MEASUREMENT OF THE PION POLARIZABILITIES AT COMPASS

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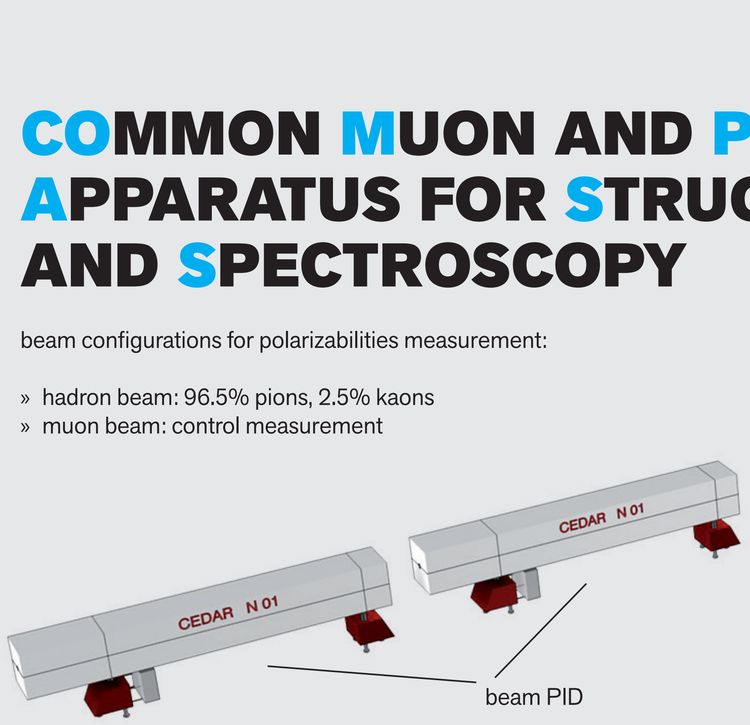
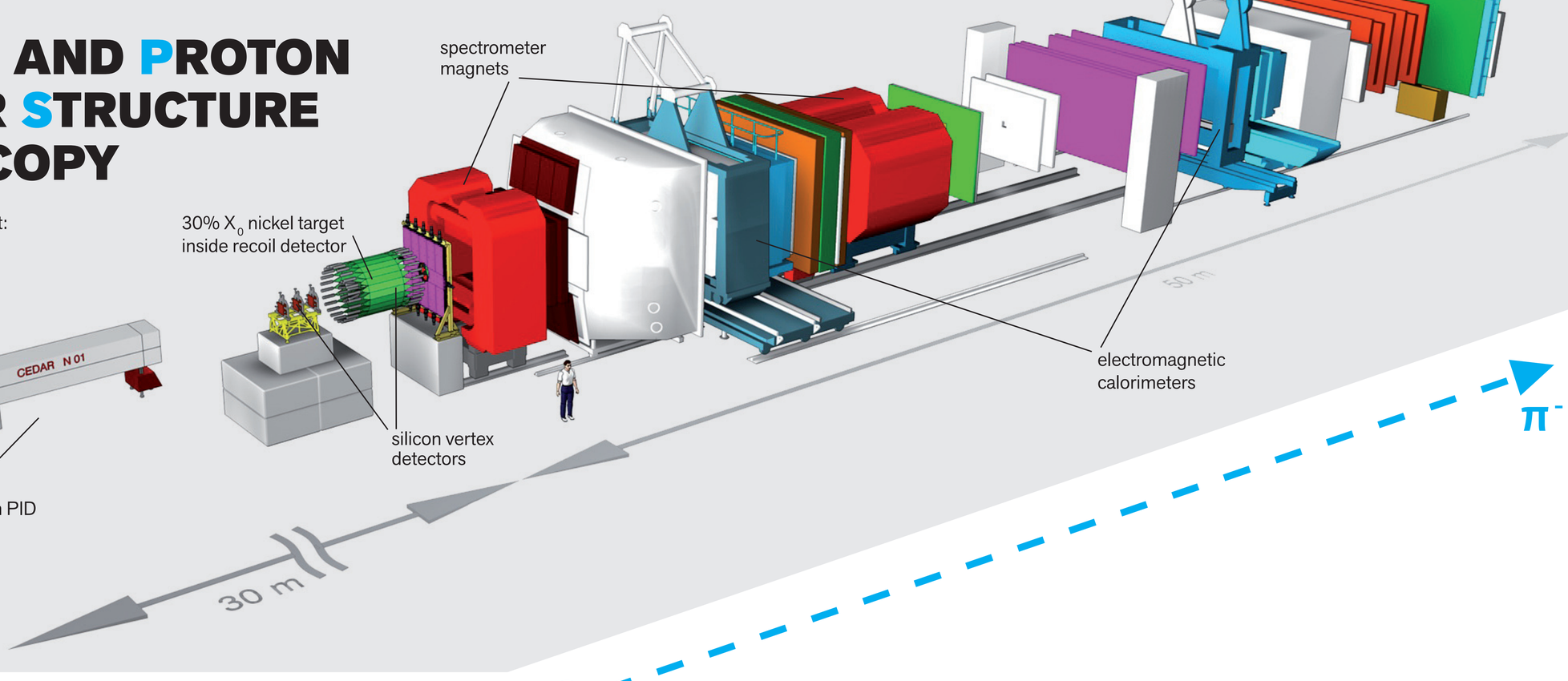
THE COMPASS COLLABORATION

