An overview of Hall A neutron transversity experiments
E-06-010 (ex E-03-004) and E-06-011

Evaristo Cisbani
on behalf of the Transversity Collaboration

INFN-Rome and Italian National Institute of Health

Hall A Collaboration Meeting
JLab
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- Introduction of the transversity
- Present status
- Experiment(s) in Hall A
- $\pi/K$ separation and RICH
Quark DFs at leading twist

\[ \Phi_{ij}(k, P, S) \sim \int d^4\xi e^{ix\cdot\xi} \langle PS|\bar{\phi}_j(0)\phi_i(\xi)|PS\rangle \]

- \( \phi, k \) quark spinor and momentum fraction,
- \( P, S \) proton momentum and spin,
- \( i, j \) Dirac indices
Quark DFs at leading twist

\[ \Phi_{ij}(k, P, S) \sim \int d^4 \xi e^{ix \cdot \xi} \langle PS | \bar{\phi}_j(0) \phi_i(\xi) | PS \rangle \]

↓ hermiticity, parity, \( k_\perp = 0 \), \( \int k \) ↓

\[ \Phi(x)^{\text{Twist}} = \frac{1}{2} \left[ q(x) \gamma^\mu P_\mu + S_\parallel \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_{\mu} \right] \]

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\[ \Downarrow \text{hermiticity, parity, } k_\perp = 0, \int k \Downarrow \]

\[ \Phi(x) \overset{\text{Twist}}{=} 2 \frac{1}{2} [ \begin{array}{l} q(x) \gamma^\mu P_\mu + S_\parallel \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_\mu \end{array} ] \]

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**Quark DFs at leading twist**

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\Phi_{ij}(k, P, S) \sim \int d^4 \xi e^{ix \cdot \xi} \langle PS|\bar{\phi}_j(0)\phi_i(\xi)|PS\rangle
\]

\[\downarrow\text{hermiticity, parity, } k_\perp = 0, \int k \downarrow\]

\[
\Phi(x) \overset{\text{Twist}}{=} 2 \frac{1}{2} \begin{bmatrix}
q(x) \\
\Delta q(x)
\end{bmatrix}
\begin{bmatrix}
\gamma^\mu P_\mu + S_\parallel \\
\gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_\mu
\end{bmatrix}
\]

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Quark DFs at leading twist

$$\Phi_{ij}(k, P, S) \sim \int d^4\xi e^{i\xi \cdot x} \langle PS| \bar{\phi}_j(0) \phi_i(\xi)|PS \rangle$$

↓ hermiticity, parity, $k_\perp = 0$, $\int k$ ↓

$$\Phi(x) \overset{\text{Twist 2}}{=} \frac{1}{2} \left[ q(x) \gamma^\mu P_\mu + S_\parallel \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_\mu \right]$$

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E. Cisbani (INFN-Roma & ISS)
Quark DFs at leading twist: data

\[ \Phi(x)^{\text{Twist 2}} = \frac{1}{2} \left[ q(x) \gamma^\mu P_\mu + S_\parallel \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_\mu \right] \]

- \( q(x) \) - unpolarized: very well known and measured
  \( 6 \cdot 10^{-5} < x < 0.65 \),
  \( 1 < Q^2 < 10^5 \) GeV

\[ F_2(x) = F_{2010}(x) + F_2^\text{em,\log_{10}(x)}(x) \]

\[ Q^2 (\text{GeV}^2) \]

\[ x = \{ 0.000102, 0.000161, 0.000253, 0.0004, 0.0005, 0.000632, 0.0008, 0.0013, 0.0021, 0.0032, 0.005, 0.008, 0.013, 0.021, 0.032, 0.05, 0.08, 0.13, 0.18, 0.25, 0.4, 0.65 \} \]
Quark DFs at leading twist: data

Φ(x)\textsuperscript{Twist 2} = \frac{1}{2} \left[ q(x) \gamma^\mu P_\mu + S_\parallel \right. \\
\left. \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_\perp)_\mu \right]

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  $6 \cdot 10^{-5} < x < 0.65,$
  
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- **\Delta q(x)** - helicity: well known and measured
  
