Count Rate Estimates for the Measurement of Generalized Distribution Amplitudes with PANDA

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Physics Motivation

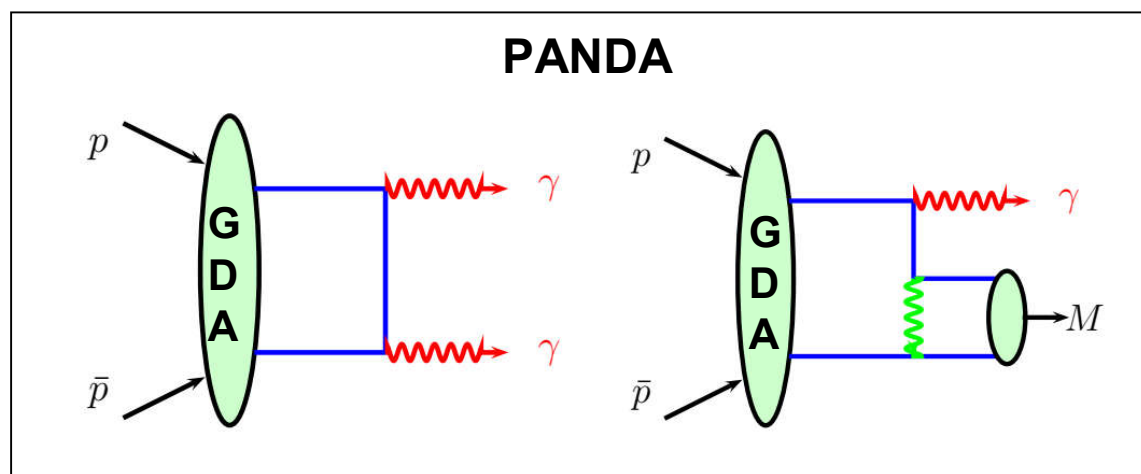$$p\bar{p} \rightarrow \gamma M$$ at large Mandelstamm variables $s, -t, -u \gg \Lambda^2$

process amplitudes factorizes:

| hard partonic subprocesses | + | annihilation form factors |

represent moments of baryon-antibaryon **G**eneralized **D**istribution **A**mplitudes (GDAs)

PANDA

Theory Predictions

Theoretical work for baryon-antibaryon GDAs:

➡️ P. Kroll, A. Schäfer, The process $p\,\bar{p} \to \gamma\,\pi^0$ within the handbag approach, The European Physical Journal A 26, 89-98 (2005)

➡️ P. Kroll, A. Schäfer, Probing moments of baryon-antibaryon generalized parton distributions at BELLE and FAIR, The European Physical Journal A 50, 1 (2014)
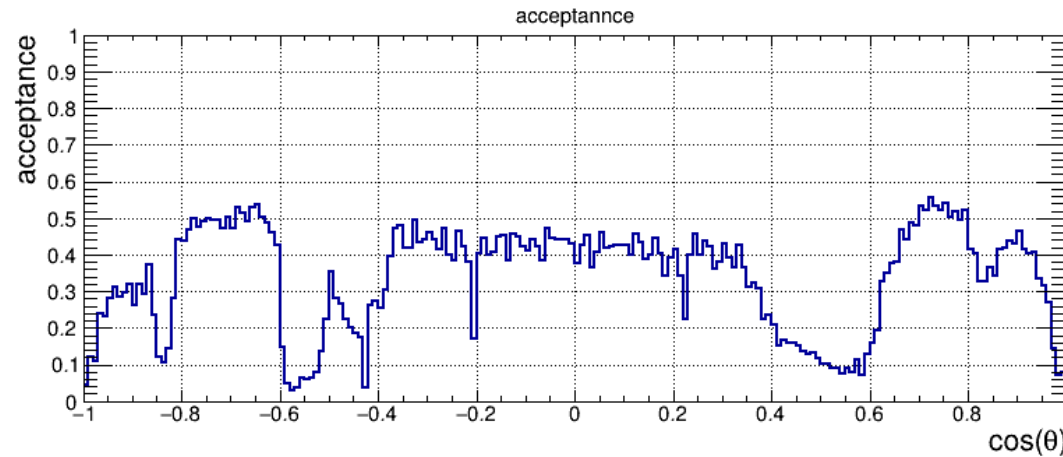
Absolute cross sections so far only available for:

