

Pion Polarizabilities

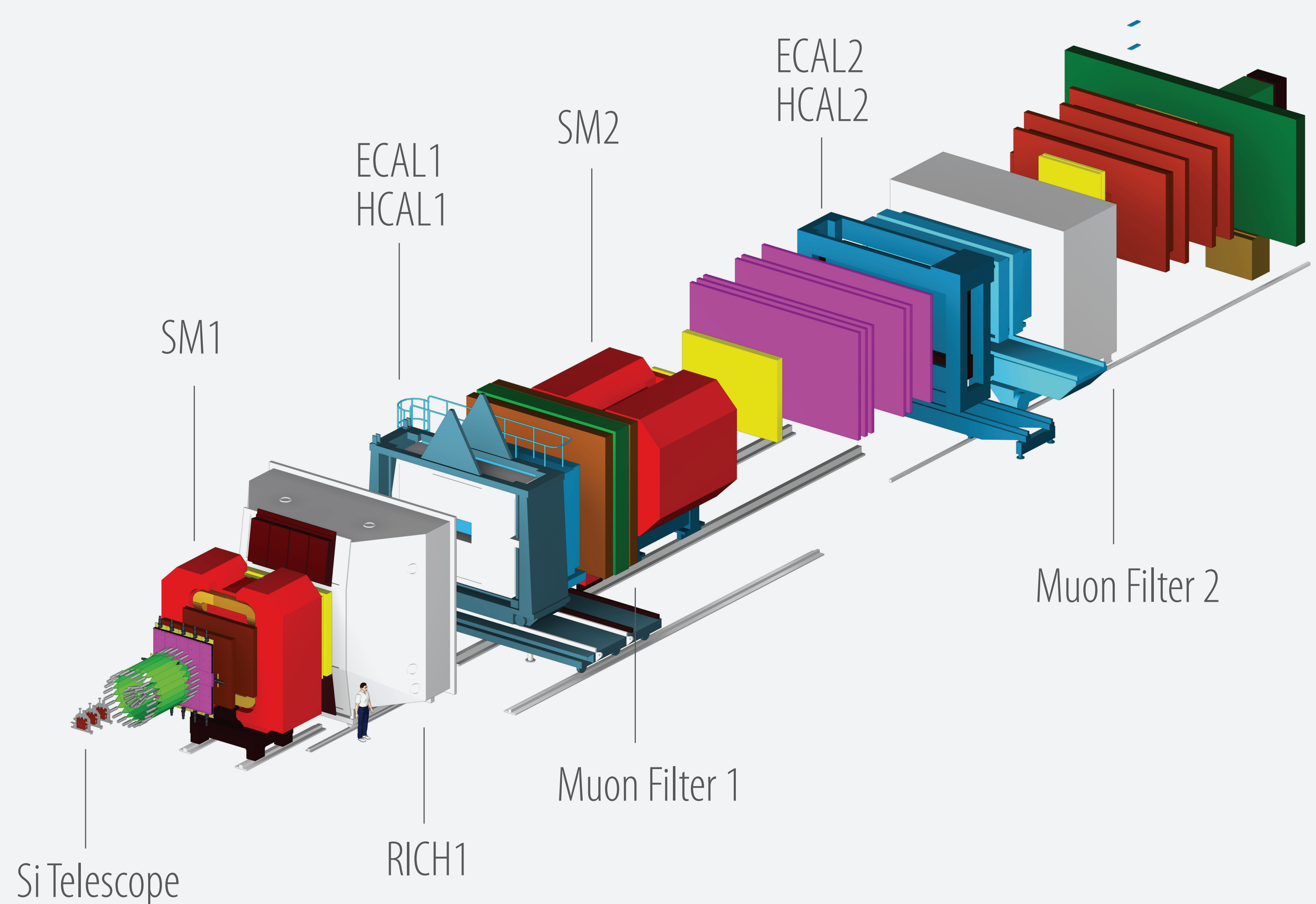
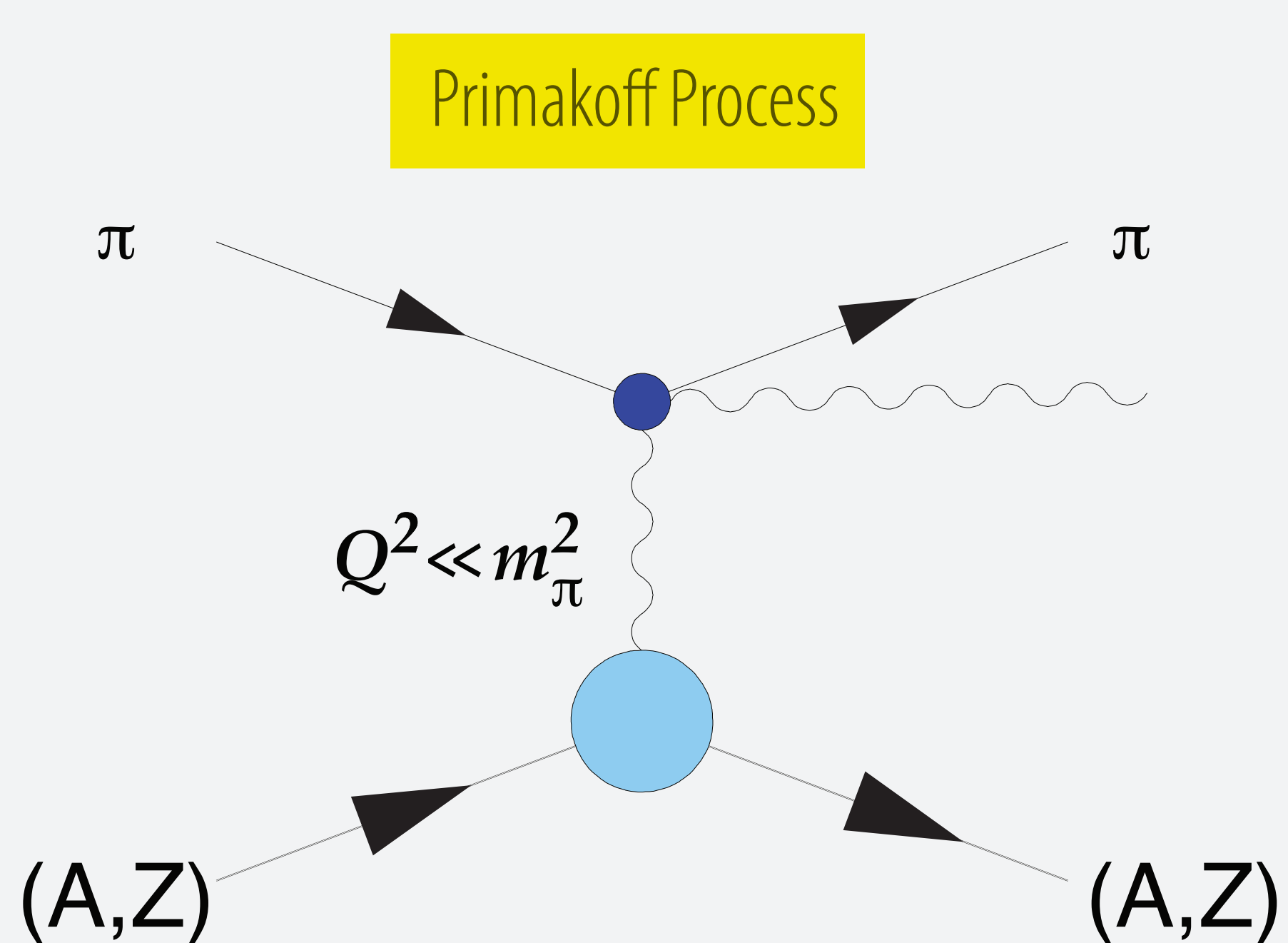
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The electric α_π and magnetic β_π charged pion Compton polarizabilities provide stringent tests of Chiral Perturbation Theory. The combination $(\alpha_\pi - \beta_\pi)$ was measured at CERN COMPASS via radiative pion Primakoff scattering (190 GeV/c pion Bremsstrahlung) in the nuclear Coulomb field:

$\pi + Z \rightarrow \pi + Z + \gamma$. COMPASS data analysis gives a value: $\alpha_\pi = -\beta_\pi = (1.9 \pm 0.7_{\text{stat.}} \pm 0.8_{\text{sys.}}) \times 10^{-4} \text{ fm}^3$.

The data were taken in 2009. Higher statistics data taken in 2012 will allow an independent determination of α_π and β_π , and a first determination of Kaon polarizabilities.



- Identify $\pi \text{ Ni} \rightarrow \pi \text{ Ni} \gamma$ exclusive reactions at smallest momentum transfer $< 0.001 \text{ GeV}^2/c^2$

- Assuming $\alpha_\pi + \beta_\pi = 0$, the dependence on $x_\gamma = E_\gamma / E_{\text{beam}}$

$$R = \frac{\sigma(x_\gamma)}{\sigma_{\alpha_\pi = 0}(x_\gamma)} = 1 - \frac{3}{2} \cdot \frac{m_\pi^3}{\alpha} \cdot \frac{x_\gamma^2}{1 - x_\gamma} \alpha_\pi$$

is used to determine the polarizability α_π

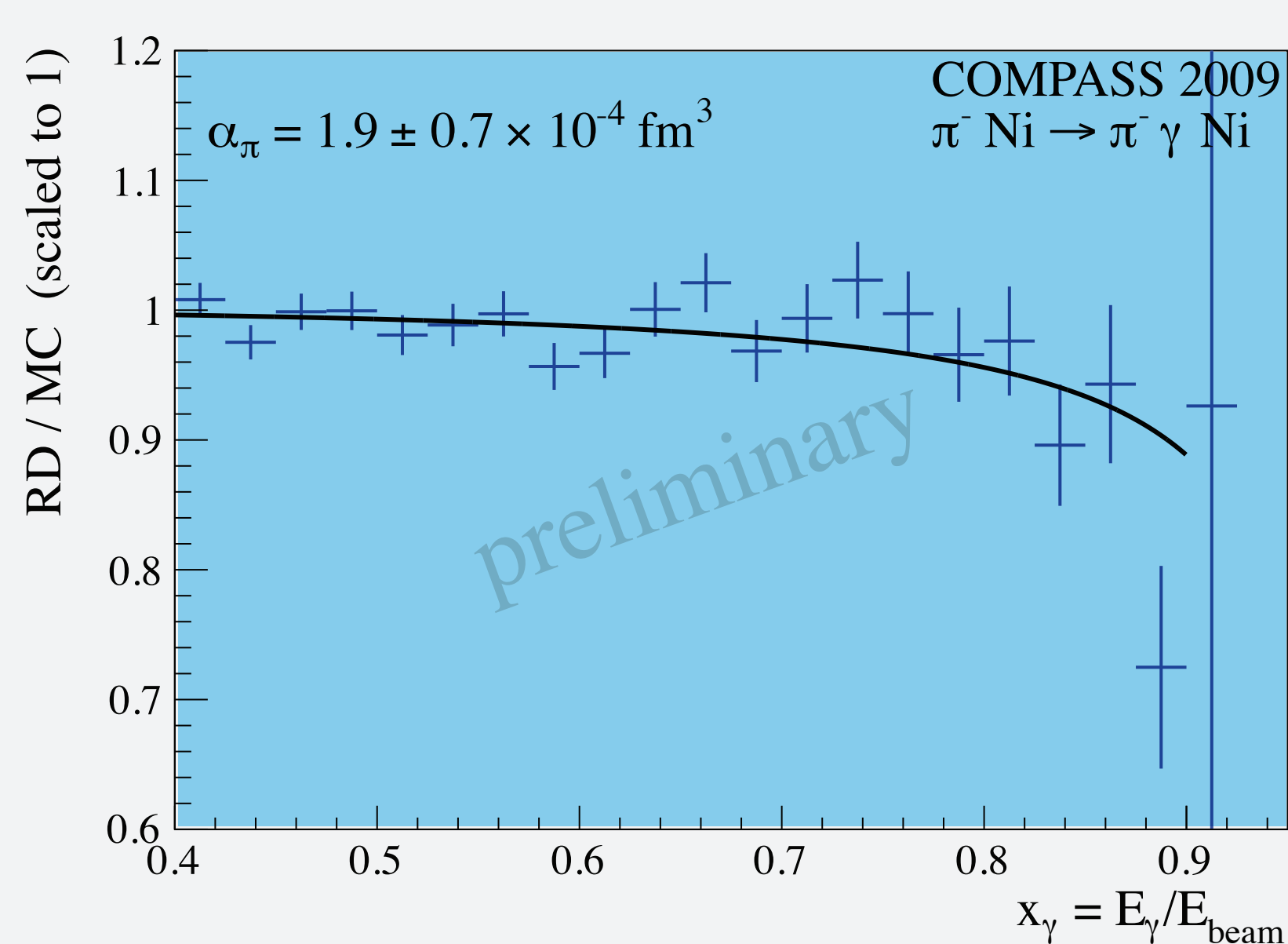
- Control systematics by investigating $\mu \text{ Ni} \rightarrow \mu \text{ Ni} \gamma, K^- \rightarrow \pi^- \pi^0$