  $6 \cdot 10^{-3} < x < 0.8,$
  
  $1 < Q^2 < 10^2 \text{ GeV}^2$
Quark DFs at leading twist: data

\[ \Phi(x) \overset{\text{Twist 2}}{=} \frac{1}{2} [ q(x) \gamma^\mu P_\mu + S_{||} \Delta q(x) \gamma_5 \gamma^\mu P_\mu + \delta q(x) \gamma^\mu P_\mu \gamma_5 \gamma^\mu (S_{\perp})_\mu ] \]

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  \[ 6 \cdot 10^{-5} < x < 0.65, \]
  \[ 1 < Q^2 < 10^5 \ \text{GeV}^2 \]

- **\( \Delta q(x) \)** - helicity: well known and measured
  \[ 6 \cdot 10^{-3} < x < 0.8, \]
  \[ 1 < Q^2 < 10^2 \ \text{GeV}^2 \]

- **\( \delta q(x) \)** - transversity: detected,
  
  ... next slides
Why is \( \delta q(x) \) important?

- Is the last (third) twist-2 DF
Why is $\delta q(x)$ important?

- Is the last (third) twist-2 DF
- In the non-relativistic limit: $\delta q(x) = \Delta q(x)$: rotation and Lorentz boost do not commute $\Rightarrow$ information on the relativistic effects in the nucleon

Sum rule:

$$\frac{1}{2} = \frac{1}{2} \sum_q \int dx \delta q(x) + L_q T + L_g T$$
Why is $\delta q(x)$ important?

- Is the last (third) twist-2 DF
- In the non-relativistic limit: $\delta q(x) = \Delta q(x)$: rotation and Lorentz boost do not commute ⇒ information on the relativistic effects in the nucleon
- No gluon counterpart (for spin 1/2 hadrons), no gluon mixing in $Q^2$ evolution
  ⇒ 'Clean probe' of QCD evolution
  ⇒ $\Delta q(x)$ and $\delta q(x)$ evolve differently
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Chiral - odd (require helicity flip) $\Rightarrow$ not accessible in inclusive DIS
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Chiral - odd (require helicity flip) $\Rightarrow$ not accessible in inclusive DIS

- Theoretical knowledge on $\delta q(x)$ similar to $\Delta q(x)$
Direct measurement of $\delta q(x)$ in polarized Drell-Yan

$$P_1^\uparrow + P_2^{[\uparrow]} \rightarrow l^+ l^- + X$$

$P_1^\uparrow$ e $P_2^{[\uparrow]}$ transverse polarized (anti)protons

$l^\pm$ unpolarized (anti)leptons
Direct measurement of $\delta q(x)$ in polarized Drell-Yan

$P_1^\uparrow + P_2^\uparrow \rightarrow l^+ l^- + X$

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Double spin transverse asymmetry, leading approximation

$$A_{TT}^{DY} \equiv \frac{\sigma(P_1^\uparrow P_2^\uparrow) - \sigma(P_1^\uparrow P_2^\downarrow)}{\sigma(P_1^\uparrow P_2^\uparrow) + \sigma(P_1^\uparrow P_2^\downarrow)} \sim \sum_q e_q^2 [\delta q(x_A)\delta \bar{q}(x_B) + \delta \bar{q}(x_A)\delta q(x_B)]$$

- only $\delta q(x)$ involved (no fragmentation function)
Direct measurement of $\delta q(x)$ in polarized Drell-Yan

\[ P_1^{\uparrow} + P_2^{[\uparrow]} \rightarrow l^+ l^- + X \]

$P_1^{\uparrow}$ and $P_2^{[\uparrow]}$ transverse polarized (anti)protons

$l^\pm$ unpolarized (anti)leptons

Double spin transverse asymmetry, leading approximation

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- only $\delta q(x)$ involved (no fragmentation function)

- RHIC has a transversity program, but kinematics ($\sqrt{s} > 100\text{GeV}$, $x < 5 \times 10^{-3}$) unfavored: $A_{TT}^{DY} \sim 1 \div 2\%$

- $(p^{\uparrow}, \bar{p}^{\uparrow})$ at lower energies, higher $x$ optimal process