$$p\;\bar{p} \to \gamma\;\gamma \qquad p\;\bar{p} \to \gamma\;\pi^0$$

Acceptance for $p\ \bar{p} \to \gamma\ \pi^0 \to \gamma\ \gamma\ \gamma$

p = 5 GeV/c

s = 12.25 GeV²

~ 45 %

p = 10 GeV/c

s = 20.25 GeV²
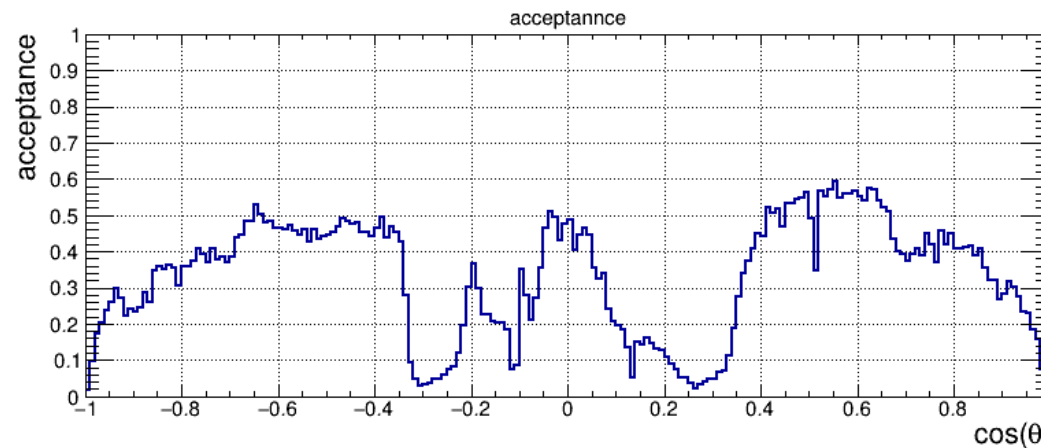
~ 45 %

➔ For a first iteration, a constant acceptance of 45 % is assumed.

Cross sections for

$$p\ \bar{p} \to \gamma\ \pi^0$$

P. Kroll, A. Schäfer, The process p p → γ π⁰ within the handbag approach, The European Physical Journal A 26, 89-98 (2005)

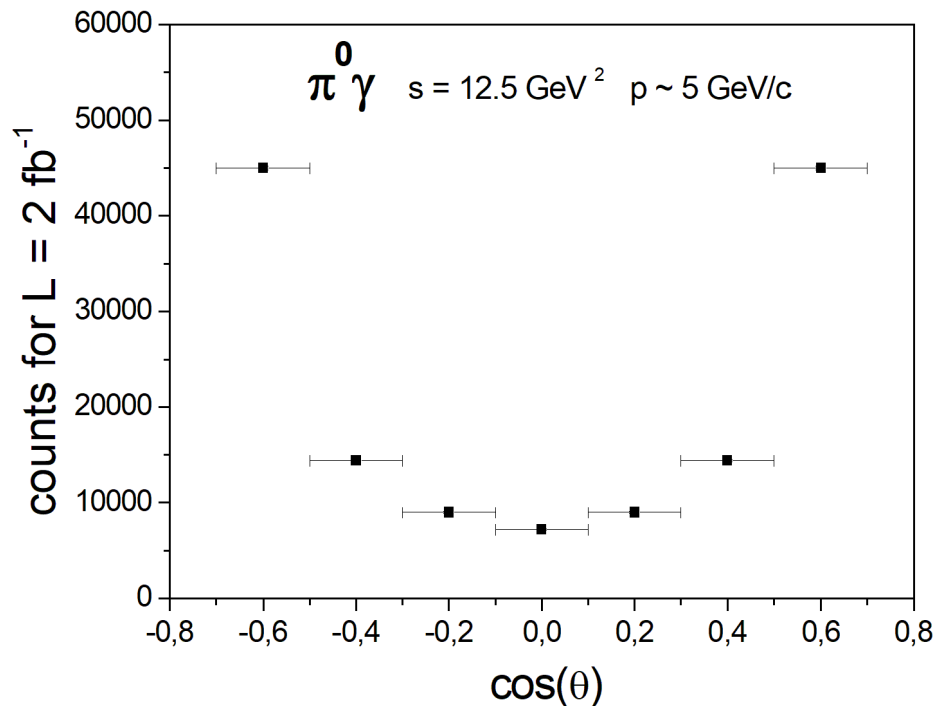→ Process at small s measured with the E760 experiment at Fermilab

