Prompt photons at SPD: status and plans

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Prompt photons



Measurement with prompt photons is direct access to gluon distributions in nucleon

Ways to access gluon structure of nucleon at low energies

prompt-photon production



The most direct way

Hard background

charmonia production



Nice signal

Model-dependent treatment

open-charm production



Rather simple treatment Problematic signal

Gluon Compton Scattering (GCS)



Decay photons



Even at very high p_T signal will dominate over background !

Previous studies at our energies

Experiment	Beam and target	\sqrt{s} , GeV	y range	x_T range
E95 (1979)	p; Be	19.4, 23.75	-0.7 - 0.7	0.15 - 0.45
E629 (1983)	p, π^+ ; C	19.4	-0.75 - 0.2	0.22 - 0.52
NA3 (1986)	p, π^+ , π^- ; C	19.4	-0.4 - 1.2	0.26 - 0.62
NA24 (1987)	p, π^+ , π^- ; p	23.75	-0.65 - 0.52	0.23 - 0.59
WA70 (1988)	p, π^+ , π^- ; p	22.96	-0.9 - 1.1	0.35 - 0.61
E706 (1993)	p, π^- ; Be	30.63	-0.7 - 0.7	0.20 - 0.65
E704 (1995)	p; p	19.4	< 0.74	0.26 - 0.39
UA6 (1993,1998)	$ar{p}; p$	24.3	-0.2 - 1.0	0.34 - 0.50

хт=2рт/√s

Low-energy measurements



Previous results: pA

J. Phys. G: Nucl. Part. Phys. 23 (1997) A1-A69.

NA3 (1987) $p C \rightarrow \gamma X$

Previous results: pA

E706 (1993) p Be $\rightarrow \gamma X$

Previous results: pp(pbar)

pp(pbar)

Nucleon PDFs

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DSA with longitudinally polarised beams

х

0.8 ¥

0.6

0.4

0.2

* EMC

SMC

△ E143

E155

 HERMES CLAS W>2.5

COMPASS

101

SSA with prompt photons

where $q(x_{a,b}, k_{Ta,b})$ and $G(x_{a,b}, k_{Ta,b})$ are quark and gluon distribution functions and $\Delta_N q(x_{a,b}, k_{Ta,b})$

Single spin asymmetries at $\sqrt{s}=19.4$ GeV

Polarized measurement at FNAL E704 Phys. Lett. B 345 (1995)

•*Fixed target.* A_N •Polarized proton beam from Λ decay 0.8 2 5 < p_T < 3.1 GeV/c •2.5 $GeV/c < p_T < 3.1 GeV/c$ 0.6 • π^0 mass resolution - 10.5 MeV 0.4 • 473 prompt photon candidates 0.2 (including 220+-22 background events) Beam Beam -0.2 Hodoscope MWPC Hodoscope Guard -0.4 MWPC Counter -0.6 CEMC1 -0.8 Polarized CEMC2 Beam Spin-rotation 0.1 -0.2 -0.1 Magnets _ead-glass XF Calorimeter Veto-counters Taryet -20 -10 10 m 0 (8)

Prompt photons at SPD

Ideal setup:

- 4π ECAL
- minimal tracking system (vertexing, charged/ neutral clusters separation)

No need for magnetic field and muon system

Measurements with prompt photons could be performed at the first stage of SPD operation

Main actors

Rymbekova Aierke, Guskov Alexey – MC simulation, methodology of analysis

Tkachenko Artur — ECAL in SPDroot

Closer interaction with ECAL group is expected

Input from theorists is welcome!

Flux in ECAL (E>0.1 MeV)

×10⁻⁶ cm² per event

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Prompt photons in SPD

Energy [GeV]

 $p_{\rm T} [{\rm GeV}/c]$

Signal and background

Preliminary requirements for ECAL

- dE/E ~ 5%/√E
- Threshold E₀~ 0.1 GeV (below MIP)
- granularity <10 cm
- time resolution ?

Main background sources

- π⁰ decay
- η-meson decay
- double clusters
- neutral hadrons (n, K, Λ)
- charged particles

Expected accuracy

Clustering and shower reconstruction

NLO generators

Counting of fragmentation photons

- - -

Plans

