Two-pion fragmentation

Transversity

\[ d^3 \sigma^+ - d^3 \sigma^- \sim (1 - y) \sin(\phi_R + \phi_s) h_t(x) H_1^\sigma(z, \theta_R, M^2) \]

Two-pion chiral-odd fragmentation function

Interference fragmentation function

\[ d^3 \sigma^+ - d^3 \sigma^- \sim (1 - y) \sin(\phi_R + \phi_s) \sin\theta_R H_1^\sigma(z, M^2) \]

Angular distribution typical of an s-p interference

We can perform the integration over three variables

\[ \int d\theta_R d\phi_R d\phi_s \sin(\phi_R + \phi_s) (d^3 \sigma^+ - d^3 \sigma^-) \sim \alpha 2\pi (1 - y) h_t(x) H_1^\sigma(z, M^2) \]
Asymmetry for interference fragmentation function

\[ A_T(\sin(\phi_h + \phi_S))(x, y, z, M^2) = \frac{(1-y)}{1-y+\frac{y^2}{2}} \left( h_1(x) H_1^x(z, M^2) + f_1(x) D_1(z, M^2) \right) \]

A model for interference fragmentation functions

M. Radici, R. Jakob, A. Bianconi, hep-ph/0110252
Results for the asymmetry

\[ A_T \langle \sin(\phi_h + \phi_s) \rangle \]

M

x

A different model

The model of Jaffe et al. suggests a different behavior with the invariant mass

Summary of interference fragmentation function

- The interference fragmentation function does not require the measurement of the angle $\theta_R$.
- The specific dependence on the invariant mass is not well known.
- The interesting part should anyway be around the $\rho$ mass.
- The only estimate points to a few percent asymmetry.
- The evolution of the function is known.

Two-pion fragmentation

$$d^7\sigma^+ - d^7\sigma^- \propto (1-y)\sin(\phi_R + \phi_h) h_1(x) H_1^\pi(z,\theta_R, M^2)$$

Spin-one fragmentation function

\[ d^7\sigma^\uparrow - d^7\sigma^\downarrow \propto (1 - y)\sin(\phi_R + \phi_S) \]

We can perform the integration over two variables (we cannot integrate over \(\theta_R\))

\[ \int d\phi_R d\phi_S \sin(\phi_R + \phi_S) \left( d^7\sigma^\uparrow - d^7\sigma^\downarrow \right) \propto \]

\[ \pi (1 - y)h_1(x)\sin 2\theta_R H_{1LT}(z)BW(M^2; M^2_\rho) \]

Asymmetry for spin-one production

\[ A_T(\sin(\phi_R + \phi_S))(x, y, z, \theta_R) = \frac{1 - y}{1 - y + \frac{y^2}{2}} \frac{h_1(x)\sin 2\theta_R H_{1LT}(z)}{f_1(x)D_1(z)} \]

Positivity bound on $H_{\text{ILT}}$

$$H_{\text{ILT}}(z) \leq \sqrt{\left(D_1(z) + \frac{2}{3} B_1(z)\right)} \left(D_1(z) - \frac{1}{3} B_1(z)\right) \leq \frac{3}{2\sqrt{2}} D_1(z)$$

Example: positivity bound on $H_{\text{ILT}}$ obtained from OPAL data for $K^*(892)$

Summary for spin-one production

- The study of the dependence on the angle $\theta_R$ is necessary to isolate the spin-one contribution.
- At the moment there are no estimates of the asymmetry (but we are going to work at it!).
- The evolution of the function is known.
Conclusions

• Transversity is an interesting and significant object to measure.
• There are at least four different fragmentation mechanisms to probe it.
• The Collins function is more complex from the theoretical point of view, but there are promising indications on its size.
• Two-hadron fragmentation is theoretically more clear, but seems to be experimentally more challenging.