$|\cos\theta| = 0$ to z_0, $z_0 = 0.5\ (0.6)$
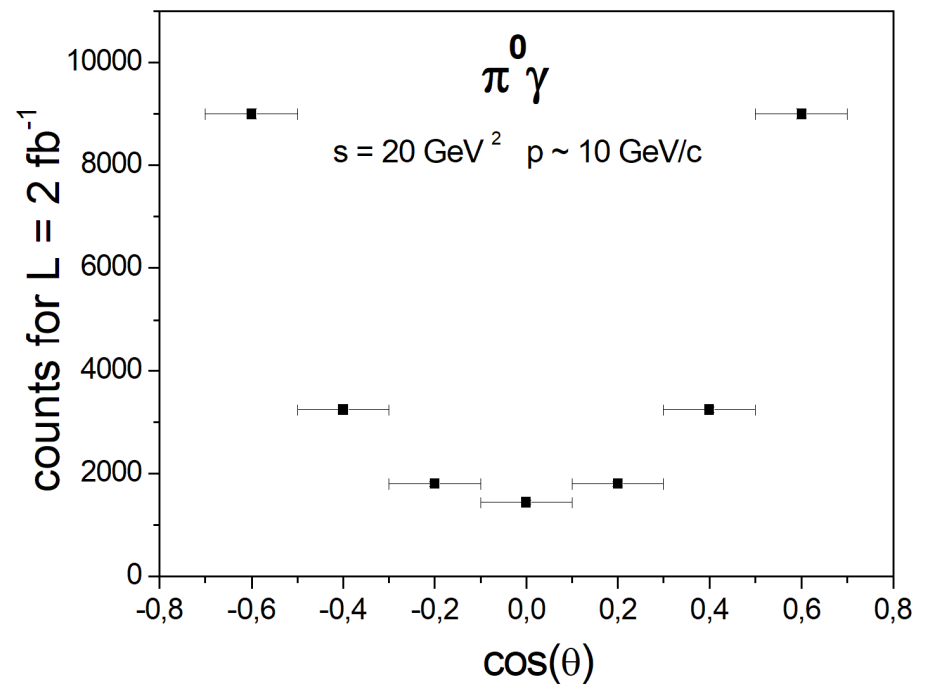
$\sigma(p\bar{p} \to \gamma\pi^0)$

