Direct photon production (Dpp): defin



The *pbar* + *p* → *gamma* + *X* process (different to DIS scattering) is mainly defined by *LO QCD* diagrams:

panda



At the maximum luminosity $L= 2 \cdot 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ one can expect up to 4 x 10⁹ signal events per year. The hadrons are build of quarks which are interconnected by gluons. None of them can be detected as the final states of hadron-hadron or leptonhadron collisions due to the so called "partons confinement". Nowadays, the physics deals mainly with the structure functions which model the distributions of partons in hadrons.

The information about such structure functions is extracted from the experimentally measured cross sections (defined as the ratio of the Number of events to the beam Luminosity, i.e. Nev /Lum) by fitting the parameters of different models of structure functions to the cross sections data.

Anna Skachkova "Study of direct photon production at PANDA experiment" 53 International Winter Meeting on Nuclear Physics. 26-30 January 2015. Bormio, Italy



Motivation for studying Dpp in hadronic collisions



- Precision test of pQCD;
- Serves to calibrate jet energy;
- Dpp is complementary to DIS and DRELL-YAN for studying the structure of hadrons;
- Dpp contributes significantly to the measurement of the gluon distributions in hadrons.

The energy region 1 < E_{beam} < 15 GeV which can be covered by antiproton beam at the accelerator center FAIR (GSI, Darmstadt) is of interest for research because it is much less investigated as compared to those regions which were studied at the accelerators having more higher energies. Also the region of intermediate beam energy is important for searches of expected deviations from the perturbative QCD.



at IDw Q² at JLab 0.1 < Q² < 8.0 GeV²





and possibly higher for the smaller E_{beam} (and correspondingly \sqrt{s})





Anna Skachkova "Study of direct photon production at PANDA experiment" 53 International Winter Meeting on Nuclear Physics. 26-30 January 2015. Bormio, Italy

panda

Our interests



<u>**Our Physical goal</u></u>: To estimate the possibility of getting the information about proton structure functions** $f(x, Q^2)$.</u>

Main interest:To estimate the size of the
 $x-Q^2$ kinematical region
in which the structure functions
can be measured.

Structure functions distributions



From these quark distributions we see that at PANDA energy (E_{beam}=15 GeV) PYTHIA6.4 (with CTEQ3L parameterization) predicts that the Bjorken x-variable can cover the region 0.05 < x < 0.7

In $pbar + p \rightarrow \gamma + X process$

(choosing pbar beam direction as the z-axis)

the role of the transferred momentum Q

plays the *photon transverse momentum*, i.e. **PT^r= Q**

As it will be shown below, at *E* beam = 15 GeV

we can expect $PT_{T} < 2.3 \text{ GeV}$, i.e.,

 $Q^2 = (PT^{\gamma})^2 < 5.3 \text{ GeV}^2$

This region is under study now at HERA and JLab.



 $0 \le PTY \le 2.3 \text{ GeV/c}, <PTY > = 0.73 \text{ GeV/c}$

Simulation was done with use of PandaRoot & Geant 4 with the initial set of <u>10⁶ events</u> generated by PYTHIA6.4.

Anna Skachkova "Study of direct photon production at PANDA experiment" 53 International Winter Meeting on Nuclear Physics. 26-30 January 2015. Bormio, Italy