Azimuthal decorrelation between jets at all orders in QCD hard processes

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Precision at the LHC

- New physics @ the LHC $\Rightarrow$ How one can distinguish massive jets originating from signals from QCD jets backgrounds?
- New tools to boost search for new physics: e.g. jet substructure for boosted objects aim: background/signal discrimination

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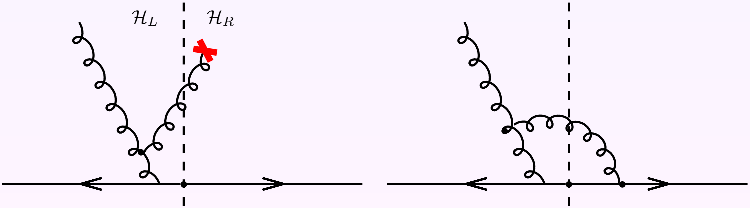
- Exclusive boundary of phase space i.e.,$\Delta \to 0$. Large logarithms arise.



Vetoed emission

Accepted emission

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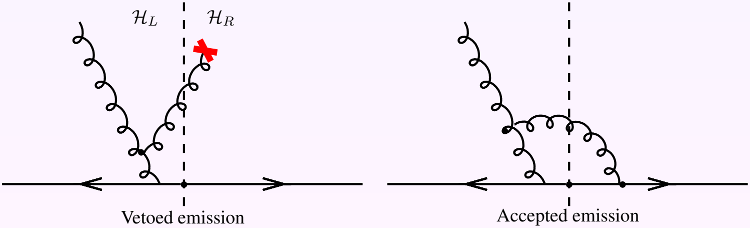
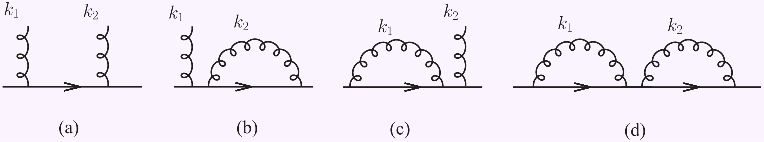


Motivation

- Employing the four vector recombination scheme ($E-$scheme), the observale at hand is non-global⇒(NGLs).
- k_t clustering algorithm ⇒ NGLs significantly diminish.
- k_t clustering algorithm ⇒ "clustering logs" (CLs).
- Consider the emission of two energy ordered gluons k_1 and k_2 with $(k_1 \ll k_2)$ off a primary dipole as shown in Fig.2



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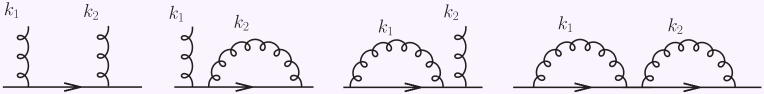

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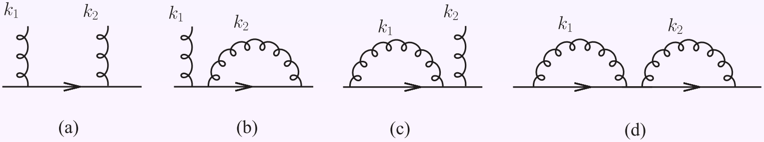

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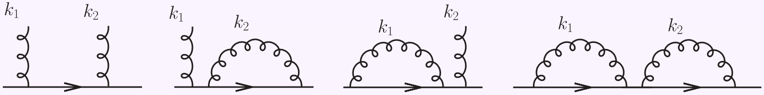

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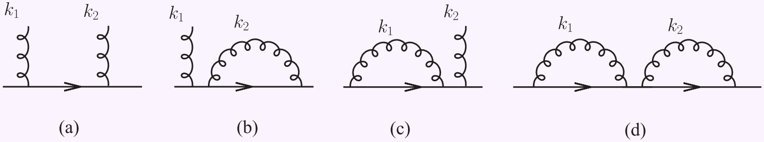

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Kinematics and observable definition

- The azimuthal decorrelation defined by the azimuthal angle $\Delta\phi = |\phi_{j1} - \phi_{j2}|$ in DIS.In this work we consider the process in which soft gluons are emitted in di-jet production in DIS

$$\left(q + p_0 \to p_1 + p_2 + \sum_i^n k_i\right),$$

- We assume these emissions to be strongly ordered such that at order n we have $k_{tn} \ll \cdots \ll k_{t2} \ll k_{t1} \ll p_t$,
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$$\vec{p}_{t1} = p_{t1}\,(1, 0)\,,$$
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Resummed global result