($\Rightarrow$ PAX, next decennium?)
\[ \delta q(x) \text{ from Semi Inclusive DIS} \]

\[ \sigma(IN \rightarrow lhX) \sim \sum_q \sigma(lq \rightarrow lq) \otimes DF(q) \otimes FF(q \rightarrow h) \]
$\delta q(x)$ from Semi Inclusive DIS

- Direct product of DF and FF
- No additional DFs
- Low statistics
- Unknown interference FF

$\sigma(IN \rightarrow lhX) \sim \sum_q \sigma(lq \rightarrow lq) \otimes DF(q) \otimes FF(q \rightarrow h)$

- Double Hadrons detected in final state

\[ \delta q(x) \text{ from Semi Inclusive DIS} \]
\( \delta q(x) \) from Semi Inclusive DIS

- ‘Simpler’ Exp. Setup
- Higher Statistics
- Additional DF involved
- Collins FF

\[
\sigma(lN \rightarrow lhX) \sim \sum_q \sigma(lq \rightarrow lq) \otimes DF(q) \otimes FF(q \rightarrow h)
\]

- Double Hadrons detected in final state
- One unpolarized hadron detected in final state \( \Rightarrow \) SSA
Transverse Target Single-Spin Asymmetry (SSA)

\[ A_{\text{UT}}(\phi_h, \phi_S) \equiv \frac{1}{|S_T|} \frac{d\sigma(\phi_h^l, \phi_S^l) - d\sigma(\phi_h^l, \phi_S^l + \pi)}{d\sigma(\phi_h^l, \phi_S^l) + d\sigma(\phi_h^l, \phi_S^l + \pi)} \]

Twist2 \[ \equiv \]

- \[ A_{\text{Collins}}^{\text{UT}} \sin(\phi_h^l + \phi_S^l) \]
- \[ A_{\text{Sivers}}^{\text{UT}} \sin(\phi_h^l - \phi_S^l) \]
- \[ A_{\text{other}}^{\text{UT}} \sin(3\phi_h^l - \phi_S^l) \]

Expected to be small

⊗ = convolution integral in initial and final quark transverse momentum

Collins and Sivers can be extracted by azimuthal fit
Transverse Target Single-Spin Asymmetry (SSA)

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\[ \text{Twist}^2 \equiv A_{UT}^{\text{Collins}} \sin(\phi^l_h + \phi^l_S) + A_{UT}^{\text{Sivers}} \sin(\phi^l_h - \phi^l_S) + A_{UT}^{\text{other}} \sin(3\phi^l_h - \phi^l_S) \]

\[ A_{UT}^{\text{Collins}} \sim \sum_q e_q^2 \left[ \delta q \otimes H^\perp_{1q} \right] \quad \text{Transversity} \otimes \text{Collins FF} \]

\[ \otimes = \text{convolution integral in initial and final quark transverse momentum} \]
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Twist2 ≡
\[ A_{UT}^{\text{Collins}} \sin(\phi_h^l + \phi_S^l) + A_{UT}^{\text{Sivers}} \sin(\phi_h^l - \phi_S^l) + A_{UT}^{\text{other}} \sin(3\phi_h^l - \phi_S^l) \]

\[ A_{UT}^{\text{Collins}} \sim \sum_q e_q^2 \left[ \delta q \otimes H_{1q}^T \right] \quad \text{Transversity} \otimes \text{Collins FF} \]
\[ A_{UT}^{\text{Sivers}} \sim \sum_q e_q^2 \left[ f_{1T}^q \otimes D_{1q} \right] \quad \text{Sivers} \otimes \text{Unpol FF} \]

\( \otimes = \) convolution integral in initial and final quark transverse momentum
\[ A_{UT}(\phi_h, \phi_S) \equiv \frac{1}{|S_T|} \frac{d\sigma(\phi_h, \phi_S^I) - d\sigma(\phi_h, \phi_S^I + \pi)}{d\sigma(\phi_h, \phi_S^I) + d\sigma(\phi_h, \phi_S^I + \pi)} \]