Runs with Hadron Beams 2004, 2008/09, 2012

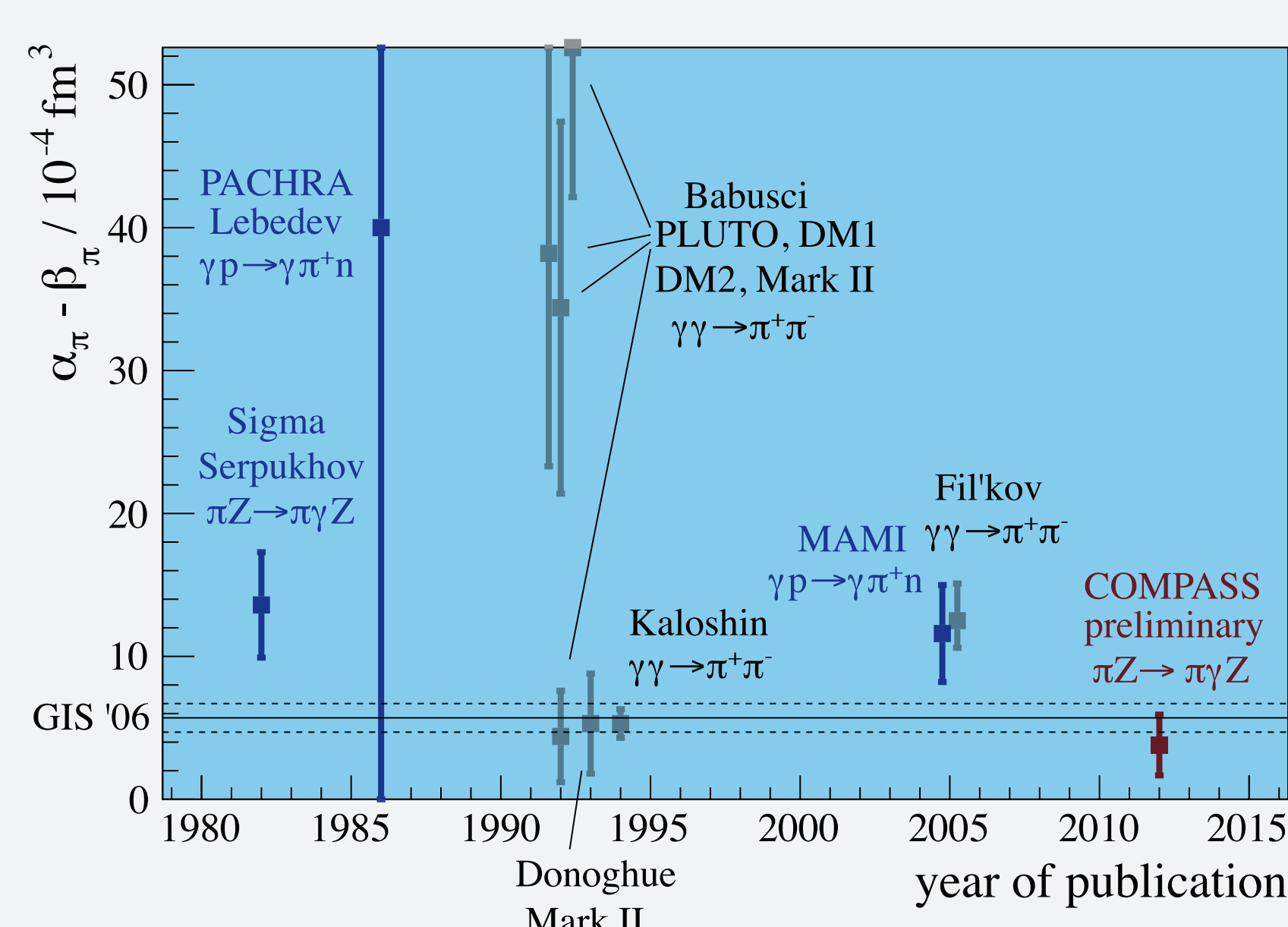
- 190 GeV π^- beam on nuclear targets
- Tracking: SMD for vertexing
- Trigger: Multiplicity trigger, (digital) ECAL trigger