E760

$\frac{d\sigma}{d\cos\theta}(p\bar{p} \to \gamma\pi^0)$

$s = 12.44\,\mathrm{GeV}^2$

$\frac{d\sigma}{d\cos\theta}(p\bar{p} \to \gamma\pi^0)$

$s = 20\,\mathrm{GeV}^2$

prediction for

p̄anda
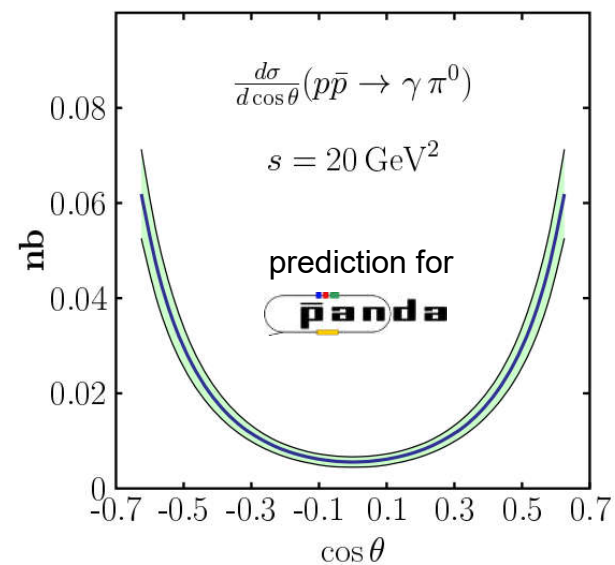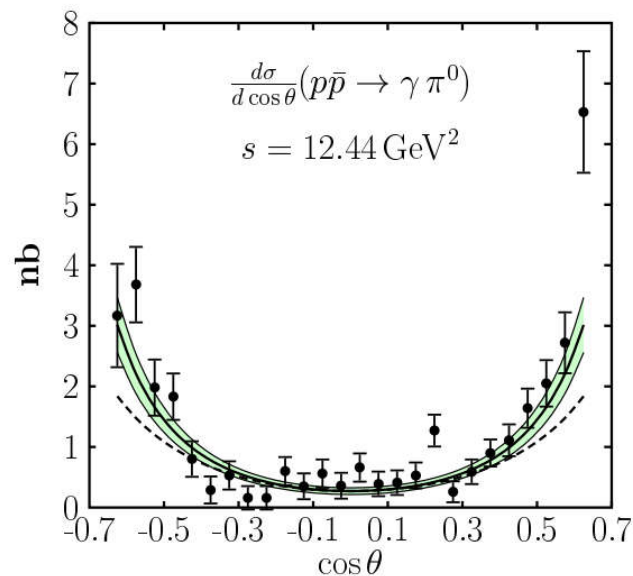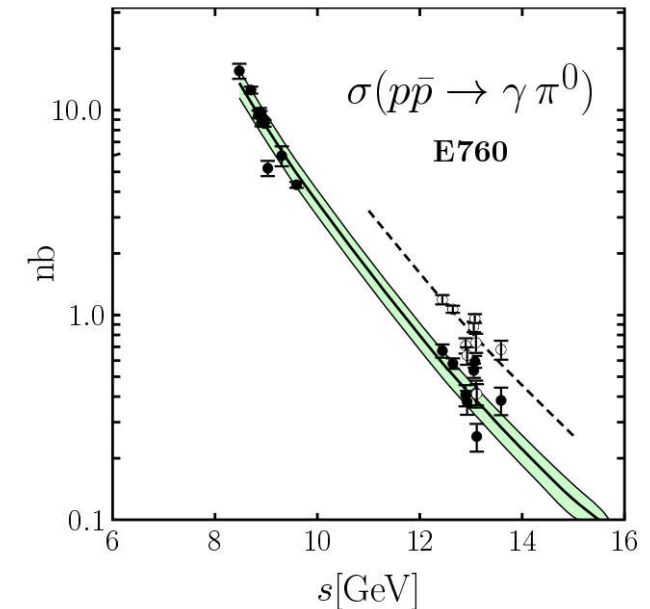
Acceptance for $p\ \bar{p} \rightarrow \gamma\ \pi^0 \rightarrow \gamma\ \gamma\ \gamma$

- L = 2 fb^{-1} → 1/2 year at the design luminosity

- Set the bin size to Δcos(θ) = 0.2

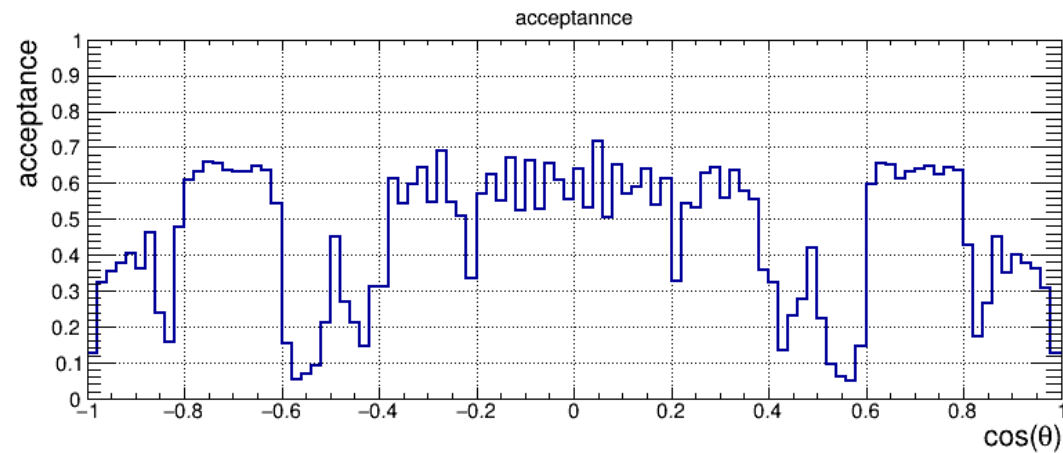dσ/σ = 0.5 − 1.2 %   dσ/σ = 1.1 − 2.6 %

→ Measurement well possible in half a year, even with 10 x lower luminosity

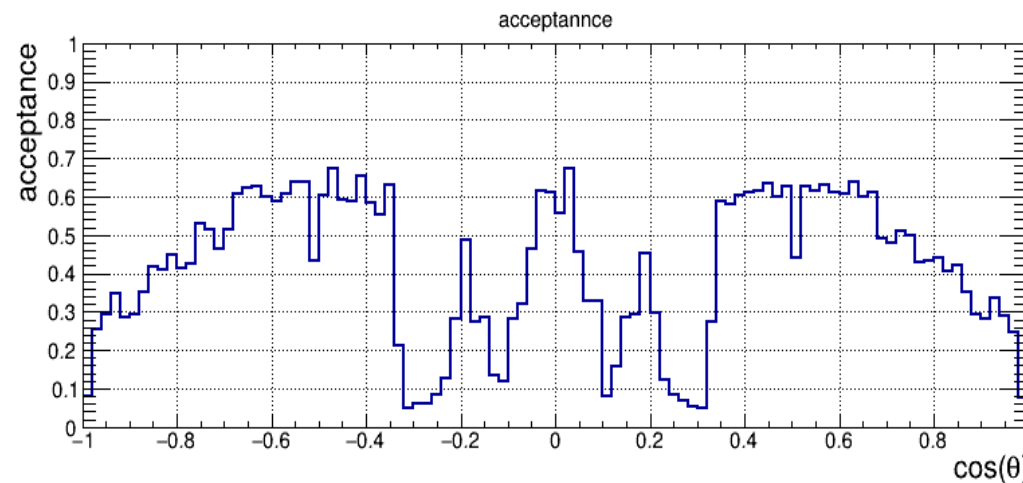→ Measurement is possible during phase 1 (L = 0.5 fb^{-1})