Twist2 \[ \equiv A_{UT}^{Collins} \sin(\phi_h^I + \phi_S^I) + A_{UT}^{Sivers} \sin(\phi_h^I - \phi_S^I) + A_{UT}^{other} \sin(3\phi_h^I - \phi_S^I) \]

\[ A_{UT}^{Collins} \sim \sum_q e_q^2 \left[ \delta q \otimes H_{1q}^\perp \right] \]
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\[ A_{UT}^{other} \sim \sum_q e_q^2 \left[ h_{1q}^\perp \otimes H_{1q}^\perp \right] \]

Transversity \( \otimes \) Collins FF
Sivers \( \otimes \) Unpol FF

Expected to be small

\( \otimes \) = convolution integral in initial and final quark transverse momentum
Transverse Target Single-Spin Asymmetry (SSA)

\[ A_{UT}(\phi_h, \phi_S) \equiv \frac{1}{|S_T|} \frac{d\sigma(\phi_h^l, \phi_S^l) - d\sigma(\phi_h^l, \phi_S^l + \pi)}{d\sigma(\phi_h^l, \phi_S^l) + d\sigma(\phi_h^l, \phi_S^l + \pi)} \]

\[ \text{Twist}^2 \equiv A_{UT}^{\text{Collins}} \sin(\phi_h^l + \phi_S^l) + A_{UT}^{\text{Sivers}} \sin(\phi_h^l - \phi_S^l) + A_{UT}^{\text{other}} \sin(3\phi_h^l - \phi_S^l) \]

\[ A_{UT}^{\text{Collins}} \sim \sum_q e_q^2 \left[ \delta q \otimes H_{1q}^\perp \right] \]

Transversity \(\otimes\) Collins FF

\[ A_{UT}^{\text{Sivers}} \sim \sum_q e_q^2 \left[ f_{1T}^\perp q \otimes D_{1q} \right] \]

Sivers \(\otimes\) Unpol FF

\[ A_{UT}^{\text{other}} \sim \sum_q e_q^2 \left[ h_{1T}^\perp q \otimes H_{1q}^\perp \right] \]

Expected to be small

\(\otimes\) = convolution integral in initial and final quark transverse momentum

Collins and Sivers can be extracted by azimuthal fit
$k_\perp$ Dependent (TMD) Quark DF at Twist-2

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$\delta q(x) = h_{1T}^{\perp} + k_{\perp}^2/(2M)h_{1T}^{\perp}$
**$k_\perp$ Dependent (TMD) Quark DF at Twist-2**

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$f_{1T}^\perp(x, k_\perp)$: Sivers DF, naive time-reversal odd, $f_{1T}^\perp(x, k_\perp) \neq 0 \rightarrow I/FSI$
$k_\perp$ Dependent (TMD) Quark DF at Twist-2

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$f_{1T}^\perp(x, k_\perp)$: Sivers DF, naive time-reversal odd, $f_{1T}^\perp(x, k_\perp) \neq 0 \rightarrow I/FSI$

Information on quark angular momentum: if $f_{1T}^\perp \neq 0 \rightarrow L_q \neq 0$!
HERMES SSA $\pi$ Proton Data [hep-ex/0507013]

\[ e + p^\uparrow \rightarrow e' + \pi^\pm + X \text{ with } \pi^+/\pi^- \text{ Favored/Unfavored channels} \]
e + p↑ → e' + π± + X with π+/π− Favored/Unfavored channels

Strong Flavor Dependence of the Collins and Sivers Asymmetries
**HERMES SSA π Proton Data [hep-ex/0507013]**

\[ e + p^\uparrow \rightarrow e' + \pi^{\pm} + X \text{ with } \pi^+ / \pi^- \text{ Favored/Unfavored channels} \]

**Strong Flavor Dependence of the Collins and Sivers Asymmetries**

Unfavored \( p(uud) \rightarrow \pi^- (d\bar{u}) \) shows large Collins Asymmetry
HERMES SSA $K$ Proton Data

\[ e + p^\uparrow \rightarrow e' + K^\pm + X \]

Contribution of sea quarks to Sivers function (?)

