Study of polarised gluon structure of proton via prompt photon production in the SPD experiment at the NICA collider.

Aierke Rymbekova

(JINR DLNP, Dubna) On behalf of the SPD working group



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Nucleon structure

Nucleon consist of partons

(3 valence quarks, gluons and sea quarks)



X

3 PDFs are needed to describe nucleon structure in collinear approximation



 $q(x,Q^2),$ $\bar{q}(x,Q^2),$ $g(x,Q^2)$



NICA (Nuclotron based Ion Collider fAcility)





It consists of the 3 parts: 2 endcaps and central one. Each part has individual magnet system, the endcaps - solenoidal coils, central part toroidal.

 \Box polarised (longitudinal and transverse) and non-polarised p –; d – collisions;

□ polarisation ~ 70%; □ $p \uparrow p \uparrow \sqrt{s} = 12 \div 27 \text{ GeV};$ □ $d \uparrow d \uparrow \sqrt{s} = 4 \div 13.8 \text{ GeV};$ □ $L_{average} \ge 10^{32} cm^{-2} s^{-1} (\text{at } \sqrt{s} = 27 \text{ GeV}).$

Prompt photons

Photons produced in the hard scattering, named the **prompt photons**, provide information about gluon component of the proton.



 $d\sigma_{AB} = \sum_{a,b=q,\bar{q},g} \int dx_a dx_b f_a^A(x_a,\mu^2) f_b^B(x_b,\mu^2) d\sigma_{ab\to\gamma X}(x_a,x_b,\mu^2).$

One of the instrument to study gluon component of proton – prompt photons

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Previous studies (data/theory)

Phys.Rev. D73 (2006) 094007







Expected accuracy

- Data sample corresponds to 10^7 s of data taking (about 100 days) with average luminosity $L = 10^{32} s^{-1} cm^{-2}$.
- Errors from polarisation and luminosity measurements are not taken into account.





Prompt photons provide an information about polarased and non-polarised gluon component of the proton

Studies of gluon structure of nucleon with prompt photons – one of the main tasks of the SPD physics program





- Low p_T region is useless for any studies of prompt photons due to huge background
- At high p_T statistics is very limited
- A reasonable cut on transverse momentum (> 4 GeV/c) of photon has to be applied in order to maximize the accuracy of the planned measurements.

Expected accuracy

The main way to suppress the background is effective reconstruction of π^0 decays and an accurate simulation of setup behaviour.



Signal to background ratio



SPD physics tasks Nucleon spin structure studies

- Drell-Yan pair production



- Nucleon PDFs by J/psi production

LO *cc* production diagram:

