Hard exclusive π^0 production in μp scattering at COMPASS

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on behalf of the COMPASS collaboration

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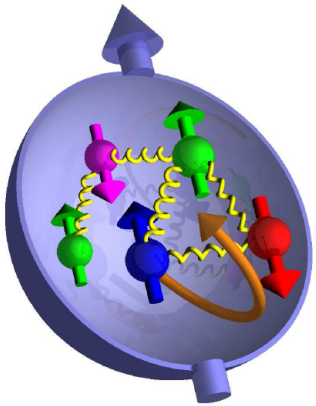
Nucleon spin & Hard Exclusive Meson Production

- Proton spin sum rule: $\frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g$

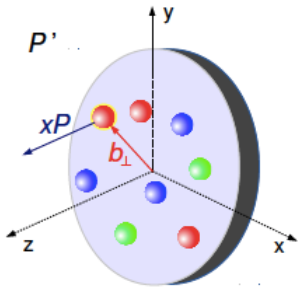
Jaffe&Manohar Nucl. Phys. B337 (1990)



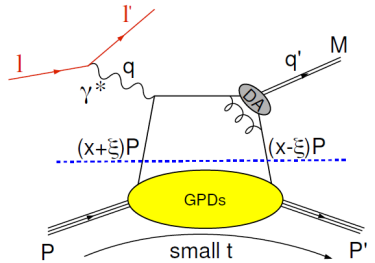
COMPASS experiment in μp DIS: $\Delta\Sigma = 0.32 \pm 0.03$
COMPASS Collaboration: Phys. Lett. B 693 (2010)

COMPASS, RHIC results: $\Delta G = 0.2^{+0.06}_{-0.07}$
de Florian et al.Phys.Rev.Lett. 113 (2014) no.1, 012001

Missing component: $L_{q,g} = ?? \rightarrow$ GPDs provides access



- GPDs encode the correlation between the longitudinal momentum of a parton and its position in the transverse plane
- Lepton-induced exclusive scattering processes as Deeply Virtual Compton Scattering (DVCS) or Hard Exclusive Meson Production (HEMP) give access to GPDs



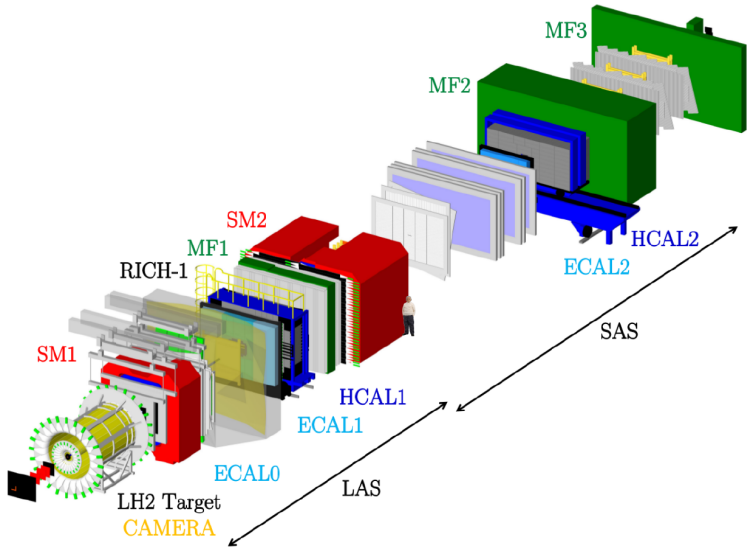
- COMPASS measured both reactions in 2012 and 2016/17 with 160 GeV/c muon beam (μ^+/μ^-)
- Exclusive π^0 production is main source of background for DVCS, it provides complementary information on GPD parametrization
- The unpolarised HEMP cross-section averaged over the two beam polarities:

$$\frac{d^2\sigma_{\gamma^* p}}{dt d\phi} = \frac{1}{2\pi}\left[\frac{d\sigma_T}{dt} + \epsilon\frac{d\sigma_L}{dt} + \epsilon\cos(2\phi)\frac{d\sigma_{TT}}{dt} + \sqrt{\epsilon(1+\epsilon)}\cos\phi\frac{d\sigma_{LT}}{dt}\right]$$

Experimental methodology

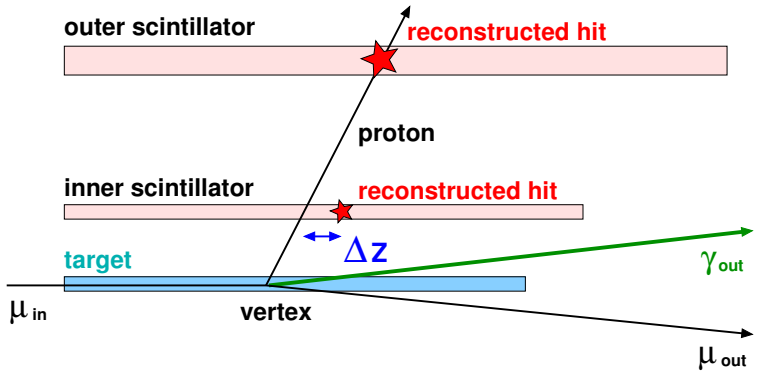
COMPASS experiment

- Two-stage magnetic spectrometer with large angular and momentum acceptance, using hadron and muon beams
- Particle identification: Electromagnetic and hadronic calorimeters, muon filters, Ring Imaging Cherenkov (RICH) detector
- Specific to GPD setup: Recoiled Proton Detector (RPD) and liquid hydrogen target



