Possible Future Fixed-Target DIS experiments at DESY

- Present fixed-target experiment: HERMES
- With polarized target and polarized beam
  $\Rightarrow$ Spin structure of nucleon
- HERMES has approved programme $\rightarrow \approx$ 2005
- Immediate future: talk by W-D.Nowak on Monday

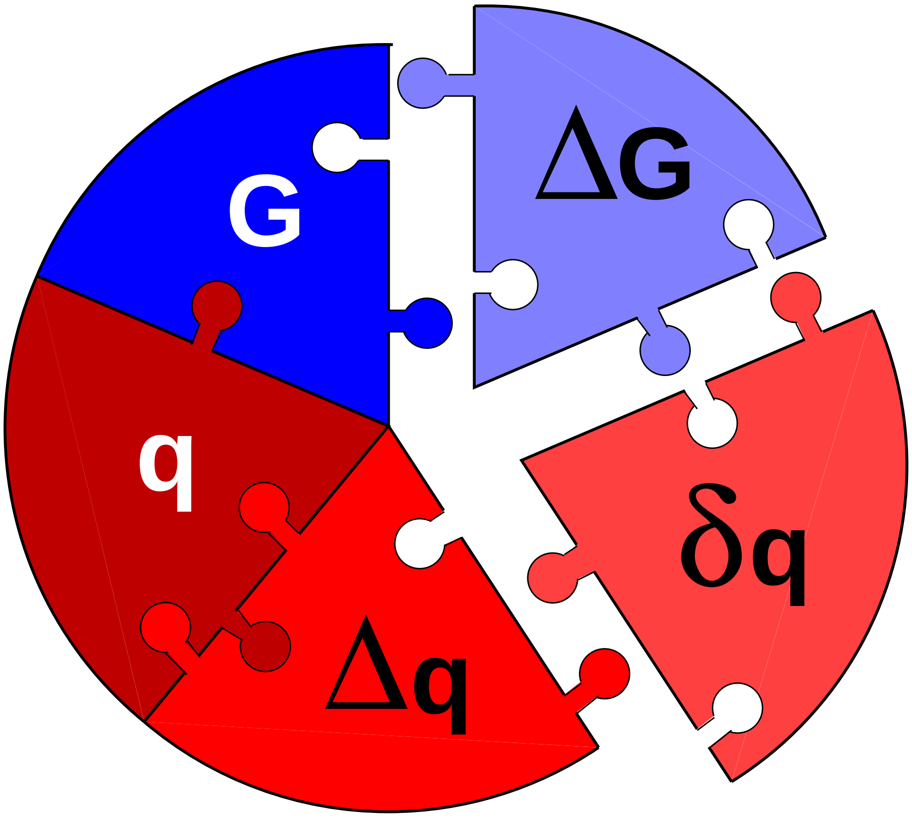
Long term future connected to TESLA proposal

- 500 GeV linear electron-positron collider
- March 2001: Technical Design Report presented

  - Appendices: 4 additional particle-physics projects
  - $\rightarrow$ 2 with fixed-target

Parton Distribution Functions

At leading twist in pQCD:

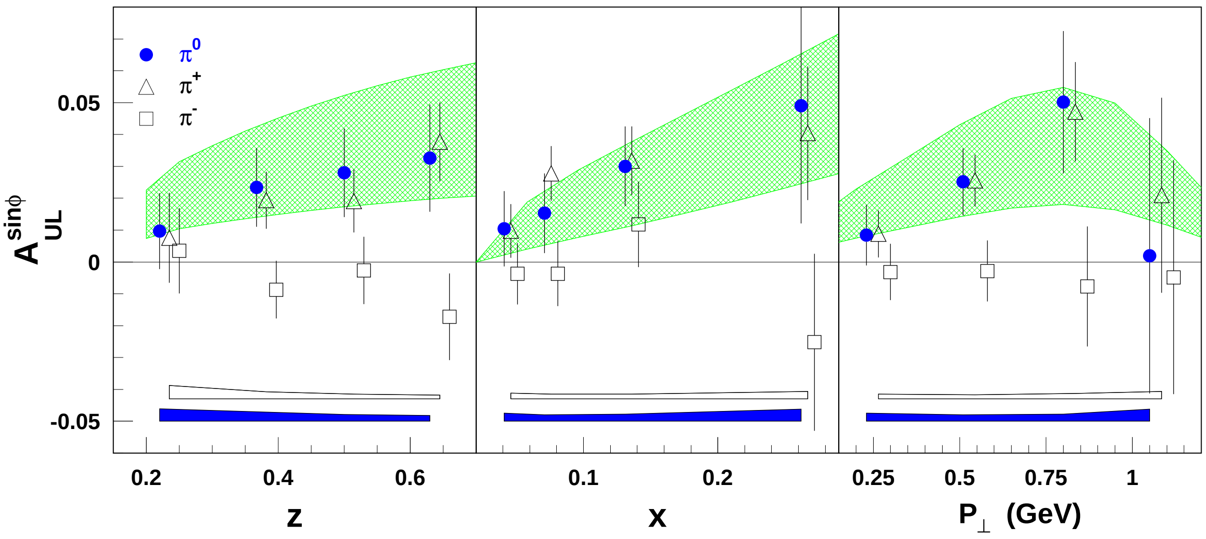


q	quark momentum distribution
Δq	quark helicity distribution
δq	quark transversity distribution
G	gluon momentum distribution
ΔG	gluon polarization