$$p\ \bar{p} \rightarrow \gamma\ \gamma$$

p = 5 GeV/c

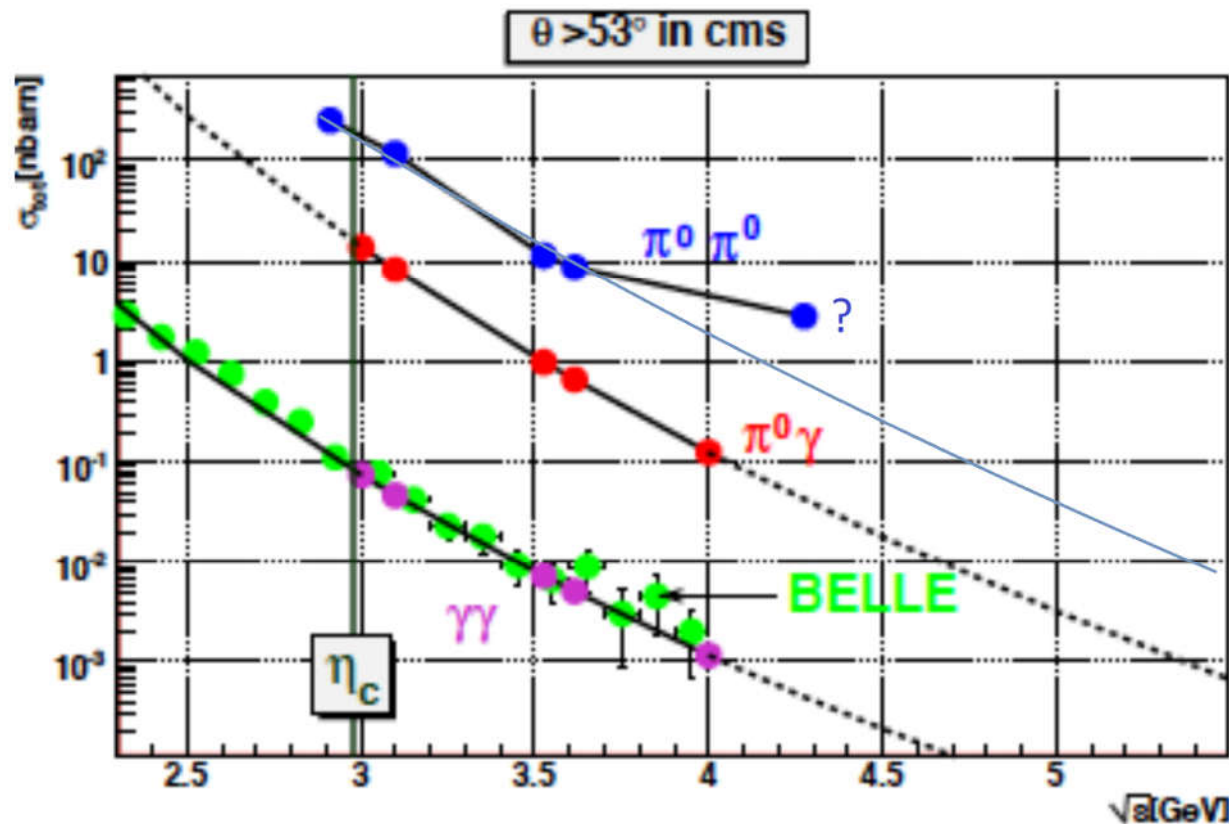**s = 12.25 GeV²**

~ 60 %

p = 10 GeV/c

s = 20.25 GeV²

~ 60 %

➔ For a first iteration, a constant acceptance of 60 % is assumed.

Cross sections for $p\,\bar{p} \to \gamma\,\gamma$

The process $\gamma\gamma \to B\overline{B}$ measured at BELLE

➔ Use symmetry relations to predict the cross sections of $p\,\bar{p} \to \gamma\,\gamma$