Event selection

- $1 < Q^2 < 5\ (\mathrm{GeV}/c)^2$, $8.5 < \nu < 28$ GeV, $0.08 < |t| < 0.64\ (\mathrm{GeV}/c)^2$, $0.01 < x_B < 0.15$
- π^0 selected by two-photon decay
- Interaction vertices reconstructed within the target
- Recoiling proton candidate measured in RPD
- As the kinematics is over-determined, we compare the proton observables reconstructed by the spectrometer alone with those measured in RPD
- Subtraction of semi-inclusive DIS background estimated from LEPTO simulation



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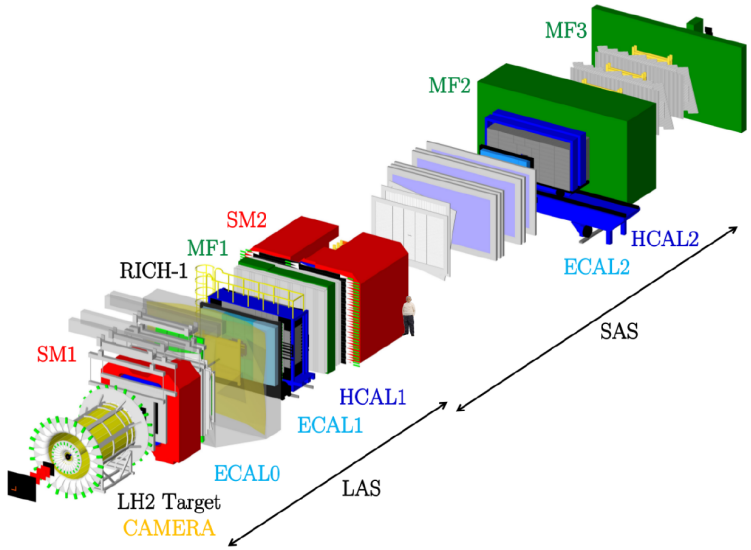

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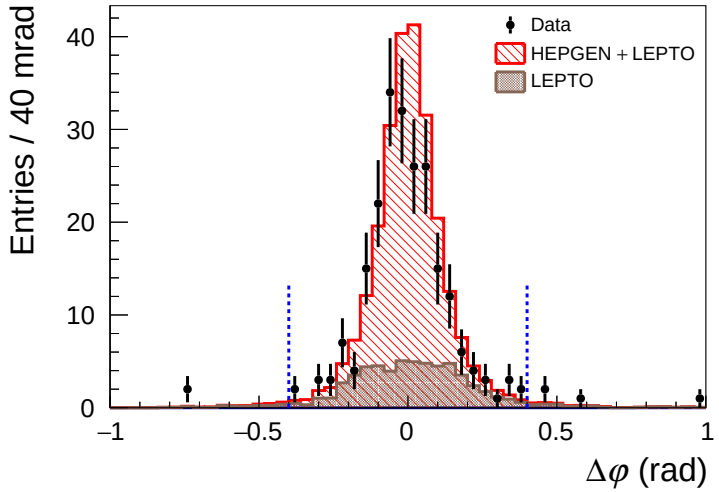

Results

2012 COMPASS results on t-dependence and ϕ-dependence of exclusive π^0 cross-section on unpolarised proton target:

- First results at $\langle x_B \rangle = 0.093$, input for constraining the phenomenological Goloskokov&Kroll model

Goloskokov S. and Kroll P., Eur. Phys. J. A **47** (2011) 112

$$\frac{\mathrm{d}\sigma_T}{\mathrm{d}t} + \epsilon\frac{\mathrm{d}\sigma_L}{\mathrm{d}t} = \left(8.1 \pm 0.9^{+1.1}_{-1.0}\right) \frac{\mathrm{nb}}{(\mathrm{GeV}/c)^2}$$

$$\frac{\mathrm{d}\sigma_{TT}}{\mathrm{d}t} = \left(-6.0 \pm 1.3^{+0.7}_{-0.7}\right) \frac{\mathrm{nb}}{(\mathrm{GeV}/c)^2}$$

$$\frac{\mathrm{d}\sigma_{LT}}{\mathrm{d}t} = \left(1.4 \pm 0.5^{+0.3}_{-0.2}\right) \frac{\mathrm{nb}}{(\mathrm{GeV}/c)^2}$$

Phys. Lett. B **805** 135454