- REACTIONS TO CONSIDER (AND NAMING)

$e^+e^- \to h + X$ SINGLE-INCLUSIVE ANNIHILATION

SIA

$e^+e^- \to h + h + X$ 2-HADRON-INCLUSIVE ANNIHILATION

2HIA? 2IA?

DOUBLE-INCLUSIVE ANNIHILATION

DIA ?

(SHOULD IT BE DISTINGUISHED FROM $e^+e^- \to (hh) + X$ DIHADRON ?)

$e^+e^- \to h + \text{jet} + X$

$e^+e^- \to (h\ \text{jet}) + X$

$e^+e^- \to \text{jet} + \text{jet} + X$ (SCET COMMUNITY)

- REACTIONS

$ep \to e h + X$

$ep \to e(hh) + X$

$ep \to e(hJ) + X$

$ep \to e + h + J + X$ (HIGHER ORDERS, GLUONS ...)

$ep \to e + J + J + X$

- REACTIONS (CONT.)

$pp \to h + X$

$pp \to h + h + X$

$pp \to (hh) + X$

$pp \to h + \text{jet} + X$

$pp \to (hj) + X$

$pp \to \text{jet} + \text{jet} + X$

- HOW TO DISTINGUISH EMISPHERES IN 2-HADRON-INC. ANNIHILATION?

USE $$\frac{P_{h1}}{z_1} \cdot \frac{P_{h2}}{z_2} > \left(\frac{Q}{2}\right)^2$$

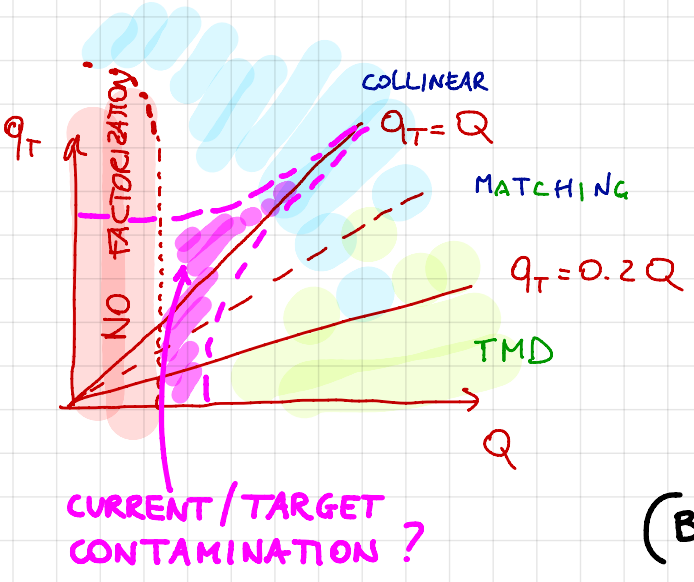
"STRESA CRITERION"

TO BE SURE THAT YOU CAN REALLY DISTINGUISH SINGLE-HADRON / DIHADRON FF YOU SHOULD PROBABLY INCREASE THE CUT VALUE OR USE q_T INFORMATION

- WHAT ABOUT THRUST CUTS?

AT LO AND PROBABLY IN MOST OF THE "SAFE" REGIONS (E.G., LOW q_T)
THE PROCESS CAN BE STILL DESCRIBED BY THE SAME FF
HOWEVER, THIS COULD PROBABLY LEAD TO FORMALLY DIFFERENT OBJECTS (DIFFERENT FACTORIZATION AND EVOLUTION)

- ANALOGOUS PROBLEM IN SIDIS



- NEED TO FIND A NICE WAY TO DISTINGUISH CURRENT / TARGET

- IMPACTS ALSO COLLINEAR OBSERVABLES (BOTH HIGH q_T AND INTEGRATED)

- MAYBE LOOK AT SOMETHING ANALOGOUS TO STRESA CRITERION

$$x P_h \frac{P_h}{z} > \left(\frac{W}{2}\right)^2$$

MAYBE THE SAME AS BERGER ?

- P_{hT} vs q_T

IN GENERAL, BETTER USING q_T,

ALTHOUGH IN IDEAL SITUATIONS IT SHOULDN'T MATTER

- REGION OF VALIDITY OF TMD APPROACH

THIS IS A "THEORY" PROBLEM, NOT EXP

"RULE OF THUMB" WORKING AT HIGH Q

$$q_T < 0.2\,Q$$

· [PAVIA 2016
SCIMEMI, VLADIMIROV]

MORE DIFFICULT TO ACCEPT THIS FOR SIDIS (SEE PAVIA 2016)

(DON'T USE $0.1 < z < 0.2$ HERMES BIN)