$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g = J_q + J_g$$

$\delta q, \Delta G, L_q, L_g$ all essentially undetermined

Transversity



Single (target-)spin azimuthal asymmetry in semi-inclusive π-production (talk by D.Hasch; theory talks)

Shows window on transversity structure function δq

▷ Essentially unknown leading twist parton distribution function.

▷ Disconnects from *gluons*

▷ Relation to *tensor charge*

- present HERMES: longitudinal target polarization
- planned HERMES: transverse target polarization
- on the menu for COMPASS, RHIC

$\Rightarrow$ will yield first information on $\delta u_v(x)$

Gluon polarization

Direct measurement of ΔG:

- Pairs of high-$p_\perp$ hadrons
- Open charm production

Proceeding through photon-gluon fusion

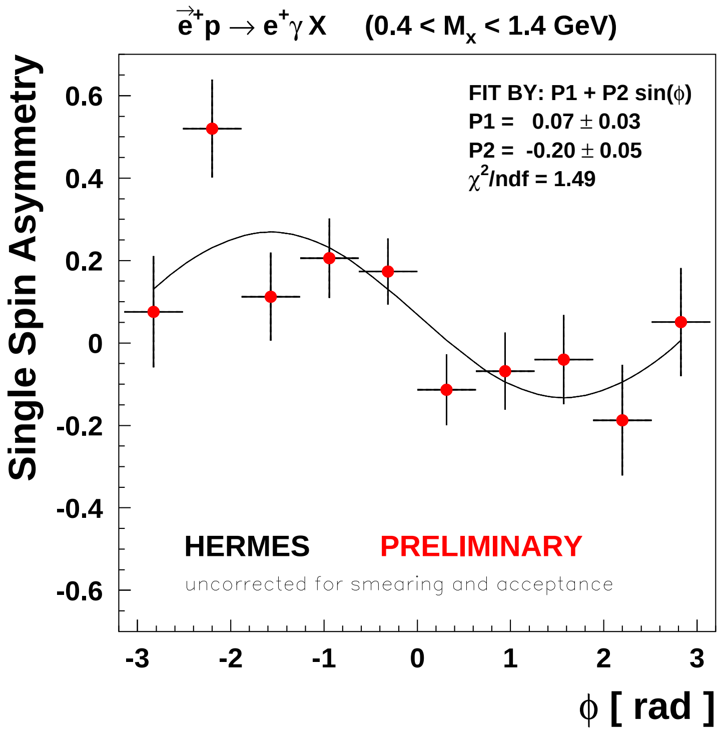
$\triangleright$ First indication from HERMES
$\triangleright$ Better data expected from COMPASS: high beam energy extremely useful
$\triangleright$ Also better data expected from RHIC

Indirect measurement of ΔG:

- from QCD (NLO) fits to Q^2-evolution of $g_1(x, Q^2)$

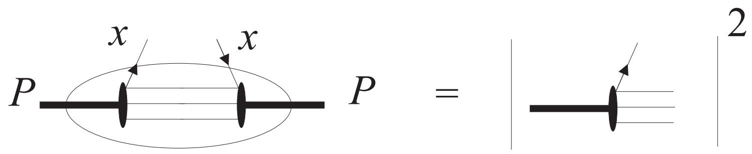
High accuracy, high beam energy necessary

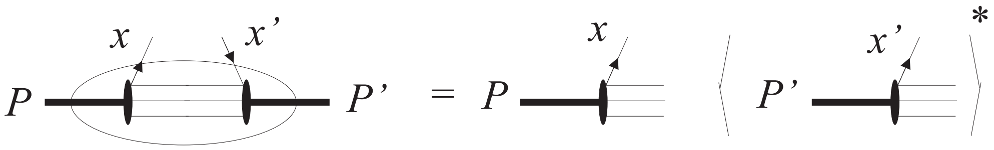
Skewed Parton Distributions



Single (beam-)spin azimuthal asymmetry in DVCS (talk by J.Volmer; theory talks)

Shows window on exclusive reactions ⇒ SPD's





▷ Sum-rule (X.Ji): possible road to J_q, J_g

Skewed Parton Distributions

- Need high resolution to distinguish exclusive channels
- High beam energy not necessary: cross sections drop of very fast with Q^2
- Need high luminosity

