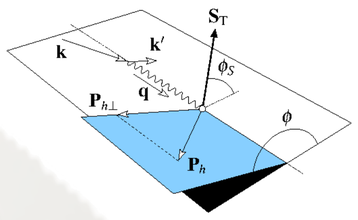
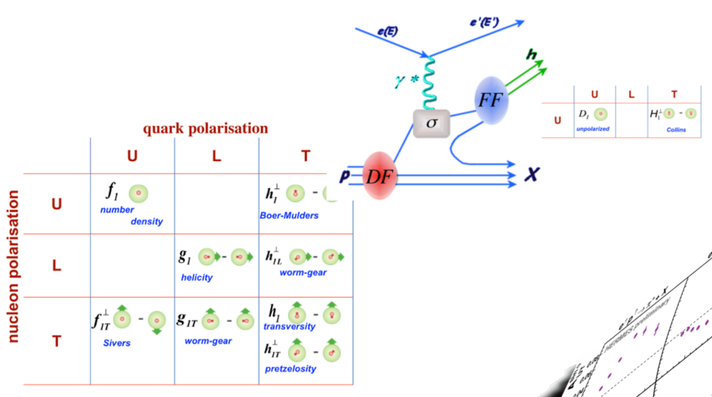
Recent TMD Results from HERMES





Collins effect

$$2\langle \sin(\phi+\phi_s)\rangle_{UT} \propto \frac{\mathcal{C}\left[-\frac{\hat{\mathbf{p}}_{h\perp}\cdot\mathbf{k}_T}{M_h} h_1^q(x,p_T^2) H_1^{\perp q\to h}(z,k_T^2)\right]}{\mathcal{C}\left[f_1^q(x,p_T^2) D_1^{q\to h}(z,k_T^2)\right]}$$

- positive for π^+ and negative for π^-
- role of disfavored Collins FF:

$$H_1^{\perp,disfav} \approx -H_1^{\perp,fav}$$

$u \Rightarrow \pi^+$; $d \Rightarrow \pi^-(fav)$

$u \Rightarrow \pi^-$; $d \Rightarrow \pi^+(disfav)$

$h_1^u > 0$

$h_1^d < 0$

- K^+ amplitudes are similar to π^+ as expected from the u-quark dominance but larger in magnitude
- K^- consistent with zero amplitudes

Sivers effect

$$2\langle \sin(\phi-\phi_s)\rangle_{UT} = \frac{\sum_q e_q^2 f_{1T}^{\perp q}(x,p_T^2)\otimes_w D_1^q(z,k_T^2)}{\sum_q e_q^2 f_1^q(x,p_T^2)\otimes D_1^q(z,k_T^2)}$$

- π^+: significantly positive u-quark Sivers DF>0
- π^0: slightly positive
- π^-: consistent with 0 d-quark Sivers DF≈0
- K^+: amplitudes are larger than the π^+ amplitudes (non-trivial role of sea quarks)
- K^-: slightly positive

pretzelosity

$$2\langle \sin(3\phi-\phi_s)\rangle_{UT} \propto \frac{\sum_q e_q^2 x h_{1T}^{\perp(1)q}(x)\otimes_w H_1^{\perp(1/2)q}(z)}{\sum_q e_q^2 f_1^q(x)\otimes D_1^q(z)}$$

- suppressed by two powers of P_{hL} compared to Collins and Sivers amplitudes

Boer-Mulders and Cahn effects

$$\frac{\cos(\phi)}{\sigma_{UU}} \propto -\frac{M}{Q}\sum_q h_1^{\perp q}(x,p_T^2)\otimes_{w_1} H_1^{\perp q}(z,k_T^2)$$

$$-\frac{M}{Q}\sum_q f_1^q(x,p_T^2)\otimes_{w_2} D_1^q(z,k_T^2)$$

worm-gear

$$2\langle \cos(\phi-\phi_s)\rangle_{LT} \propto \frac{\mathcal{C}\left[-\frac{\hat{\mathbf{p}}_{h\perp}\cdot\mathbf{p}_T}{M_h} g_{1T}^{\perp q}(x,p_T^2) D_1^q(z,k_T^2)\right]}{\mathcal{C}\left[f_1^q(x,p_T^2) D_1^q(z,k_T^2)\right]}$$

- π^+: slightly positive
- π^0: compatible with zero
- π^-: positive: evidence for non-zero worm-gear distribution
- K^+: slightly positive
- K^-: compatible with zero

Boer-Mulders effect

$$\frac{\cos(2\phi)}{\sigma_{UU}} \propto -\sum_q h_1^{\perp q}(x,p_T^2)\otimes_w H_1^{\perp q}(z,k_T^2)$$

π^+ and π^-

$$H_1^{\perp,u\to\pi^+} = -H_1^{\perp,u\to\pi^-}$$

- data support Boer-Mulders DF h_1^u and h_1^d
- striking differences w.r.t. pions
- role of the sea in DF and FF

E.Avetisyan (DESY) on behalf of HERMES Collaboration