- HADRON + JET ANNIHILATION

$e^+e^- \to \text{jet} + h + X$

NAIVELY: REPLACE THE SECOND FF WITH 1 (IN b_T SPACE)

$$\frac{d\sigma^{h_1 h_2}}{dz_1\, dz_2\, dq_T^2\, dy} = \frac{6\pi\alpha^2}{Q^2}\, A(y)\, \mathcal{H}(Q^2,\mu)$$
$$\times \sum_q e_q^2 \int_0^\infty db_T\, b_T\, J_0(q_T b_T)\, \left[z_1^2\, D_1^{q\to h_1}(z_1, b_T;\, \zeta_1,\, \mu)\, z_2^2\, D_1^{\bar{q}\to h_2}(z_2, b_T;\, \zeta_2,\, \mu) + (q \leftrightarrow \bar{q}) \right]$$
$$+ Y(q_T^2/Q^2) + \mathcal{O}(M^2/Q^2)\,, \qquad (2.8)$$

LESS NAIVE: REPLACE THE SECOND FF WITH SOME NEW FUNCTION (JET FUNCTION ?)

THAT CAN CONTAIN:

- NONPERTURBATIVE PARTS (SMEARING)
- DEPENDENCE ON SCALES (ABSORPTION OF SOFT FACTOR)
- DEPENDENCE ON JET DEFINITION

- HADRON-IN-JET FRAGMENTATION

FACTORIZATION, EVOLUTION, JET DEFINITION ...
SHOULD BE SCRUTINIZED.

$$D_1^{q \to J h}(z, k_T^2) \stackrel{?}{=} \left(J \otimes D_1^{q \to h}\right)(z, k_T^2)$$

- QED RADIATIONS

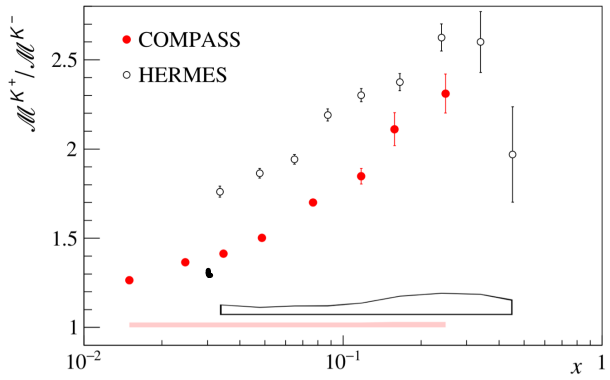
IT'S BETTER TO TAKE THEM OUT
(UNFOLDED CROSS SECTIONS
BORN CROSS SECTIONS)

- EW CONTRIBUTIONS TO FF

I HAVE SOME DOUBTS, BASED ON FORMAL CONSIDERATIONS, BUT PROBABLY IT'S NOT SO RELEVANT (THE ONLY POTENTIAL DIFFERENCE IS IN INTERFERENCE TERMS)

- HERMES/COMPASS KAON DISCREPANCY

- Figure from Phys. Lett. B 767 (2017) 133



UNRESOLVED

SUGGESTIONS

- ν DEPENDENCE NOT INCLUDED IN THEORY
- HADRON MASS CORRECTIONS (ACCARDI, GUERRERO ...) ONLY PARTIALLY HELP
- SEE WHAT JLAB DATA SAY
- DO A COMBINED HERMES-COMPASS ANALYSIS

- HOW MUCH WE KNOW ABOUT FF ?

- PRETTY GOOD KNOWLEDGE OF $D_1^{q+\bar{q}}(z)$

  NOT MUCH $D_1^{s+\bar{s}}(z)$

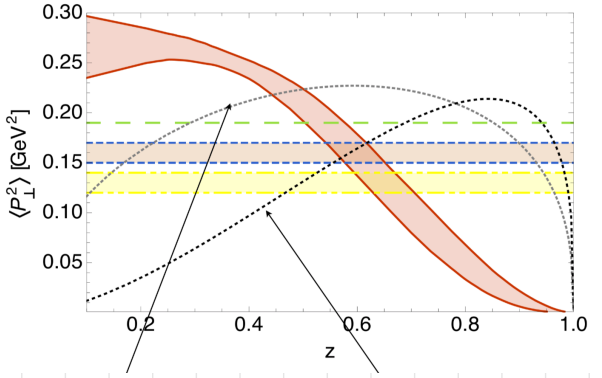
- LIMITED KNOWLEDGE ON FLAVOR-SEPARATED

  $D_1^q(z)$ $D_1^g(z)$

  PROGRESS EXPECTED SOON

- FIRST INDICATIONS OF $D_1^q(z, k_T^2)$

  PROGRESS EXPECTED



- FIT-RELATED ISSUES

- USE COVARIANCE MATRIX IF AVAILABLE

- SPECIFY THE "MEANING" OF UNCERTAINTY BANDS (E.G., $\Delta\chi^2 = ?$)

- BE CAREFUL WITH FLEXIBLE FUNCTIONAL FORMS

- INCLUDE THEORY BANDS