Two-pion fragmentation

Transversity

$$d^7\sigma^{\uparrow} - d^7\sigma^{\downarrow} \propto (1-y)\sin(\phi_h + \phi_R)\, h_1(x)\; H_1^{\sphericalangle}(z, \theta_R, M^2)$$

Two-pion chiral-odd fragmentation function

Interference fragmentation function

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

Angular distribution typical of an s-p interference

We can perform the integration over three variables

$$\int d\theta_R\, d\phi_R\, d\phi_S \sin(\phi_R + \phi_S)\left(d^7\sigma^{\uparrow} - d^7\sigma^{\downarrow}\right) \propto$$

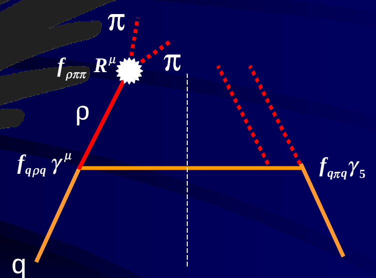
$$\alpha\, 2\pi\,(1-y)\, h_1(x)\, H_1^{\sphericalangle}(z, M^2)$$

Asymmetry for interference fragmentation function

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

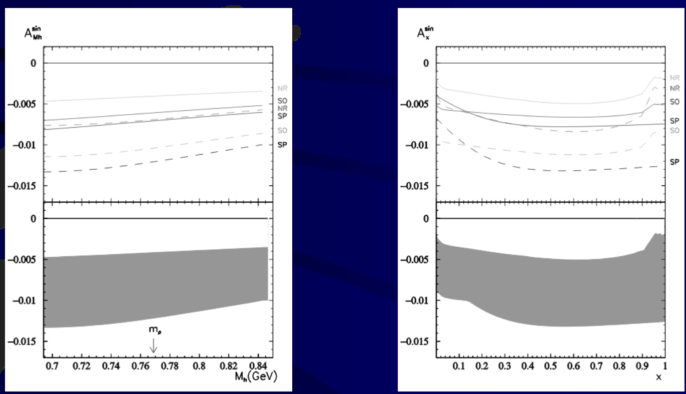
A model for interference fragmentation functions

M. Radici, R. Jakob, A. Bianconi, hep-ph/0110252



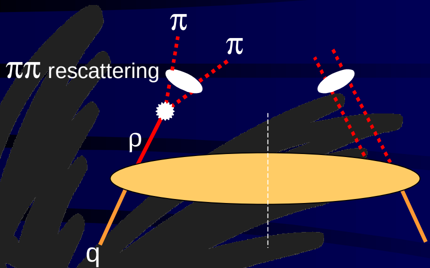
Results for the asymmetry

$$A_T \left\langle \sin(\phi_h + \phi_S) \right\rangle$$

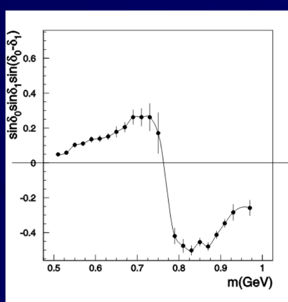


M ***x***

A different model



R. Jaffe,X. Jin, J. Tang, PRL 80 (1997)



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 θ_R.
- The specific dependence on the invariant mass is not well known.
- The interesting part should anyway be around the ρ mass.
- The only estimate points to a few percent asymmetry.
- The evolution of the function is known.

Two-pion fragmentation

Transversity

$$d^7\sigma^{\uparrow} - d^7\sigma^{\downarrow} \propto (1-y)\sin(\phi_h + \phi_R)\, h_1(x)\; H_1^{\sphericalangle}(z,\theta_R,M^2)$$

Two-pion chiral-odd fragmentation function

A. Bianconi, S. Boffi, R. Jakob, M. Radici, PRD 62 (2000)

Spin-one fragmentation function

$$d^7\sigma^{\uparrow} - d^7\sigma^{\downarrow} \propto (1-y)\sin(\phi_h+\phi_R)\; h_1(x)\sin 2\theta_R\, H_{1LT}^{\measuredangle}(z)\,\mathcal{BW}(M^2;M_\rho^2)$$

Angular distribution typical of a spin-one system ($\sin 2\theta_R$)

Breit-Wigner invariant mass distribution typical of a resonance ($\mathcal{BW}(M^2;M_\rho^2)$)

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

$$\int d\phi_R\, d\phi_S\, \sin(\phi_R+\phi_S)\left(d^7\sigma^{\uparrow} - d^7\sigma^{\downarrow}\right) \propto \pi(1-y)h_1(x)\sin 2\theta_R\, H_{1LT}(z)\,\mathcal{BW}(M^2;M_\rho^2)$$

Asymmetry for spin-one production

A. B., P. Mulders, PRD 62 (2000)

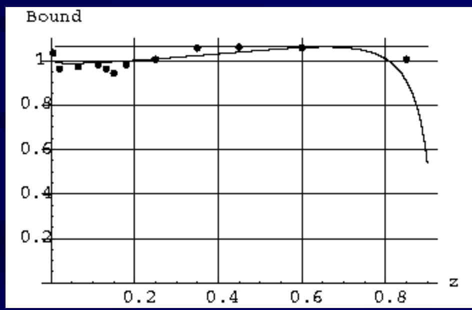
$$A_T\langle\sin(\phi_h+\phi_S)\rangle(x,y,z,\theta_R) = \frac{(1-y)}{\left(1-y+\frac{y^2}{2}\right)}\,\frac{h_1(x)\sin 2\theta_R H_{1LT}(z)}{f_1(x)D_1(z)}$$

Positivity bound on H_{1LT}

A. B., P. Mulders, PLB 518 (2001)

$$H_{1LT}(z) \le \sqrt{\left(D_1(z) + \frac{2}{3} B_1(z)\right)\left(D_1(z) - \frac{1}{3} B_1(z)\right)} \le \frac{3}{2\sqrt{2}} D_1(z)$$

$$\frac{H_{1LT}(z)}{D_1(z)}$$



Example: positivity bound on H_{1LT} obtained from OPAL data for K*(892)

Summary for spin-one production

- The study of the dependence on the angle θ_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.