- HERMES: plans for recoil detector to improve resolution
  $\rightarrow$ still relatively low luminosity
- JLAB: upgrade in energy

2 Proposals

TESLA-N

- Use one (positron) arm of TESLA for polarized fixed target experiment
- Beam energy varied between 30 - 250 GeV
- Use large kinematic domain for Q^2 evolution studies

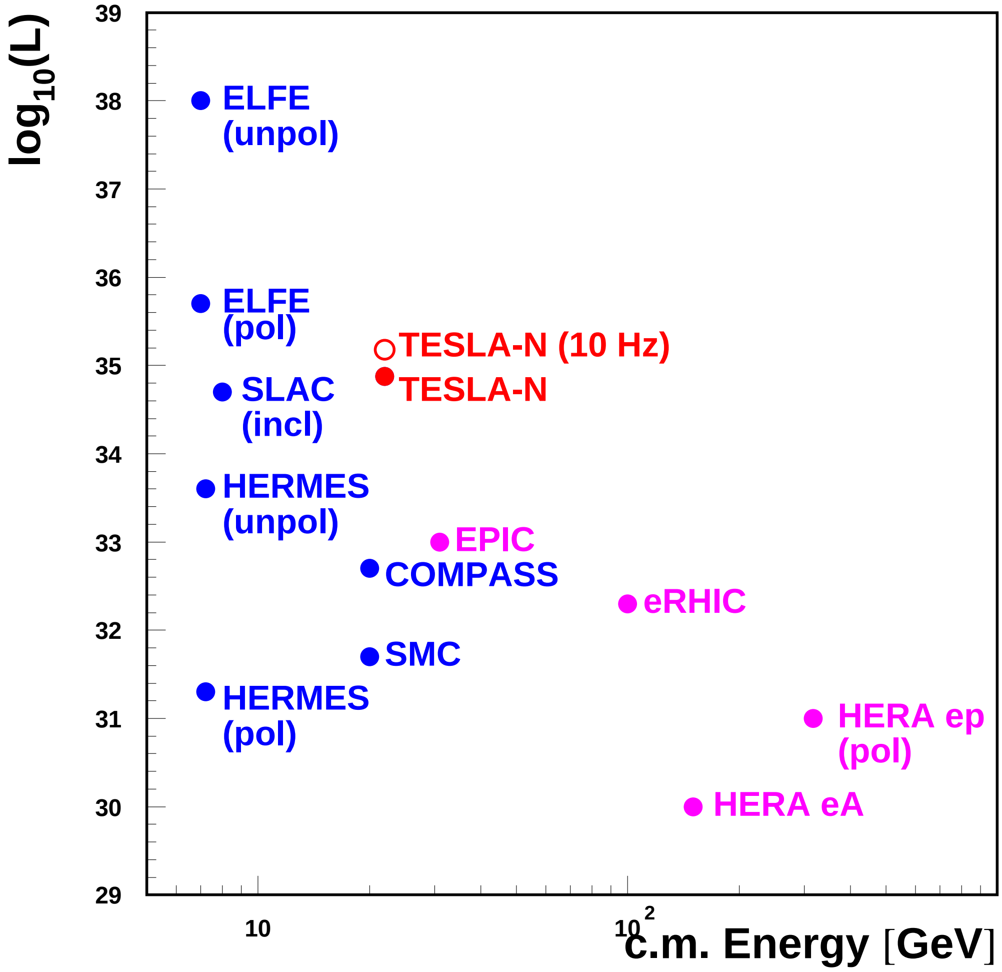
- Transversity distribution
- Gluon polarization

ELFE

- Inject electron beam @ 30 GeV in modified HERA-e
- Use HERA as stretcher ring $\Rightarrow$ extract high dutyfactor beam
- Fully exploit high resolution for exclusive reactions

