Definitions of multiplicity for COMPASS and HERMES.

Let us define

$$\sigma_0 = \frac{2\pi \alpha_{em}^2}{Q^2} \frac{1+(1-y)^2}{y}$$

so that DIS cross-section at LO is

$$\frac{d\sigma^{DIS}}{dx\,dy} = \sigma_0 \sum_q e_q^2 f_{q/p}(x, Q^2)$$

and

$$\frac{d\sigma^{DIS}}{dx\,dQ^2} = \frac{\sigma_0}{sx} \sum_q e_q^2 f_{q/p}(x, Q^2)$$

HERMES defines multiplicity as

$$M_n^h(x, Q^2, z, P_{hT}) = \frac{1}{\frac{d\sigma^{DIS}}{dx\,dQ^2}} \frac{d^4\sigma}{dx_B\,dQ^2\,dz\,dP_{hT}}$$

where n denotes the kind of the target, h is the produced hadron.

COMPASS defines multiplicity as:

$$\frac{d^2 n^h(x, Q^2, z, P_{hT}^2)}{dz_h dP_{hT}} \equiv \frac{1}{\frac{d^2\sigma^{DIS}}{dx\,dQ^2}} \frac{d^4\sigma}{dx\,dQ^2 dz_h dP_{hT}}$$

so that we have the following relation

$$M_n^h(x, Q^2, z, P_{hT}) = 2 P_{hT} \frac{d^2 n}{dz_h dQ^2}$$

that we can use to relate COMPASS and HERMES.

Nobuo has calculated $\frac{d^2\sigma^{DIS}}{dx\,dQ^2}$ for all bins

of experimental data.

For deuteron $\sigma^{DIS} = \sigma_p^{DIS} + \sigma_N^{DIS}$

We also here :

$$\frac{d\sigma}{dx\, dQ^2 dz\, dP_{hT}} = 2\pi \frac{\sigma_0}{sx} P_{hT} \int_0^\infty \frac{db\, b}{(2\pi) z^2} J_0\left(\frac{P_{hT}\, b}{z}\right) \cdot$$

$$\cdot\ \tilde{f}_1(x, b)\ \tilde{D}_1(z, b)$$

where (in my notations)

$$\tilde{f}_1(x, b) \equiv f_1(x, c/b_*) \exp\left\{ -\int_{c/b_*}^{Q} \frac{d\mu}{\mu}\left(A \ln\frac{Q^2}{\mu^2} + B\right)\right\} \cdot$$

$$\cdot \exp\left\{ -b^2 \left(\frac{\langle k_\perp^2 \rangle}{4}\right) + \frac{g_2}{2} \ln\frac{b}{b_*} \ln\frac{Q}{Q_0} \right)\Big\}$$

$$\tilde{D}_1(z, b) \equiv D_1(z, c/b_*) \exp\left\{ -\int_{c/b_*}^{Q} \frac{d\mu}{\mu}\left(A \ln\frac{Q^2}{\mu^2} + B\right)\right\} \cdot$$

$$\cdot \exp\left\{ -b^2 \left(\frac{\langle p_\perp^2 \rangle}{4z^2}\right) + \frac{g_2}{2} \ln\frac{b}{b_*} \ln\frac{Q}{Q_0} \right\}$$

(Note , $\frac{\sigma_0}{sx} = \frac{2\pi \alpha_{em}^2}{Q^4}(1 + (1-y)^2)$ is called

σ_0 in Kang, Echevarria)

Nobuo reports in his calculation

$$F_2 \equiv x \sum_q e_q^2 f(x, Q^2)$$

so that, if we define

$$F_{UT} \equiv x \sum_q e_q^2 \int_0^\infty \frac{db\, b}{2\pi} J_0\left(\frac{P_{hT}\, b}{z}\right) \tilde{f}_1(x,b) \frac{\tilde{D}_1(z,b)}{z^2}$$

then multiplicity becomes

$$M_n^h(x, Q^2, z, P_{hT}) = 2\pi P_{hT} \frac{F_{UT}}{F_2}$$