- The real emission contribution to the integrated distribution is given by

$$\Sigma(\Delta)^r = \sum_{\delta} \int \mathrm{d}\mathcal{B}\, \sigma^{\delta}_{\mathcal{B}} \sum_{n} \int \mathrm{d}P^a_n \Theta \left(\Delta - \sum_{\notin jets} \frac{k_{ti}}{pt} |\sin \phi_i| \right) ,$$

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- $$\Theta\left(\Delta - \delta\phi\right) = \sum_{\delta} \int \mathrm{d}\mathcal{B}\sigma_{\mathcal{B}}^{\delta} \int_{-\infty}^{+\infty} \frac{1}{\pi}\frac{\mathrm{d}b}{b}\sin(b\Delta)\prod_{i}^{n}\exp\left(ib\frac{k_t}{p_t}|\sin\phi|\right)$$

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$$\mathcal{I}_{02} = \frac{-1}{4\pi\beta_0 N_c}\left[\frac{-\beta_1}{\beta_0^2}\left(\frac{1}{2}\ln^2(1-2\lambda)\right) + \frac{\ln(1-2\lambda)+2\lambda}{1-2\lambda} - L\frac{\ln(1-2\lambda)+2\lambda}{\lambda} - 4\ln 2\frac{\lambda}{1-2\lambda} - \ln(1-2\lambda)\left(2B_0 + 2\ln\frac{Q_{13}^2}{p_t^2} - 2\ln R - \left(\frac{1}{4}+\frac{\exp(\Delta\eta)}{2(1+\cos\Delta\eta)}\right)R^2 - \left(\frac{1}{288} + \frac{1}{32}\frac{1}{\cosh^4}\frac{\Delta\eta}{2}\right)R^4 - \left(\frac{1}{3}\frac{1}{\sinh^6}\Delta\eta\sinh^8\frac{\Delta\eta}{2}\right)R^6\right)\right]$$

2. The jet-jet dipole

$$\mathcal{I}_{12} = \frac{-2}{N_c}\frac{1}{4\pi\beta_0}\left[-\ln(1-2\lambda)\left(2\ln 2 - 2\ln R + 2\ln\cosh\frac{\Delta\eta}{2} - \tanh^2\left(\frac{\Delta\eta}{2}\right)\frac{R^2}{4} - \frac{(-5+\cosh\Delta\eta)^2}{1152\cosh^4\frac{\Delta\eta}{2}}R^4 - \mathcal{O}(6)\right)\right]$$

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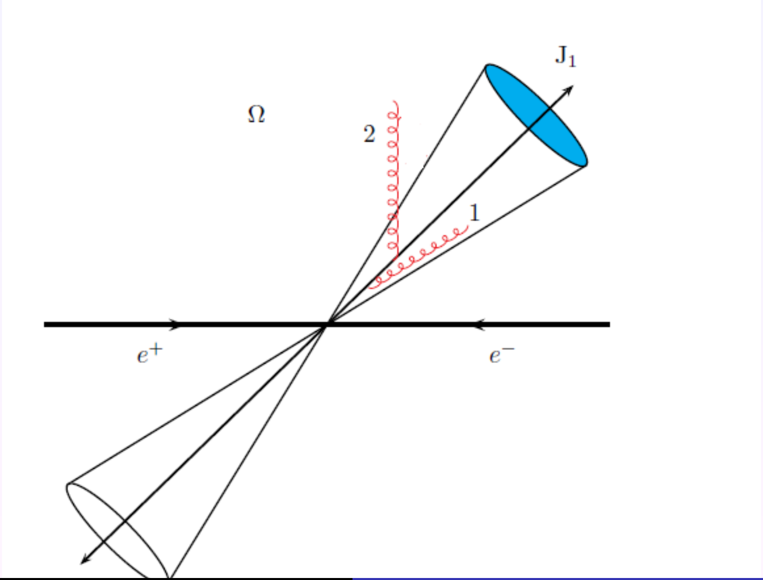
NGLs at two-loops with anti-k_t



Future directions

- The gobal part
- NGLs and CLs logarithms at two-loops for the three dipoles .i.e., the in-jet dipole and jet-jet dipole.
- Reummation of NGLs and CLs to all orders numerically in the large N_c limit.
- We shall perform a matching of the resummed distribution to next-to-leading order results from Madgraph and compare our findings with the output of the Monte Carlo event generator Pythia8.
- After accounting for non-perturbative effects we compare our results with available experimental data.

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