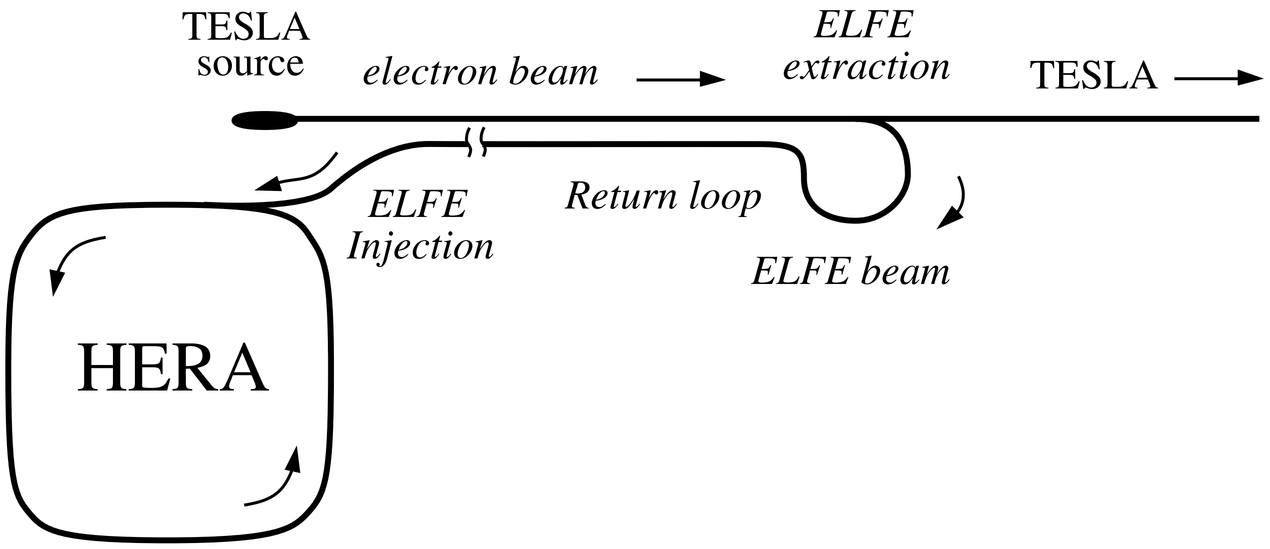
- Skewed Parton Distributions
- High precision exclusive reactions

Luminosity - Energy



- $\mathcal{L}$(TESLA-N) factor 50 higher than COMPASS
- $\mathcal{L}$(ELFE) of 10^{38} only possible with dedicated small acceptance spectrometers
- Fixed target-experiments have large dilution factors

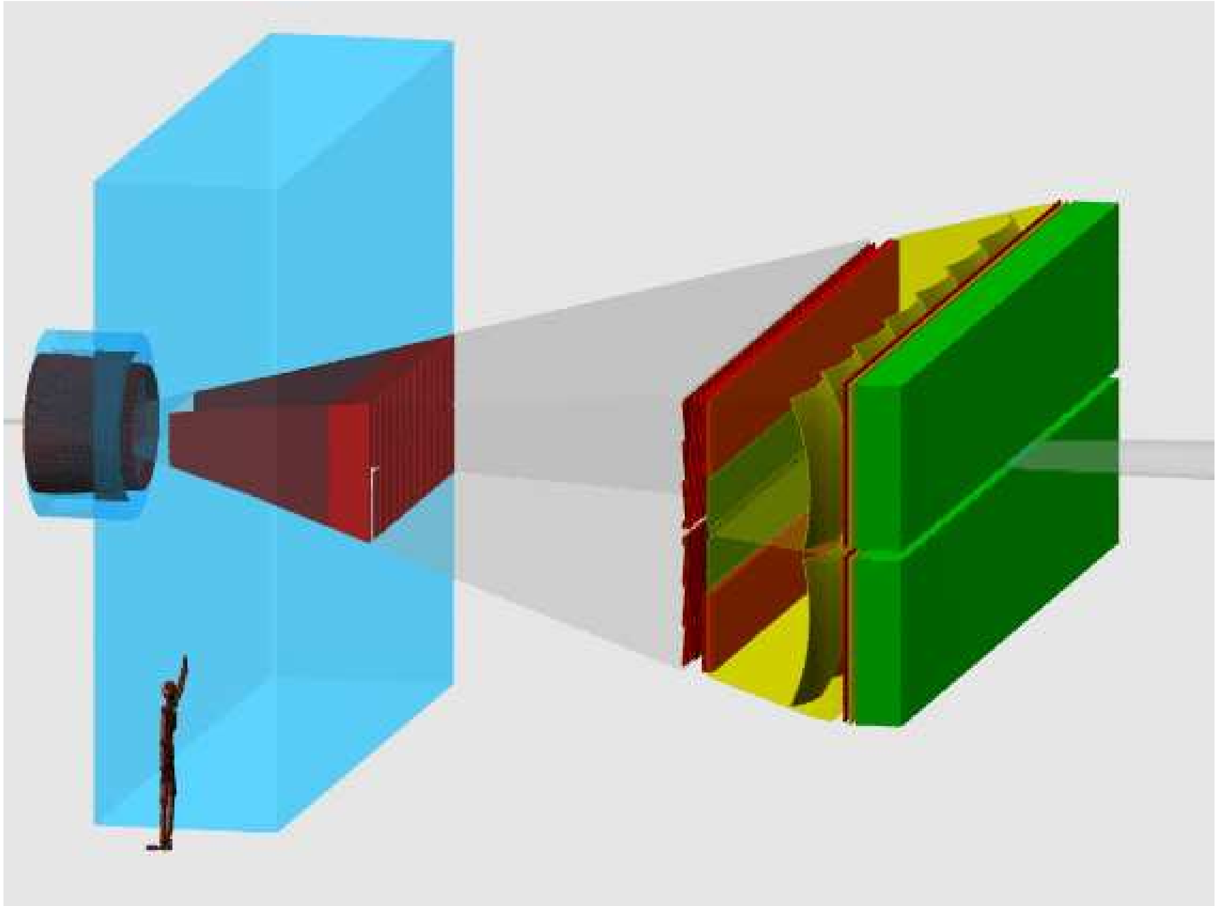
Possible Layout - ELFE



Requires:

- Return loop to HERA ring
- Modification of HERA-e ring
- Extraction from HERA

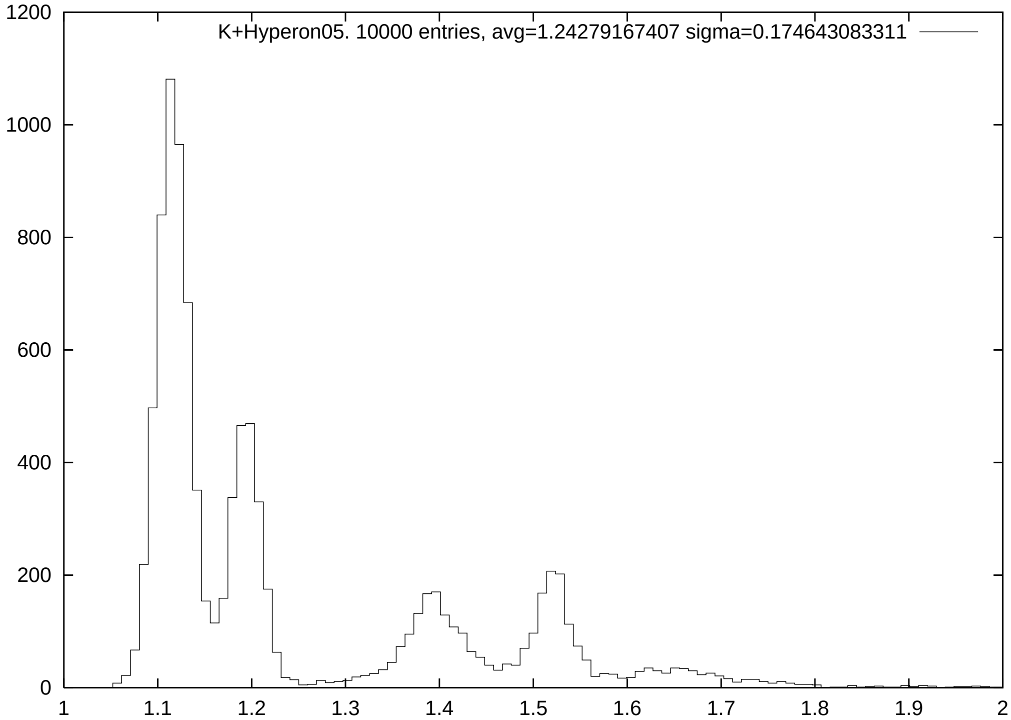
Spectrometer design - ELFE



- Large forward dipole
- Dual RICH detector
- State-of-the-art e.m. calorimeter
- Vacuum chamber to reduce multiple scattering
- Fast scintillating fiber trackers
- Recoil detector

Projected Performance

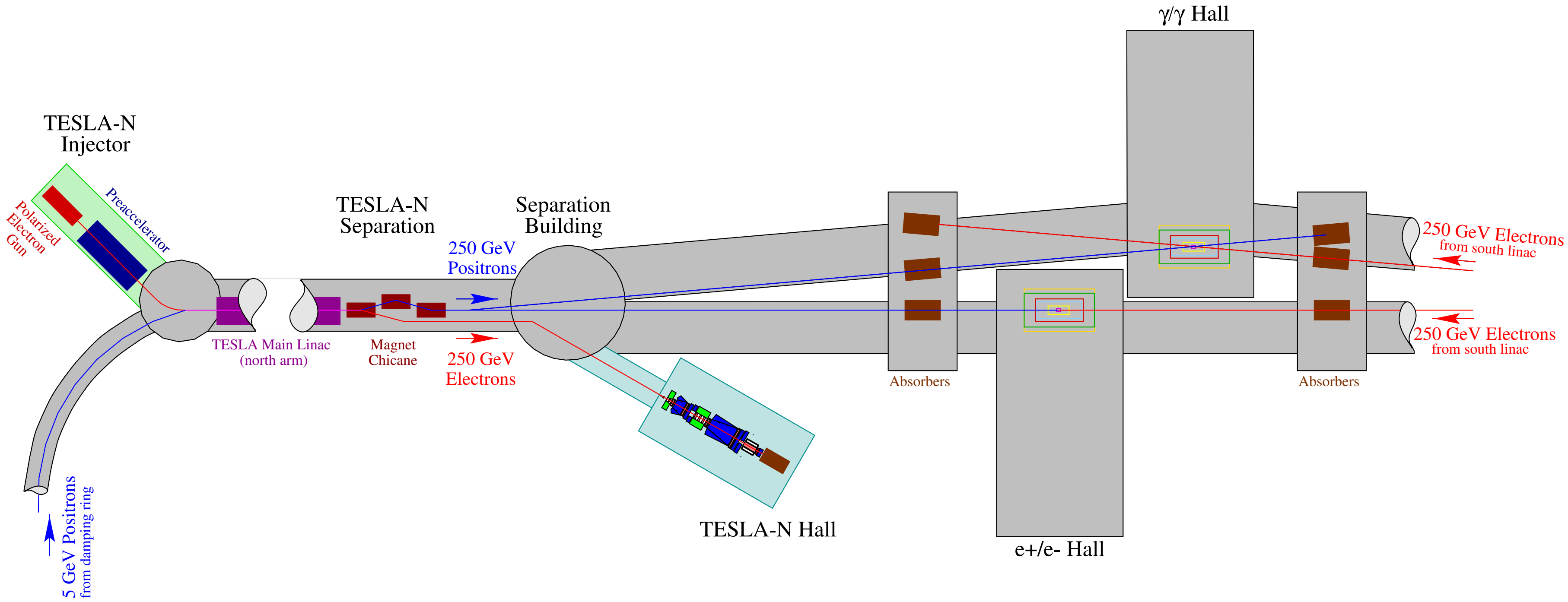
Exclusive reactions: $e + p \rightarrow e + K^+ + \Lambda/\Sigma$



