanism is expected to be a $2 \to 2$ process~\cite{next-paper-JPhi}. However, for the $\Upsilon$, the required momentum fraction carried by the initial partons is larger and can reach the EMC region. We will compare our results~\cite{paper-upsilon} to the recent $dA$ data, and see how the $\Upsilon$ may be used as a probe of the EMC region, where the strength of the nuclear PDF modification still suffers from rather large uncertainties.

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Primary authors : Dr. RAKOTOZAFINDRABE, Andry (CEA Saclay, IRFU/SPhN, France)

Co-authors : Dr. FERREIRO, Elena G. (Departamento de Fisica de Particulas, Universidade de Santiago de Compostela, Spain) ; Dr. FLEURET, Frédéric (Laboratoire Leprince Ringuet, Ecole Polytechnique, CNRS-IN2P3, France) ; Dr. LANSBERG, Jean-Philippe (Centre de Physique Théorique, Ecole Polytechnique, CNRS, France) ; Dr. MATAGNE, Nicolas (Université de Mons, Service de Physique Nucléaire et Subnucléaire, Belgium)

Presenter : Dr. RAKOTOZAFINDRABE, Andry (CEA Saclay, IRFU/SPhN, France)

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