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Measurements of Polarization of Λ in Inelastic Scattering by HERMES

HERMES の非弾性散乱におけるラムダ粒子の偏極度の測定

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HERMES
Phys. Rev. D90 (2014) 072007 Transverse polarization of Lambda hyperons from quasi-real photoproduction on nuclei

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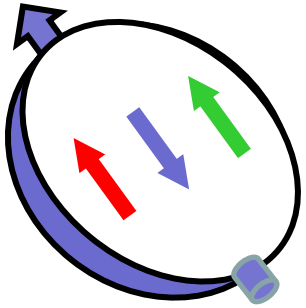
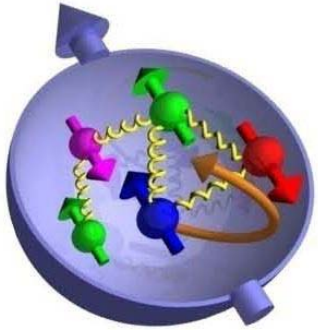
1. Introduction

■ Spin Structure of the Nucleon



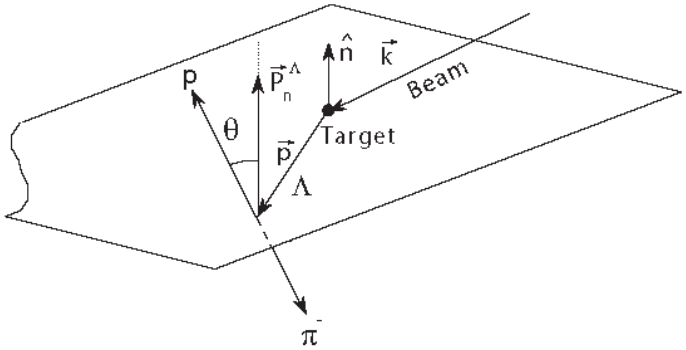


Longitudinally polarized beam

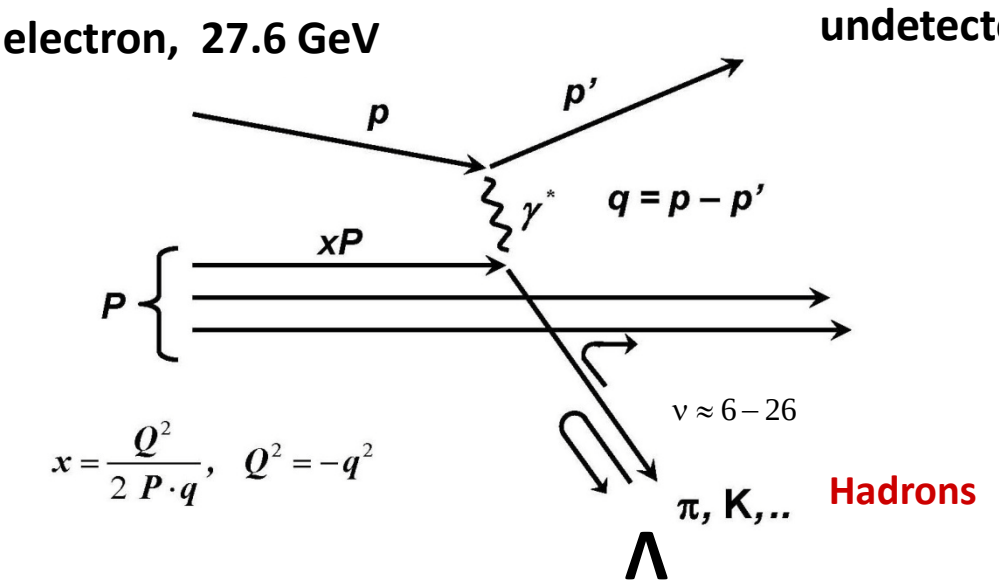
Longitudinally/transversely polarized target

■ Hadronization of Λ and Nuclear Effects

Polarization of Λ



Electron Inelastic Scattering



Typical cuts when electron is detected:

$Q^2 > 1\ \mathrm{GeV}^2$, $W > 3.3$ GeV,

$0.023 < x < 0.6$, $0.2 < y < 0.85$

$z > 0.2$, $x_F > 0.2$, $1 < P_h < 15$ GeV

Electrons are not detected:

$Q^2 \approx 0$ **Quasi-real photons**

$\nu = 6 - 26$ GeV, $< \nu >$ = 16 GeV

$\gamma^* N$

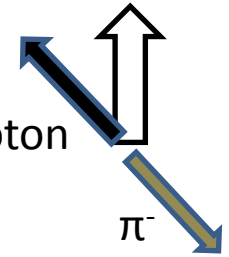
Λ decay, Angular distribution

$$\frac{dN}{d\Omega} = \frac{dN_0}{d\Omega}(1 + \alpha P^{\Lambda} \cos\theta)$$

Proton angle

$$\alpha = 0.642 \pm 0.013 \quad \text{(PDG)}$$

Analyzing power



Transverse Polarization P^{Λ}, HERMES $\gamma^* N$

Λ	0.078 ±0.006 ±0.012	HERMES
$\bar{\Lambda}$	- 0.025 ±0.015 ±0.018	Phys. Rev. D76 (2007) 092008

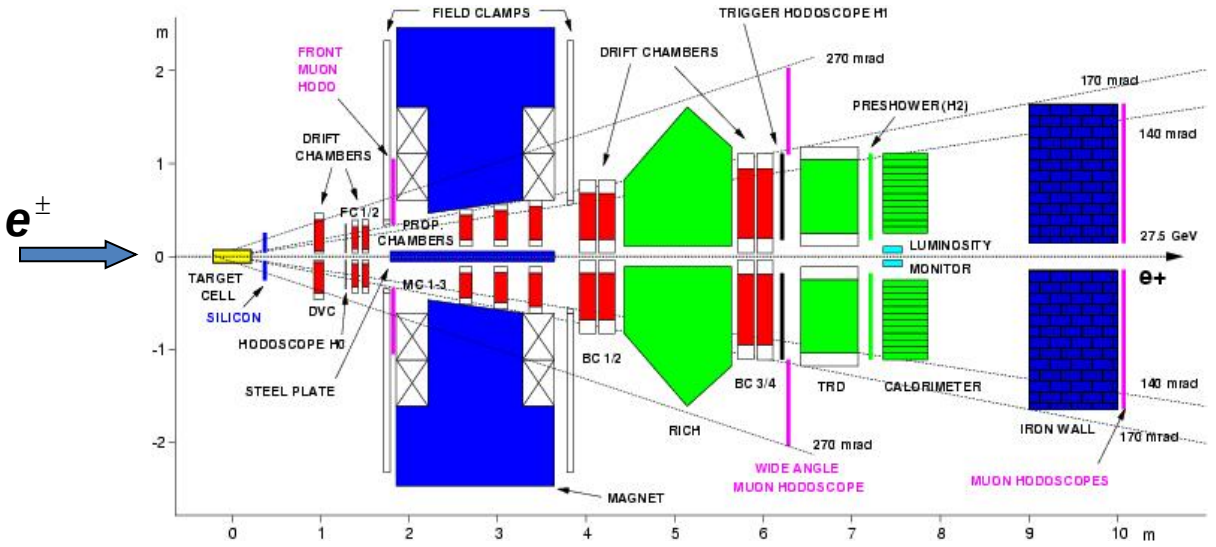
1976－ Λ production, Transverse Polarization

p + A, p + p, ….

2. HERMES Experiment

at DESY－HERA

E_e = 27.6 GeV



Internal gas target: H, D, He, Ne, Kr, Xe

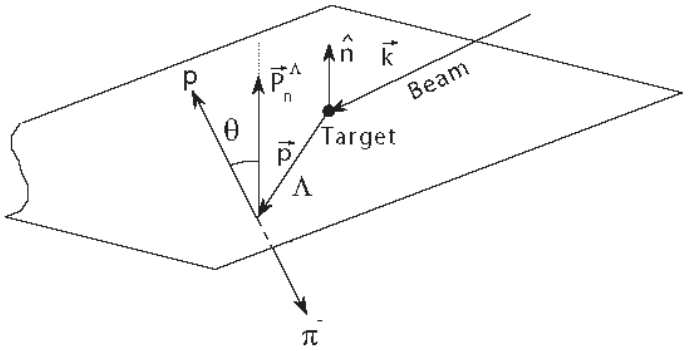
Acceptance:

< 170 mrad horizonatally,

40-140 mrad vertically

Λ Program at HERMES

Unpolarized beam and target



Longitudinally polarized electron beam

Electron

Virtual photon

Target nucleon

Λ

Transverse polarization of Lambda hyperons from quasireal photoproduction on nuclei,
A. Airapetian et al, Phys. Rev. D 90 (2014) 072007