Simulation of detector.
$E_e = 25$ GeV

$\Rightarrow$ Resolution sufficient to distinguish different exclusive channels.

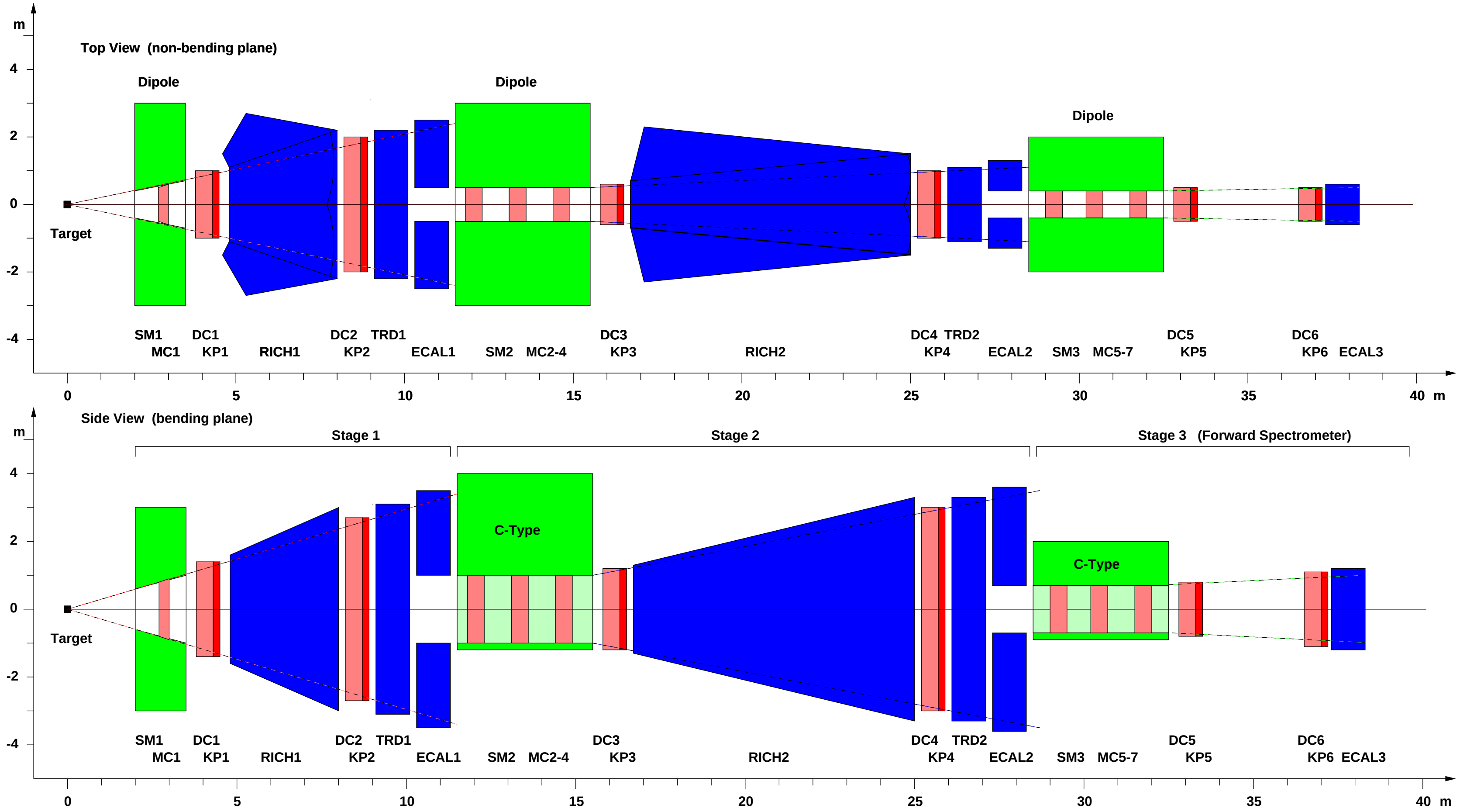
Possible Layout - TESLA-N



Requires:

- Separate e^- injector at North End
- Separation building + short tunnel to hall
- TESLA-N Hall

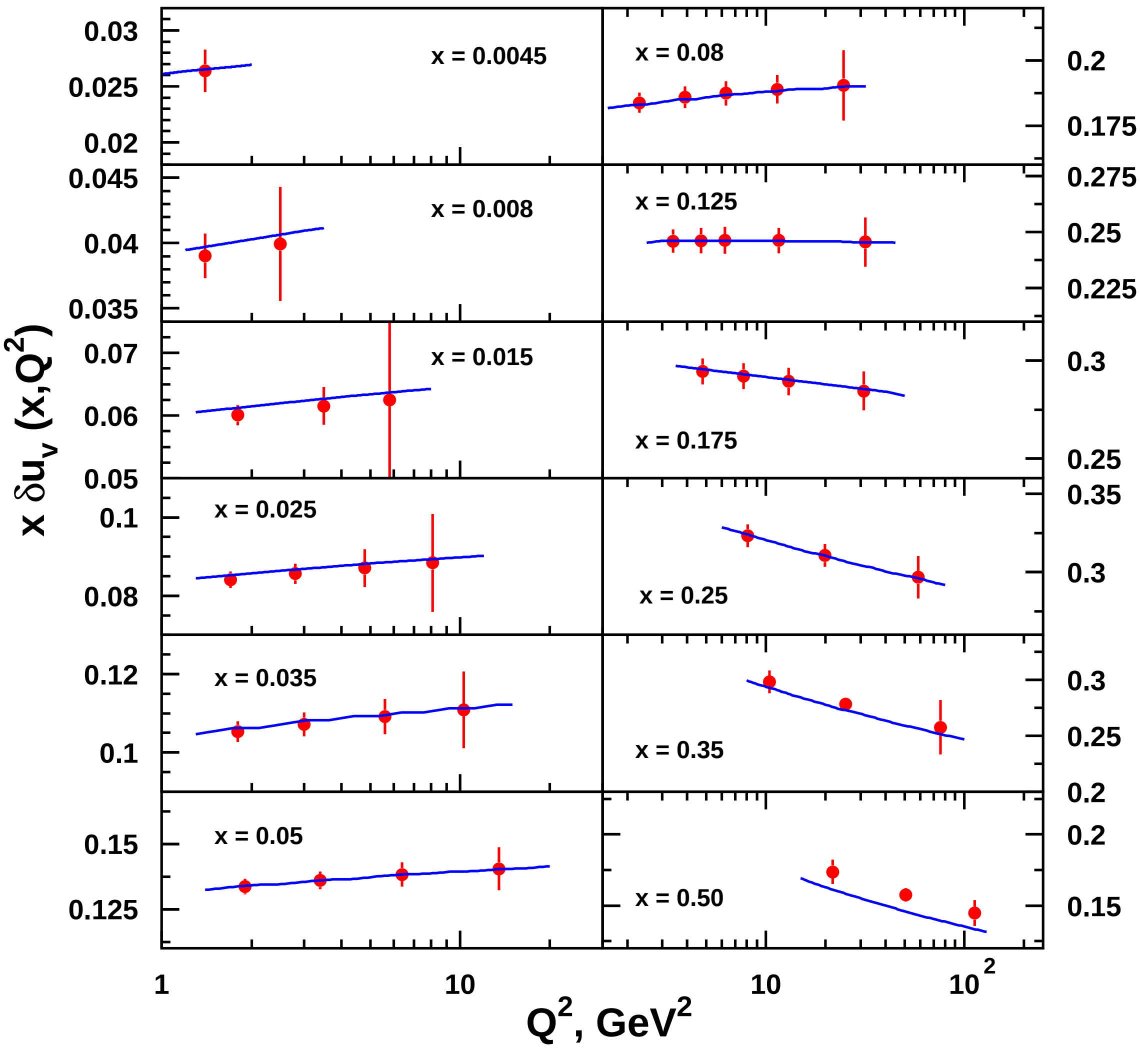
Spectrometer design - TESLA-N



Three-stage forward spectrometer.

