

# UPC 2023: International workshop on the physics of Ultra Peripheral Collisions

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## Vector meson production as a tool to search for gluon saturation from pA to eA to UPC

*Tuesday 12 December 2023 09:00 (30 minutes)*

Vector meson production in high-energy UPCs is an excellent tool to study the dynamics of small- $x$  gluons inside nuclei. Employing the Color Glass Condensate (CGC) effective field theory, I will describe the impact that gluon saturation has in exclusive and semi-inclusive  $J/\psi$  production in UPC reactions.

In the first part of the talk, I will focus on exclusive  $J/\psi$  production and show how non-linear saturation effects change the density profile of a heavy nucleus, and that such modifications are necessary to obtain a good description of ALICE and LHCb data on Pb+Pb UPCs [1]. We employ a joint impact parameter and transverse momentum-dependent cross-section framework in order to incorporate the finite photon transverse momentum and the interference between the cases for which the role of photon emitter and target are interchanged between the nuclei. We show that these effects are comparable to the experimental precision for  $p_T$  differential cross sections and must be included when comparing to LHC data.

In the second half of the talk, I will present our results for direct  $J/\psi$  production in a joint CGC + Non-relativistic QCD framework [2]. We establish the correspondence between our results with those obtained within the transverse momentum dependent (TMD) framework and its “Improved” version ITMD. We show quantitative results for the size of  $k_T$  factorization-breaking contributions in the CGC at realistic kinematics attained in UPCs at RHIC and the LHC.

[1] Heikki Mäntysaari, Farid Salazar and Björn Schenke. Phys.Rev.D 106 (2022) 7, 074019. e-Print: 2207.03712 [hep-ph]

[2] Vincent Cheung, Zhongbo Kang, Farid Salazar, and Ramona Vogt.  
[in progress]

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