DIS $x \to 1$ Factorization

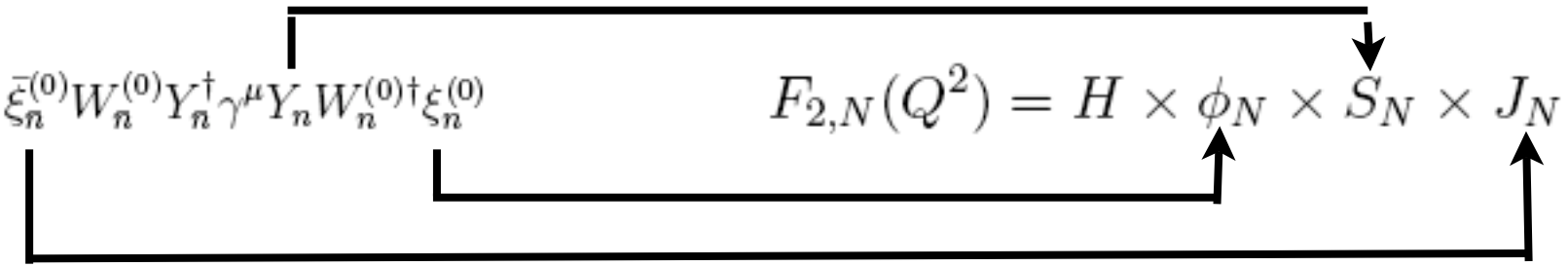
- analyzed by Sterman 20 years ago
- many (too many?) SCET analyses

(Manohar; Chay & Kim; Chen,et. al.; Idilibi, et. al.; Pecjak; Becher, et. al.; Idilbi & Mehen,...)

Is there consensus on how to analyze this process?

- Idilbi & Mehen, hep-ph/0702022 (see Idilbi's talk)

$$j^\mu = C(Q^2)\, \bar{\xi}_n^{(0)} W_n^{(0)} Y_n^\dagger \gamma^\mu Y_n W_n^{(0)\dagger} \xi_n^{(0)} \qquad F_{2,N}(Q^2) = H \times \phi_N \times S_N \times J_N$$



reproduce Sterman's fact. theorem

zb subtraction in collinear matrix elements ϕ, J essential:

- reproduce QCD virtual, tree level IR divergences (pure DR)
- get right jet UV divergences, anomalous dimension

- Chay and Kim., hep-ph /0511066

Similar analysis, zb subtraction in jet function ?

Why are there subleading terms in the one-loop calculation

$$\left[M_a + M_b + M_c\right]_q = \frac{\alpha_s C_F}{2\pi} \frac{\not{n}}{2} \frac{1}{\epsilon} \left[2\delta(\omega - \omega') + \frac{1 + (\omega/\omega')^2}{(\omega' - \omega)_+} \theta(\omega' - \omega)\theta(\omega)\right],$$

$$\omega/\omega' \longrightarrow 1$$

Why isn 't this 2?!?!

- Manohar, hep-ph/0309268

New Notation!!!!

$$\omega/\omega' \longrightarrow \omega$$

Same issue (pre zb subtraction)

$$P_{q \leftarrow q}(w) - C_F\,(1 - w)$$

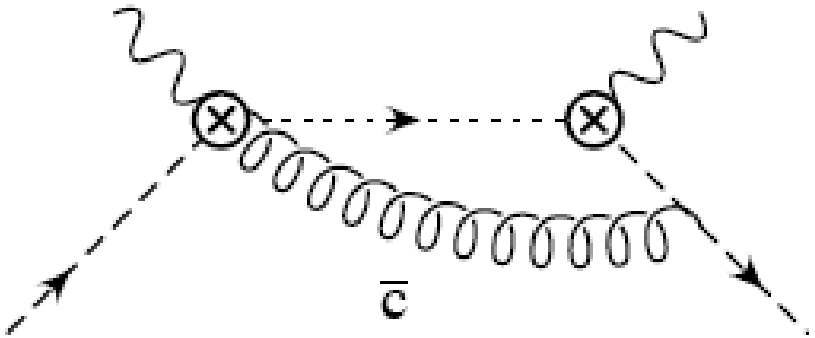
$$P_{q \leftarrow q}(w) \;=\; C_F \left[\frac{1 + w^2}{(1 - w)_+} + \frac{3}{2}\delta(1 - w)\right] \theta\,(0 \leq w \leq 1)\,.$$

- Becher et. al., hep-ph/0607228

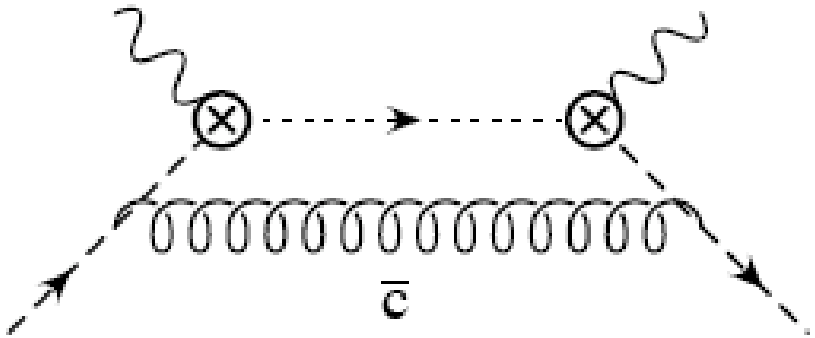
Same fact. thm. (if s-c modes decoupled from BOTH c and h-c modes)

Correct $x \longrightarrow 1$ limit:

Contribution from 'forbidden graphs' which are removed by 'in-out' rule



Is Subtracted by zero-bin (purely soft)



This is subleading in SCET powercounting and should automatically be excluded!

How do we know that the 'in-out' rule works to remove these types of contributions in other processes