Projected Performance

Transversity

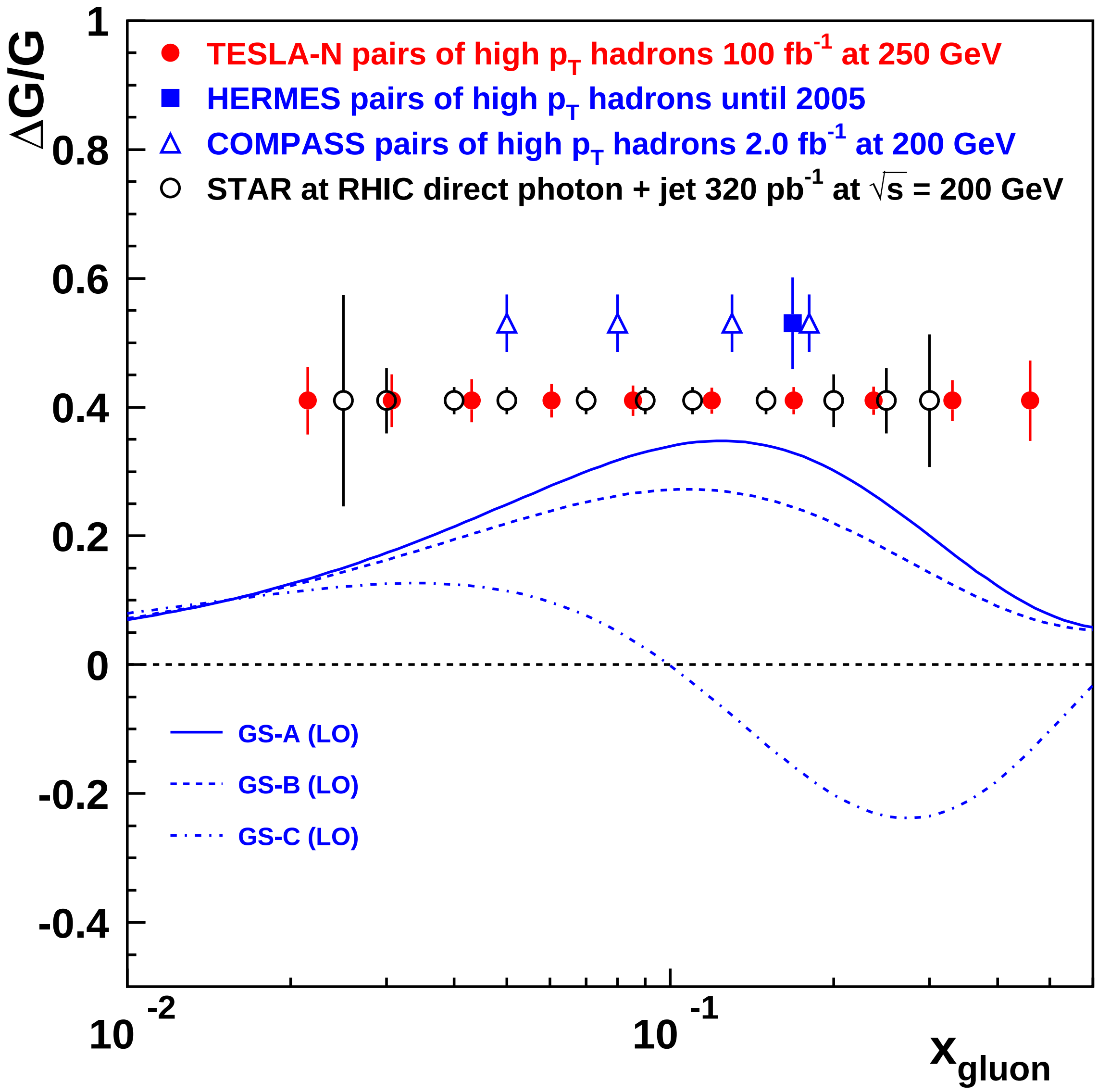


- Simulations for single-spin azimuthal asymmetry measurement.
- Assumed $\int \mathcal{L} = 100\mathrm{fb}^{-1}$

⇒ Accurate determination of u and d tensor charges
⇒ Also: polarized fragmentation function

Projected Performance

Gluon polarization



⇒ High accuracy over large x_g-range
⇒ Independent confirmation of (projected) RHIC data
⇒ TESLA-N and RHIC complement each other

Cost price

The road ahead

When TESLA is started $\rightarrow$ good opportunity to incorporate fixed-target facility.

- ELFE $\Rightarrow$ Next step in hadron structure physics
- TESLA-N $\Rightarrow$ Next step in parton structure of nucleon

$\star$ Work out possibilities for high-duty factor:
$\Rightarrow$ use HERA as stretcher
$\Rightarrow$ increase df of part of TESLA accelerator (to 10%)

$\star$ Work out concept of detector to be used as:
$\Rightarrow$ HERMES-2
$\Rightarrow$ high-resolution ELFE-detector
$\Rightarrow$ 1st stage of TESLA-N detector