Fixed-target experiment

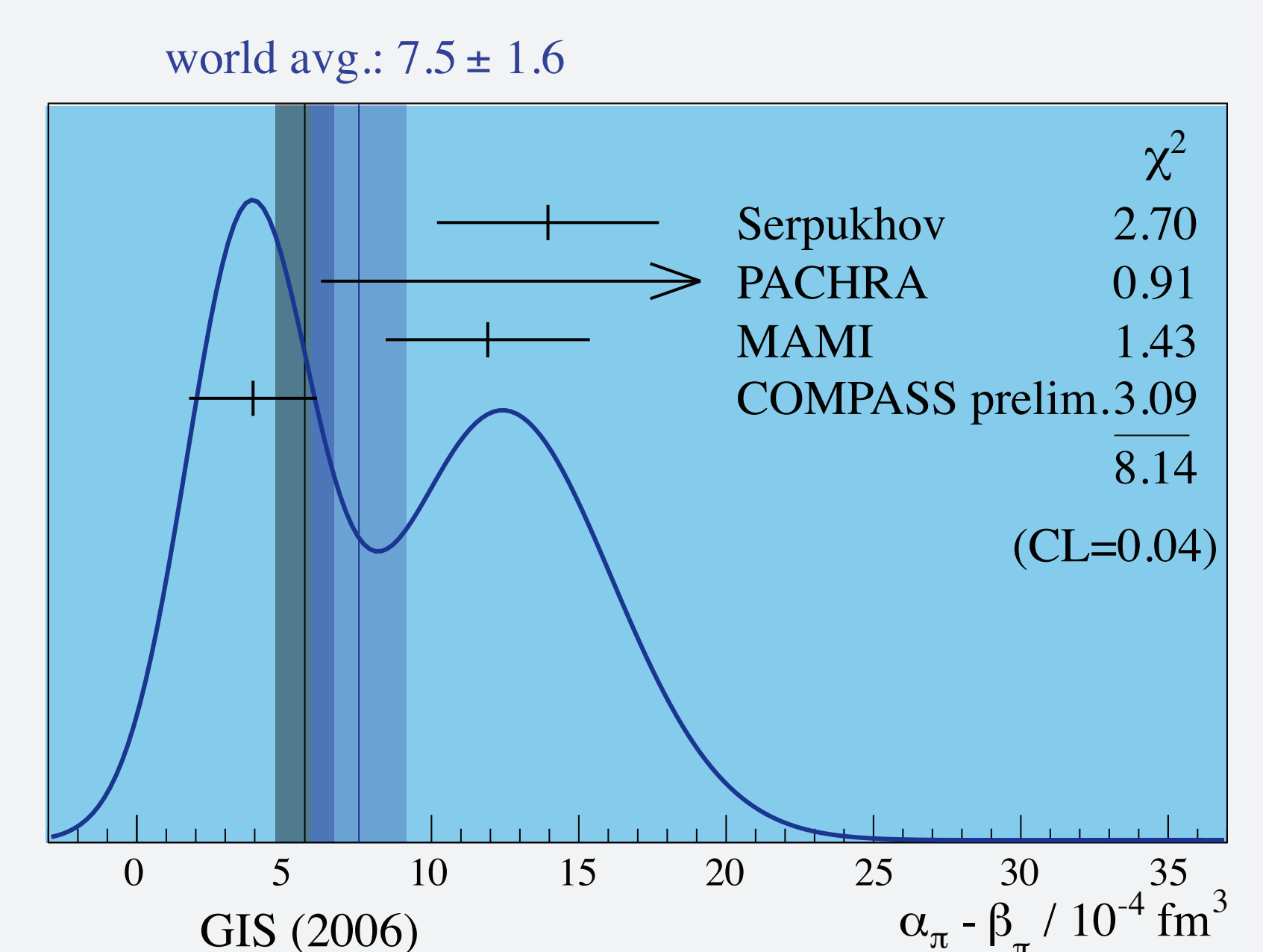
- Two-stage magnetic spectrometer
- High-precision, high-rate tracking, PID, calorimetry



Polarizability fit to the x_γ distribution of the ratio of real data (RD) to a Monte Carlo (MC) simulation with zero polarizabilities.



Overview of polarizability measurements; GIS'06 ChPT $\alpha_\pi - \beta_\pi = (5.7 \pm 1.0) \times 10^{-4} \text{ fm}^3$



PDG style ideogram of polarizability data