Cross section is two orders of magnitude lower than for

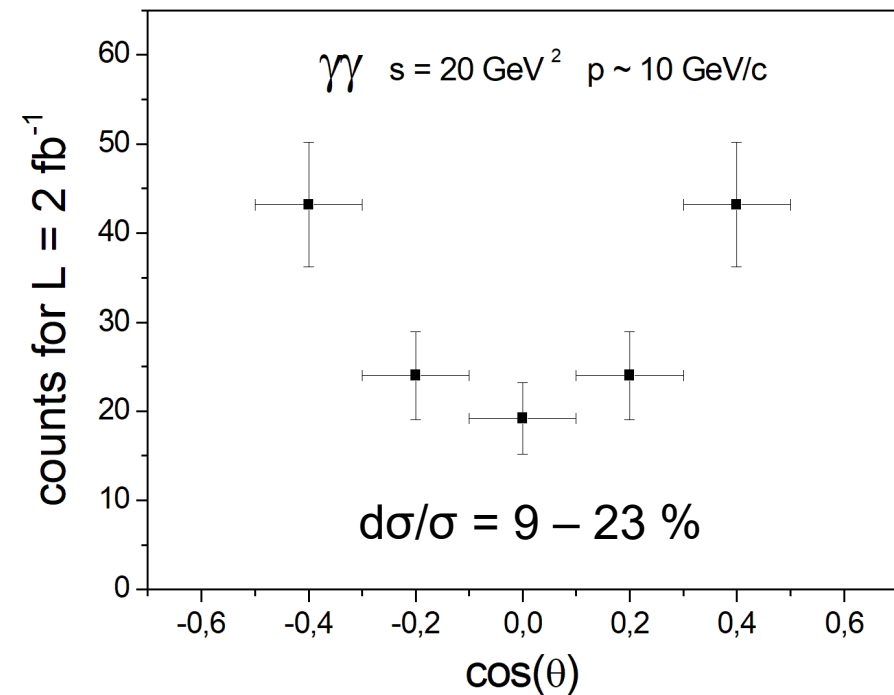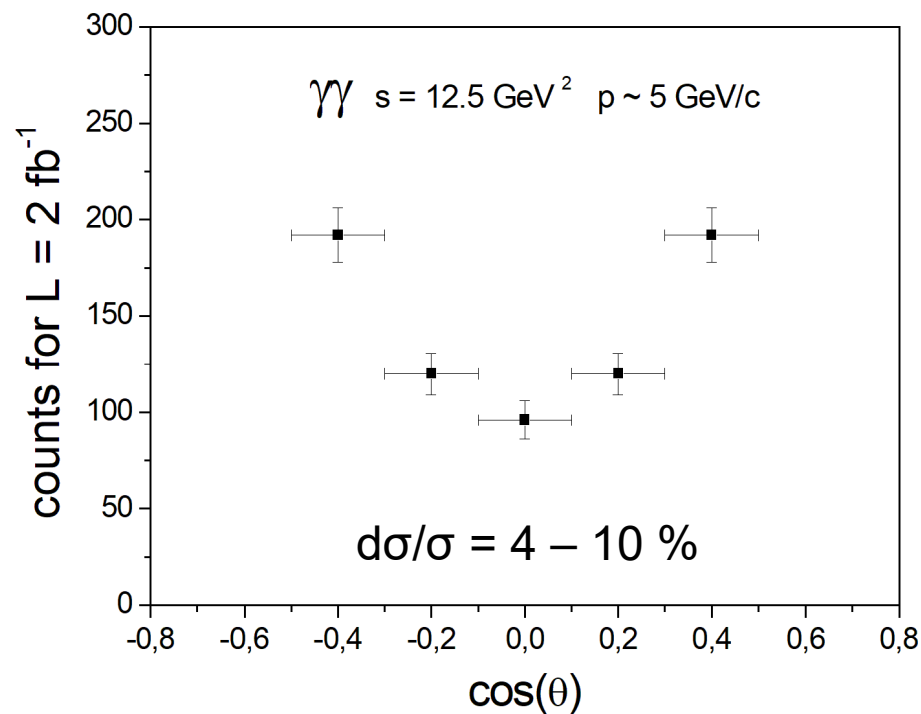$$p\,\bar{p} \to \gamma\,\pi^0$$

➔ Scale values down

➔ Adjust acceptance

$$p \ \bar{p} \rightarrow \gamma \ \gamma$$

- L = 2 fb^{-1} → 1/2 year at the design luminosity

- Set bin size to Δcos(θ) = 0.2

➔ Statistics of half a year at the design luminosity is required

➔ With a lower luminosity, the cos(θ) integrated cross section can be measured → phase 1

Summary and Outlook

➡ With an integrated luminosity of 2 fb^{-1} both channels can be measured

➡ For $\pi^0\gamma$ even a more than 10 times lower integrated luminosity
  is sufficient to get first results ➔ Study can be done during phase 1

➡ For $\gamma\gamma$ at least 2 fb^{-1} are needed (phase 2), but the $\cos(\theta)$ integrated cross
  section can be measured with lower integrated luminosities (phase 1)

➡ More detailed studies on the expected uncertainty of the cross section
  will be done, including the real acceptance, the effect of acceptance corrections,
  bin migration, …

➡ For the introduced channels with other mesons, no absolute cross sections
  are available so far, only normalized ratio predictions