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E. Cisbani (INFN-Roma & ISS)
COMPASS Deuteron Data [PRL 94 (2005) 202002]

\[ \mu + d^\uparrow \rightarrow \mu' + h + X \]

(\bullet = h^+, \circ = h^-)
COMPASS Deuteron Data [PRL 94 (2005) 202002]

\[ \mu + d^\uparrow \rightarrow \mu' + h + X \]

- All hadrons
- Leading hadrons

\[ (\bullet = h^+, \circ = h^-) \]

- Both \( u \) and \( d \) quarks probed
\[ \mu + d^\uparrow \rightarrow \mu' + h + X \]

(● = \( h^+ \), ○ = \( h^- \))

- Both \( u \) and \( d \) quarks probed
- Small SSA & HERMES data \( \Rightarrow \) large contribution to asymmetry from \( d \) quark (?)
Assume: \( H_{1,fav}^\perp(z) = C_{fav}z(1-z)D_{1,fav}(z), \quad H_{1,unfav}^\perp(z) = \frac{C_{unfav}}{C_{fav}}H_{1,fav}^\perp(z) \)

\[ \Rightarrow \quad \frac{H_{1,unfav}^\perp(z)}{H_{1,fav}^\perp(z)} \sim -1 ! \]
Assume: $f_{1T,u}(x) = S_u x (1-x) u(x)$, $f_{1T,d}(x) = \frac{S_d}{S_u} f_{1T,u}(x)$

$\Rightarrow S_u \sim -0.81, S_d \sim 1.86$!
Collins and Sivers Asymmetries Exp. Status

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<tr>
<td></td>
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Collins and Sivers Asymmetries Exp. Status

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No direct data on neutron

E. Cisbani  (INFN-Roma & ISS)  Transversity  JLab - 22/June/06  14 / 22
Collins and Sivers Asymmetries Exp. Status

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No direct data on neutron

⇒ Opportunity in Hall A @ JLab
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No direct data on neutron

⇒ Opportunity in Hall A @ JLab

E-06-010 (ex E-03-004) and E-06-011 / 29 PAC days

SSA in SIDIS $^3He^{\uparrow}(e, e'\pi^{\pm})X$ (and $K^{\pm}$)
Hall A Experimental Setup for Transversity

Beam
6 GeV, 15 $\mu$A $e^-$ (target limit)

Target
$^3$He, 50 mg/cm$^2$, $\sim$ 42% polar./15 $\div$ 20 min trasversely polarized, tunable direction

Electron Detection: BigBite
$E' = 0.8 \div 1.9$ GeV, $\theta = -30^\circ$, $\Delta \Omega = 64$ msr

Charged Hadron Detection: HRS Left
$P_h = 2.4$ GeV/c, $z \sim 0.5$, $\theta = 16^\circ$, $\pi/K$ ID

Luminosity Monitor (Lumis fro HAPPEX)
Lumi up - Lumi down $\sim 5 \times 10^{-5}$
Choice of the kinematics

- Largest invariant mass achievable at 6 GeV beam: $W > 2.33$ GeV
- Detect hadron at $z \sim 0.5$ (current fragmentation favored)
- Minimize resonance production channels choosing largest invariant mass of the remnant: $W' > 1.5$ GeV
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**Phase Space Coverage**

One setup covers four $x$-bins:

- One BigBite setting
- One HRS$_L$ setting

**JLab**

$\langle Q^2 \rangle$ 2.2

$\langle z \rangle$ 0.5

$x$ 0.13-0.4

**HERMES**

$\langle Q^2 \rangle$ 2.4

$\langle z \rangle$ $\sim$ 0.4

$x$ 0.02-0.3
Azimuthal Phase Space

\[ \phi_{Collins} = \phi_h + \phi_S \quad \text{and} \quad \phi_{Sivers} = \phi_h - \phi_S \]
Azimuthal Phase Space

\[ \phi_{\text{Collins}} = \phi_h + \phi_s \quad \text{and} \quad \phi_{\text{Sivers}} = \phi_h - \phi_s \]

\~ 2π coverage by Up/Down and Left/Right Target polarizations for each x-bin
Azimuthal Phase Space

\[ \phi_{Collins} = \phi_h + \phi_S \text{ and } \phi_{Sivers} = \phi_h - \phi_S \]

∼ 2\pi coverage by Up/Down and Left/Right Target polarizations for each \( x \)-bin

3\textsuperscript{rd} set of Helmholtz coils added for the vertical spin direction of the \(^3\text{He}\) target
Trigger/PID