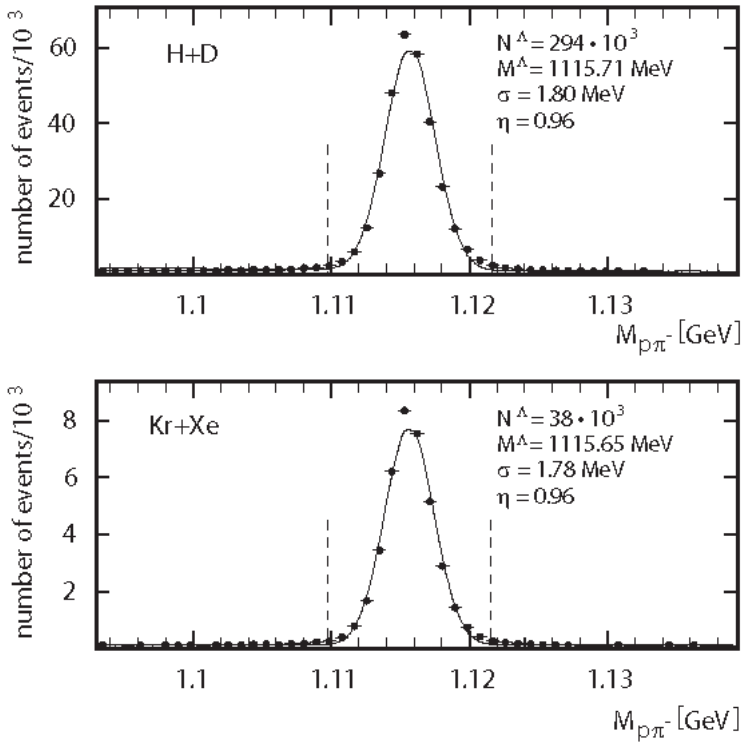
Transverse Polarization of Lambda and Lambda-bar Hyperons in Quasi-Real Photon-Nucleon Scattering at HERMES,
A. Airapetian et al, Phys. Rev. D76 (2007) 092008

Longitudinal Spin Transfer to the Lambda Hyperon in Semi-Inclusive Deep-Inelastic Scattering,
A. Airapetian et al, Phys. Rev. D 74 (2006) 072004

Measurement of Longitudinal Spin Transfer to Lambda Hyperons in Deep Inelastic Lepton Scattering,
A. Airapetian et al, Phys.Rev. D64 (2001) 112005

Data Analysis

Identification of Λ $p\,\pi^-$ reconstruction

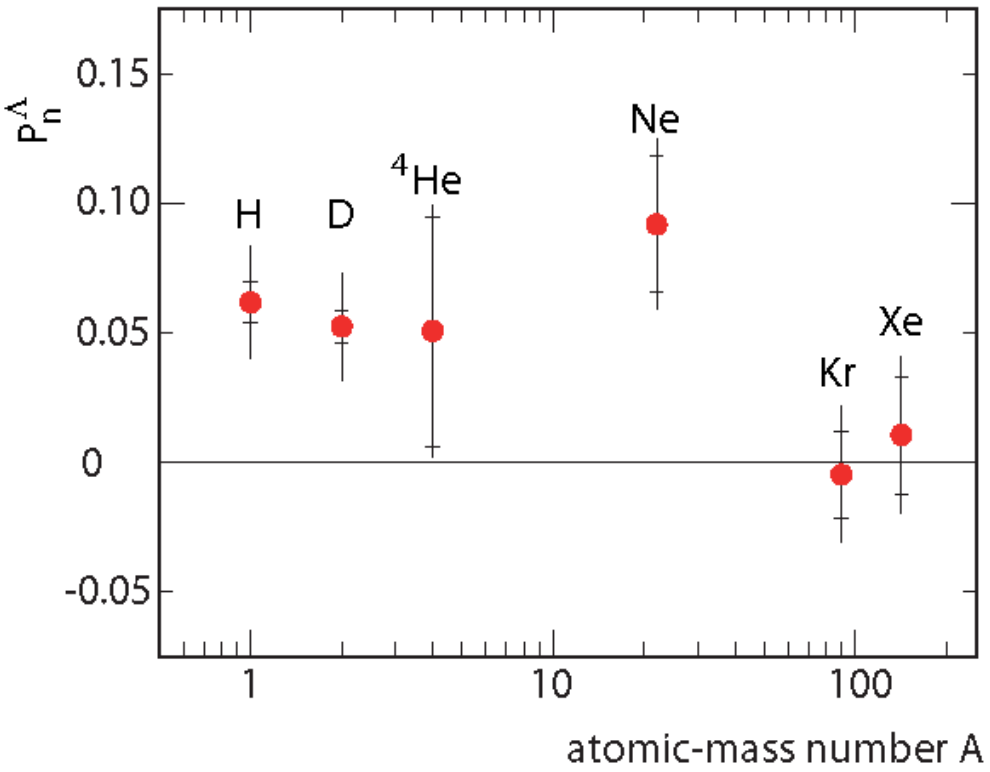


Gaussian + second-order Polynomial

Good agreement with
1115.683 ± 0.006 MeV (PDG)