COMMON MUON AND PROTON APPARATUS FOR STRUCTURE AND SPECTROSCOPY

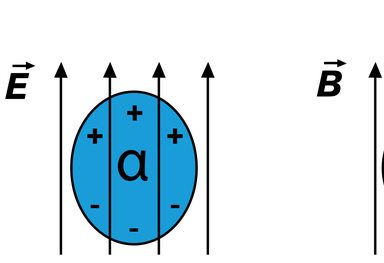
beam configurations for polarizabilities measurement:

» hadron beam: 96.5% pions, 2.5% kaons
» muon beam: control measurement





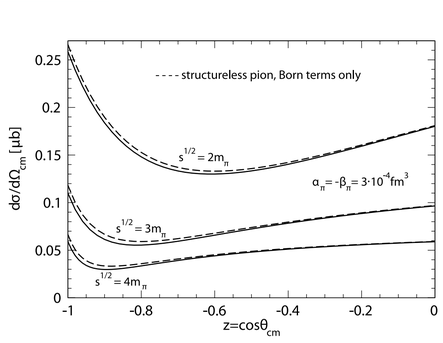
PION POLARIZABILITIES



χPT prediction for the pion as the Goldstone boson of chiral symmetry:

$$\alpha_\pi - \beta_\pi = 5.7 \pm 1.0 \times 10^{-4}\,\mathrm{fm}^3$$ (two loop calculation)

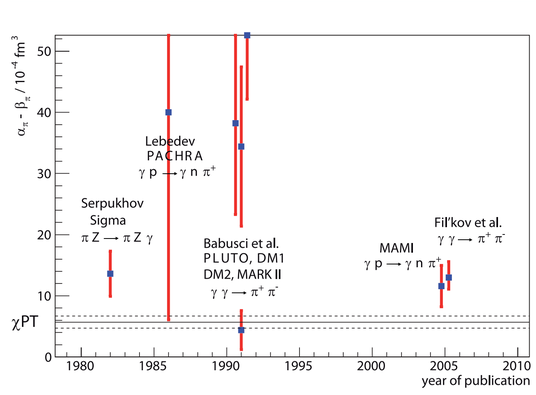
Gasser, Ivanov, Sainio, Nucl. Phys. B **745** (2006)



Kaiser, Friedrich, Eur. Phys. J. A **36**, 181-188 (2008)

Effect of the polarizabilities on the scattering cross section which may be leveraged to access $\alpha_\pi - \beta_\pi$.