- Coincidence time Window of \(\sim 50\) ns should provide accidentals rate of \(< 15 \text{ Hz}\)
Trigger/PID

- Coincidence time Window of \( \sim 50 \) ns should provide accidentals rate of \(< 15 \) Hz
- Hadron Contamination in BigBite and Lepton contamination in HRS suppressed by respective PreShower+Shower (factor of \( \sim 100 \)); (Gas Cherenkov requirement in BB under investigation)
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- Offline vertex reconstruction reduce accidentals below \( 10^{-3} \)
Trigger/PID

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- Protons in hadron arm are rejected by TOF
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- $\pi/K$ in hadron arm are identified by A1+A2 and independently (upgraded) RICH with rejection at $\sim 1:1000$
π/K PID: Proximity Focusing RICH

Radiator: 15 mm thick Liquid Freon (C₆F₁₄, n=1.28)
Photon converter: 300 nm CsI film coated on Pad Planes
Position Detector: 1940 × 403 mm² - Multi Wire/Pad Proportional Chamber filled with Methane at STP, HV= 1050 ÷ 1100 V
FE Electronics: 11520 analog chs, multiplexed S&H
**π/K PID: Proximity Focusing RICH**

Radiator: 15 mm thick Liquid Freon ($C_6F_{14}$, $n=1.28$)
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Position Detector: 1940 x 403 mm$^2$ - Multi Wire/Pad Proportional Chamber filled with Methane at STP, HV = 1050 ÷ 1100 V
FE Electronics: 11520 analog chs, multiplexed S&H

Successfully operated at 2 GeV/c in Hypernuclear Experiment with

$\pi/K$ rejection $< 1:1000$
RICH upgrade for 2.4 GeV/c

- add a inox frame spacer to increase the proximity gap of $\sim 2$ cm

GEANT3 MonteCarlo prediction, normalized to Hypernuclear Experiment data

$n_\sigma \sim 4.1 \Rightarrow \pi : K \sim 1 : 140$
RICH upgrade for 2.4 GeV/c

- add a inox frame spacer to increase the proximity gap of $\sim 2$ cm
- move closer to the VDC (from 280 cm to $\sim 170$ cm)

GEANT3 MonteCarlo prediction, normalized to Hypernuclear Experiment data

$n_{\sigma} \sim 4.4 \Rightarrow \pi : K \sim 1 : 500$

better light collection (smaller charge particle phase-space)

compatibility with A1 and A2 to be confirmed
RICH upgrade for 2.4 GeV/c

- add a inox frame spacer to increase the proximity gap of $\sim 2$ cm
- move closer to the VDC (from 280 cm to $\sim 170$ cm)
- new radiator: use a lower refractive index ($C_5F_{12}$)

GEANT3 MonteCarlo prediction, normalized to Hypernuclear Experiment data

$n_\sigma \sim 5.5 \Rightarrow \pi : K \sim 1 : 1000$

$C_{5F_{12}}$ boils at $30^\circ$C
cooling system required
this is the current direction of the upgrade
RICH upgrade for 2.4 GeV/c

- add a inox frame spacer to increase the proximity gap of $\sim 2$ cm
- move closer to the VDC (from 280 cm to $\sim 170$ cm)
- new radiator: use a lower refractive index ($\text{C}_5\text{F}_{12}$)
- other options considered but rejected (cost/performance)

GEANT3 MonteCarlo prediction, normalized to Hypernuclear Experiment data

$$n_\sigma \sim 5.5 \Rightarrow \pi : K \sim 1 : 1000$$

$\text{C}_5\text{F}_{12}$ boils at $30^\circ\text{C}$
cooling system required
this is the current direction of the upgrade
$A_{UT}$ Projected Performance (errors are $\sim 30\%$ larger)

Expected errors comparable to existing HERMES/COMPASS data
Summary

- Transversity and TMD DFs and FFs are outstanding topics in nucleon structure investigation.
- The Hall A facility offers a unique chance to perform the first SSA SIDIS measurements on the transversely polarized neutron, detecting $\pi^{\pm}$ ($K^{\pm}$) in the final state.
- Such measurements will provide new information, complementary to the existing data, with comparable errors (in much shorter beam time).