# Jet Algorithms and energy flow – logarithmic surprises

Mrinal Dasgupta

University of Manchester

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# Outline

#### • Definitions used in gaps between jets studies at HERA.

- Resummation and non-global logarithms.
- Reducing the non-global component via k<sub>t</sub> clustering.
- Recently uncovered problems in theoretical predictions.
- Impact of new findings, other variables affected.
- Further resummed results and conclusion.

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# Definitions

One way of quantitatively describing gaps between hard jets is in terms of  $E_t$  flow into the gap. Thus we study the differential distribution

 $\frac{1}{\sigma}\frac{d\sigma}{dQ_{\Omega}}.$ 

 $Q_{\Omega}$  is sum over  $E_t$  of emissions inside the gap :

 $Q_{\Omega} = \sum_{i \in \Omega} E_{t,i}.$ 

Here the sum can refer to either a sum over hadrons or a sum over minijets in the gap. Minijets are soft jets obtained after running a jet algorithm e.g  $k_t$  clustering. Commonly used definition experimentally (H1 ,ZEUS).

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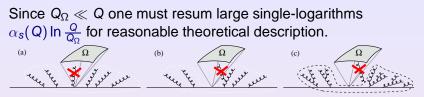
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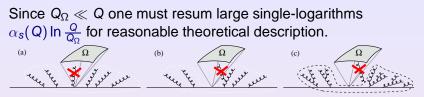
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$$\frac{d\sigma}{dQ_{\Omega}} = \frac{d}{dQ_{\Omega}} \left[ e^{-R(Q/Q_{\Omega})} S(Q/Q_{\Omega}) \right]$$

*R* independent-emission piece, exponentiates one gluon result. S represents effects of correlated soft emission, only numerical results for two/(1+1) jets, in large  $N_c$  limit exist.

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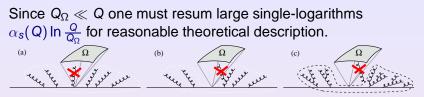
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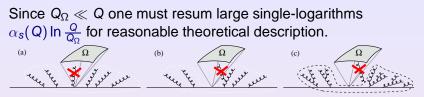


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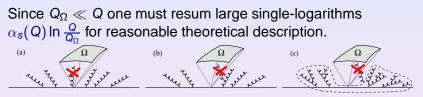
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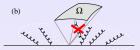
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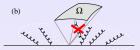
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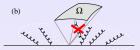
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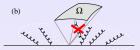


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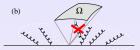
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Computed just primary emission piece (analogous to  $e^{-R}$ ) exactly. More complicated colour structure with colour anomalous dimension matrices.

- Approximated NG component, arguing that it's small.
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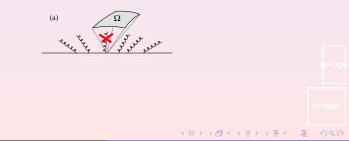
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## New terms due to clustering

- There are algorithm dependent single-log pieces in addition to e<sup>-R</sup>S.
- Discovered while studying jets e.g azimuthal correlations between dijets near  $\phi = \pi$ .
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 Take 2/(1+1) jet-case. The energy-ordered independent emission prob. for 2 gluons k<sub>1</sub> and k<sub>2</sub>:

 $M^2 = C_F^2 \alpha_s^2 W_{ab}(k_1) W_{ab}(k_2)$ 

while the one-real one-virtual term reads

 $M^2 = -C_F^2 \alpha_s^2 W_{ab}(k_1) W_{ab}(k_2)$ 

• Only real-virtual piece contributes to  $Q_{\Omega}$  distribution if

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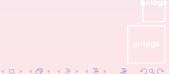
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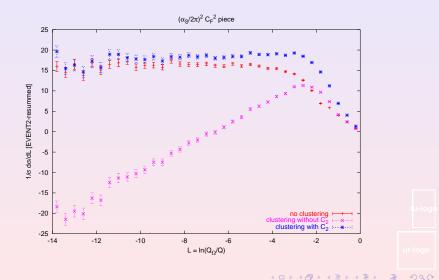
Leading  $\mathcal{O}\left(\alpha_{s}^{2}\right)$  correction thus obtained :

$$C_2^{\text{indep.}} = rac{16}{3\pi} C_F^2 \left( lpha_s^2 L^2 
ight) r^3, \ \Delta \eta \geq r.$$

Need to integrate the real-virtual piece over region where pure real emission are clustered away. Not accounted for by  $e^{-R}S$  form.

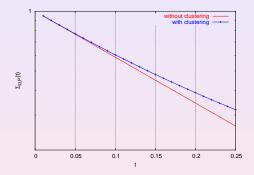


## Comparisons with EVENT2



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# Resummation



Straightforward numerically in the 2 jet or 1+1 jet (DIS) cases. Replace  $C_A/2$  by  $C_F$  and turn-off correlated emission in MC developed to treat NG logs.

Image: A math a math

- Another finding : NG logs may be reduced even further by clustering than found by AS. This would mean the effect here is the main complication.
- Need to understand its computation in cases with more complicated colour structure e.g photoproduction and dijets in pp collisions.
- Work on this is in progress through dijet resummations in DIS and pp collisions
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