Events are selected with ±3.3 σ cut

3. Results of Polarization of Λ



Positive polarization for H, D, ^{4}He and Ne

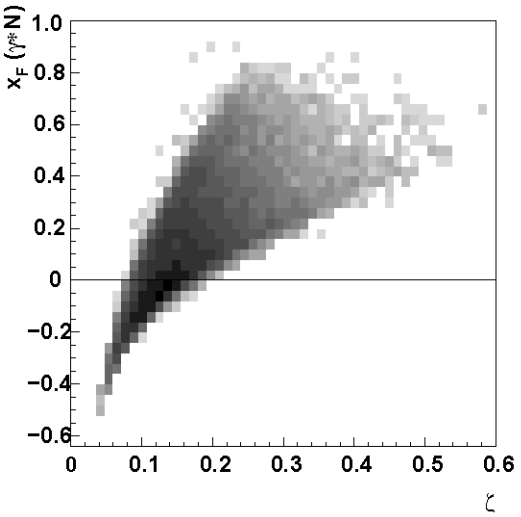
Nearly zero polarization for Kr and Xe

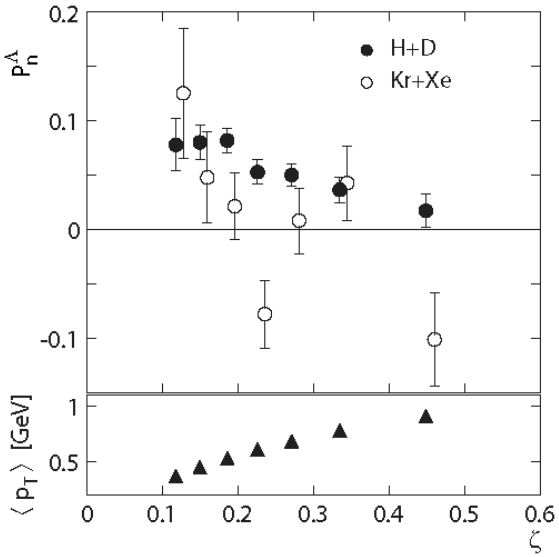
$$\varsigma = \frac{E_\Lambda + p_{z\Lambda}}{E_e + p_e}$$

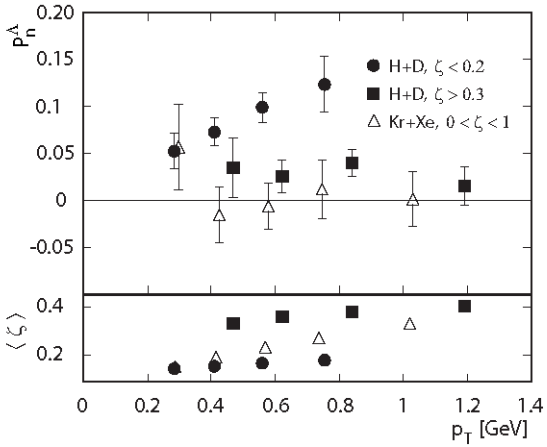
$E_\Lambda, p_{z\Lambda}$: produced Λ

$E_e,\ p_e$: electron beam

Fraction of the beam electron's light-cone momentum carried by the outgoing Λ







Correlation between ς and X_F(γ*N)

ς dependece

p_T dependece

PYTHIA Monte Carlo simulation

4. Summary

-- HERMES is an electron scattering experiment at DESY-HERA

-- Electron/positron beam energy is 27.6 GeV.

-- Internal gas targets H, D, ^{4}He, Ne, Kr, and Xe were used.

-- Quasi-real photoproduction of Λ was used: $Q^2 \approx 0$

-- Transverse polarization of produced Λ was measured using Parity-violating weak decay.

Transverse polarization is positive for H, D, ^{4}He and Ne while it is nearly zero for Kr and Xe.

-- These results, together with the results from hadron beam experiments, will be useful inputs to theoretical studies.