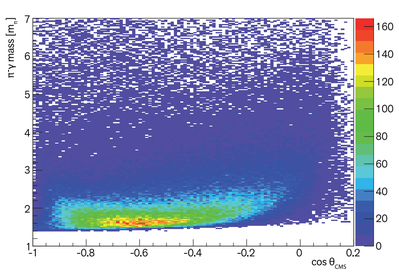
PREVIOUS MEASUREMENTS



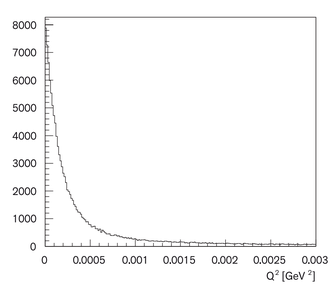
Almost all previous measurements are at variance with the χPT prediction.

SIMULATED DATA

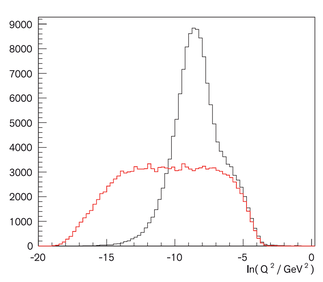
(analysis of 2009 data still ongoing)



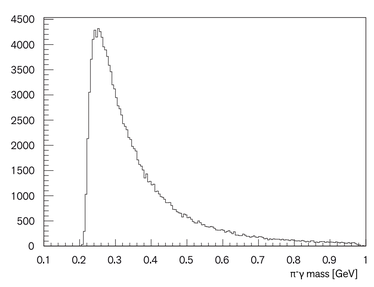
kinematic domain accessible by COMPASS displayed in center-of-momentum variables



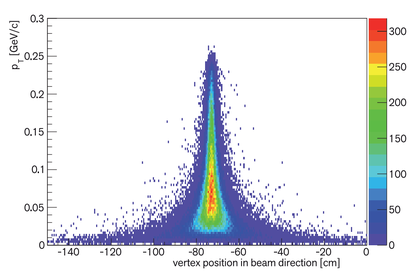
Electromagnetic interactions are identified by a sharp peak at very small Q^2.



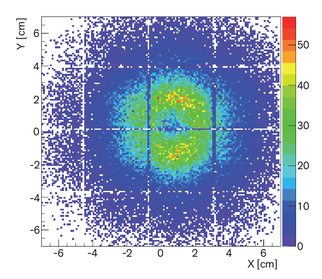
red: MC truth
black: MC reconstruction



$\pi^-\gamma$ final state mass



Longitudinal vertex resolution strongly depends on transverse momentum p_T.



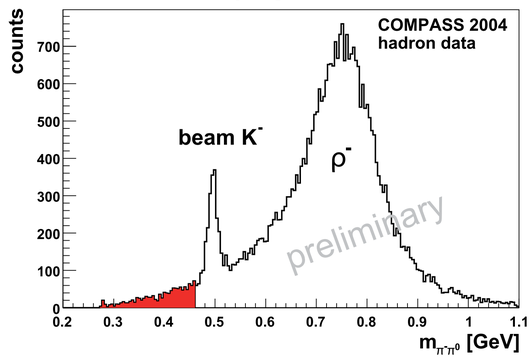
The largest fraction of Primakoff photons is deposited within 4×4 calorimeter blocks.

CHIRAL ANOMALY

Study of anomalous $\pi^- \pi^0$ production allows extraction of the $F^{3\pi}$ coupling constant.

» flux normalization through free decay of beam kaons
» inclusion of ρ contribution (new calculation upcoming)

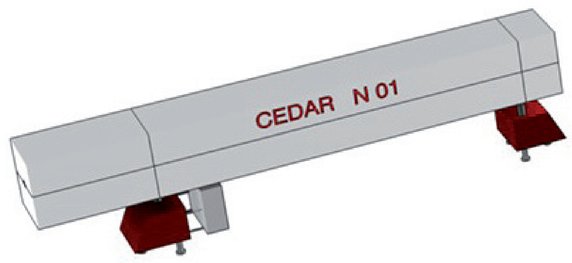
red: chiral anomaly region



OUTLOOK 2012

18 weeks of Primakoff data taking applied for:

» independent measurement of α_π and β_π
» determination of quadrupole polarizability term $\alpha_2 - \beta_2$
» measurement of kaon polarizabilities



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