ALICE Measurements of Coherent $\rho^0$ Photoproduction in Pb-Pb Ultra-peripheral Collisions

David Horák for the ALICE Collaboration
Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague

May 25-30, 2020

Abstract

The powerful photon fluxes of relativistic nuclei provide the possibility to study photomuclear and two-photon interactions in ultra-peripheral collisions (UPC), where the nuclei do not overlap and no strong nuclear interactions occur. Within the Vector Meson Dominance Model (VMD), the $\rho$ contribution dominates the QCD part of the photon structure function. The $p + A \rightarrow p + A$ process in heavy-ion UPC is an excellent tool to test the black disk regime, where the target nucleus appears as a black disk and the total $p + A$ cross section reaches its limit. RHIC and LHC results have deviated from some Glauber-VDM calculations, which thus call for new data. ALICE reports [1] the first measurements of coherent rho photoproduction accompanied by electromagnetic dissociation (EMD) with data taken at $\sqrt{s_{NN}} = 5.02$ TeV. The rapidity-dependent cross section of coherent $\rho^0$ photoproduction is measured and it is compared to theoretical models. In addition, a side resonance-like structure around 1.7 GeV/$c^2$ is observed.

Motivation

Both contributions can be distinguished using different techniques.
- Neutrons from pion decay in the UPC process can be identified with negative ion drift time in the V0 detectors.
- Using kinematics from low-$p_T$ pions in the event,

High-mass state

Data consistent with all models around 2 sigma level:
- **STAR** [7] model based on the Vector Meson Dominance model and photoproduction off proton, data combined with the Gluonic-like approach [8].
- **AP98** [10] model by Gyulassy, Greiner, Kniehl and Stocks based on the Color Dipole Model with the saturation of gluons, described by the Pomeron exchange.
- **QCDM** [9] model by Gubarev, Michael, Noveras and de Santis based on QCD-like implementation of gluon saturation within the Color Dipole Model.

Conclusions

ALICE reports [1] the cross section of $\rho^0$ photoproduction at mid-rapidity at $\sqrt{s_{NN}} = 5.02$ TeV. The measured cross section is compatible with all models within around 2 standard deviations, except for the single neutron emission class (1n0x), where models underestimate data slightly. This suggests that the measurement of coherent vector meson production accompanied by EMD could also be used to separate the low and high energy contributions to the cross section at forward rapidities as suggested in [2].