ENERGY FLOW OBSERVABLES

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(I) FACTORIZED CROSS SECTIONS & 'CLASSICAL' FIELDS

$$\sigma_{AB\to E} = \sum_{ab} f_{a/A} \otimes H_{ab\to E} \otimes f_{b/B} + \mathcal{O}(1/Q^2) + \cdots$$

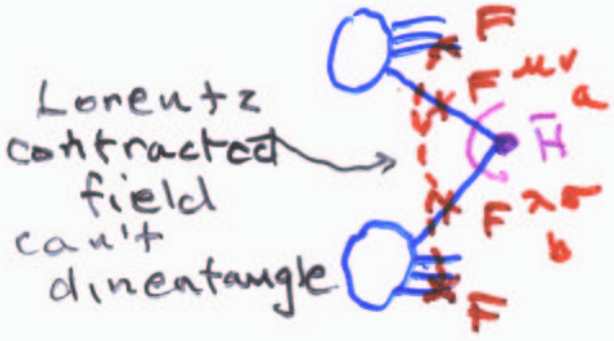
Corrections

1) 'Strong coupling' in $H_{ab\to F}$
$\alpha_s^n b_0^n n! \to 1/Q^2 + \cdots$

2) 'Multiparton' (incl'g. k_T)
$\frac{1}{Q^2}\sum_{aa';b} F_{aa'} \otimes H_{(aa')b} \otimes \cdots$

3) 'Multiple scattering' Treleani...
$\frac{1}{Q^2}\Sigma F_{aa'} \otimes h_{ab\to E_1} \otimes h_{a'b'\to E_2} \otimes F_{bb'}$

4) Nonfactoring
$\frac{1}{Q^4}\sum_{ab} \mathcal{F}_{ab} \otimes \bar{H}_{ab\to E}$



Analogy to CGC... or more in a full picture

Venugopalan
Jalilian-Marian

CAN WE DEVELOP PHENOMENOLOGICAL TOOLS TO CONTINUOUSLY CONNECT pQCD-DOMINATED AND npQCD-DOMINATED ?

II ENERGY FLOW OBSERVABLES

- LHC rapidity coverage (Eggert, Papageorgiou)
- Shower EGs (Engel)

Global Observables (Salam, Dasgupta, Banfi, Zanderighi)

- Every particle contributes, but not necess. equally
- Perturbatively calculable (IR safe) (factorized...)
- Adjustable $\{k_T, \eta$ / PT, NP

Here just test 'angularities' (Kucs, cf Berger, GS, Magnea)

$$\tau_a(N) = \frac{1}{\sqrt{s}} \sum_{i \in N} \omega_i \sin^a\theta \, (1-|\cos\theta|)^{1-a}$$

a: adjustable

$$= \frac{1}{\sqrt{s}} \sum_{i \in N} k_{iT} \, e^{-(1-a)|\eta|}$$

$0 < \tau_a < 1$

defined w.r.t. c.m. & collision axis

$$\langle \tau_a^{(LO)}(\eta) \rangle \sim \frac{1}{S} \int dx_1\, dx_2\, G_A(x_1)\, G_B(x_2)$$

$$\cdot \int d\hat{\eta}\; \delta\left(\hat{\eta} - \tfrac{1}{2}\ln\frac{x_2}{x_1}\right)$$

$$\cdot \int d\eta^*\, \frac{1}{\cosh^2 \eta^*} \cdot \left[\left(\frac{\hat{s}}{t}\right)^2 + \dots\right]$$

↑ Rutherford

$$\cdot\; \delta(\eta - \hat{\eta} - \eta^*)$$

$$\cdot\; \sqrt{x_1 x_2}\, e^{-(1-a)|\hat{\eta} + \eta^*|}$$

↑ tames IR ↑ tames CO

$$\int d\eta \langle \tau_a^{(LO)}(\eta) \rangle \sim \frac{1}{1-2\Delta} C(a) \frac{1}{2-a-2\Delta}$$

$$C(\gamma) = \int_0^\infty d\eta\, \frac{e^{(1+\gamma)\eta}}{\cosh \eta}$$

$\boxed{a < 0}$ ✗ FOR IR Safety

(compare e^+e^-: $a < 2$ OK)

$a<0 \rightarrow$ IR stable: calculable for multiple minijet cross sections

Typical Observables:

- $\langle \tau_a^m(N) \rangle_N$ expectations fluctuations

- $\sum_N \tau_a^*(N)\, W_{trigger}^{(N)}$ correlations

e.g.

$$\sum_N |\langle N, J | pA \rangle|^2 \cdot \delta(p_T - p_{TJ})\, \delta(\eta - \eta_J) \cdot e^{-\nu \tau_a(N)}$$

PERHAPS ν dependence vs $p_T \Rightarrow$ rapidity response of particles at 'large' η to hard scattering

Frankfurt Strikman

IF NOT THIS SET OF SHAPES; PERHAPS ANOTHER...