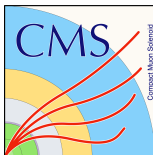


High p_T -jets angular correlations in CMS.

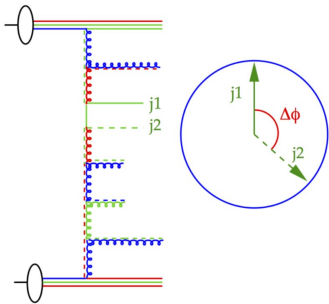
A. Bermudez Martinez on behalf of the QCD group

HLHE-LHC WG1 Meeting – QCD Physics

March 2, 2018

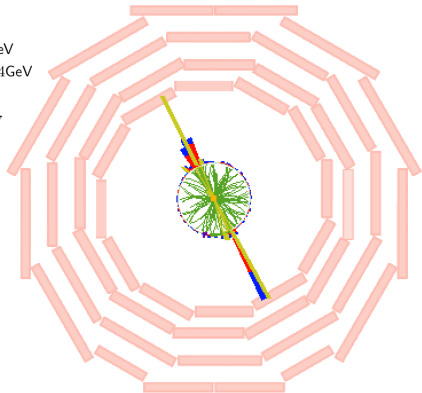


Back-to-back topologies



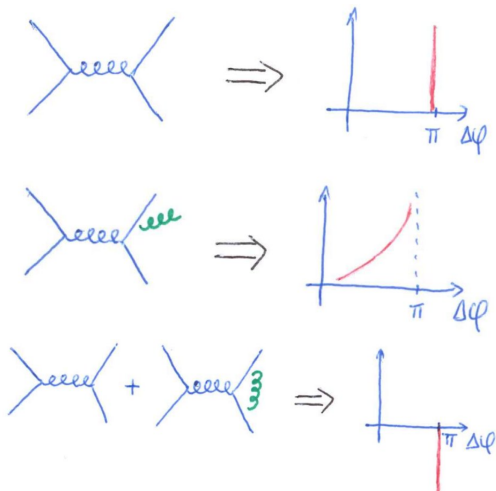
CMS Experiment at LHC, CERN
Data recorded: Sun Aug 14 13:01:17 2016 CEST
Run/Event: 278820 / 21368498
Lumi section: 18

Leading $p_T = 696\text{GeV}$
Subleading $p_T = 694\text{GeV}$
Leading $y = 0.23$
Subleading $y = 0.57$
 $\Delta\phi_{1,2} = 178.2^\circ$



Why is it interesting?

- Not addressable at fixed order in pQCD \rightarrow sensitive to all orders.
- Test for resummation strategies.



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-

$$\int \left[\left| \text{diagram 1} \right|^2 + \left| \text{diagram 2} + \text{diagram 3} \right|^2 \right] d\phi_{\text{rad}} = \text{finite}$$

The equation shows two terms in brackets, each representing the squared magnitude of a sum of Feynman diagrams. The first term is the square of a single diagram with a gluon emission from a quark line. The second term is the square of the sum of two diagrams: one with a gluon emission from a quark line and another with a gluon emission from a ghost line. The integration is over the phase space of the radiated gluon, and the result is finite.

$$\text{If } p_T^{\text{rad}} \sim 30 \text{ GeV} \text{ and } -\frac{\alpha_S}{2\pi} \ln^2 \frac{(p_T^{\text{rad}})^2}{(p_T^{\text{max}})^2} \sim 1 \Rightarrow p_T^{\text{max}} \sim 2 \text{ TeV}$$

- Truly perturbative resummation effects at large scales

Why is it interesting?

- Not addressable at fixed order in pQCD \rightarrow sensitive to all orders.
- Test for resummation strategies.
- Factorization (collinear/kt) and factorization breaking.

q_T

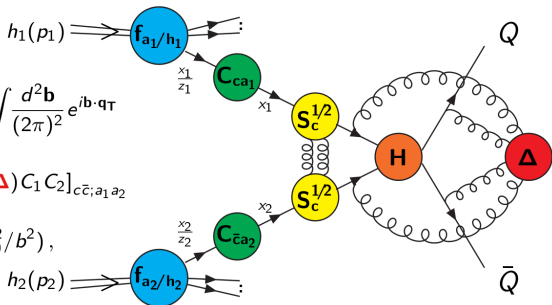
Resummation for heavy-quark hadroproduction

[Catani, Grazzini, Torre ('14)]

$$\frac{d\sigma^{(res)}}{d^2\mathbf{q}_T dM^2 dy d\Omega} = \frac{M^2}{s} \sum_{c=q,\bar{q},g} \left[d\sigma_{c\bar{c}}^{(0)} \right] \int \frac{d^2\mathbf{b}}{(2\pi)^2} e^{i\mathbf{b}\cdot\mathbf{q}_T}$$

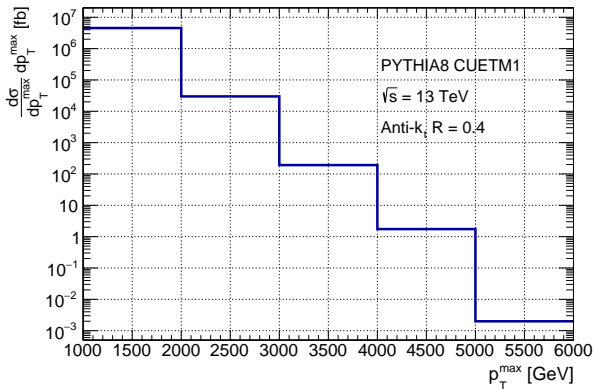
$$\times S_c(M, b) \sum_{a_1, a_2} \int_{x_1}^1 \frac{dz_1}{z_1} \int_{x_2}^1 \frac{dz_2}{z_2} [(\mathbf{H}\Delta) C_1 C_2]_{c\bar{c}; a_1 a_2}$$

$$\times f_{a_1/h_1}(x_1/z_1, b_0^2/b^2) f_{a_2/h_2}(x_2/z_2, b_0^2/b^2),$$

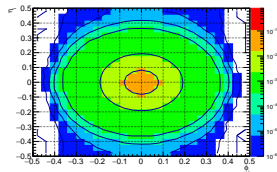


How far can we get?

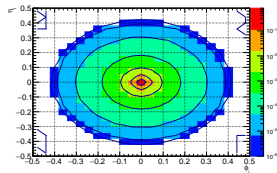
- Absolute leading jet cross section in bins of p_T^{\max}
- Luminosity $36\text{fb}^{-1} \rightarrow 100\text{fb}^{-1} \rightarrow 300\text{fb}^{-1} \rightarrow 3000\text{fb}^{-1}$
- $3000\text{fb}^{-1} \Rightarrow N_{\text{jets}}^{p_T > 4000\text{GeV}} \sim 6000$



$p_T \sim 30\text{GeV}$



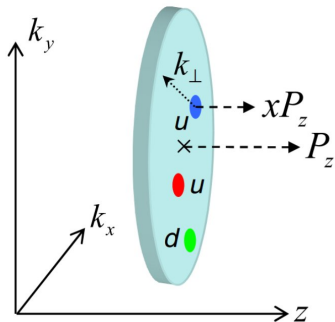
$p_T \sim 5000\text{GeV}$



How far can we get?

- Reaching high fractions of proton momentum

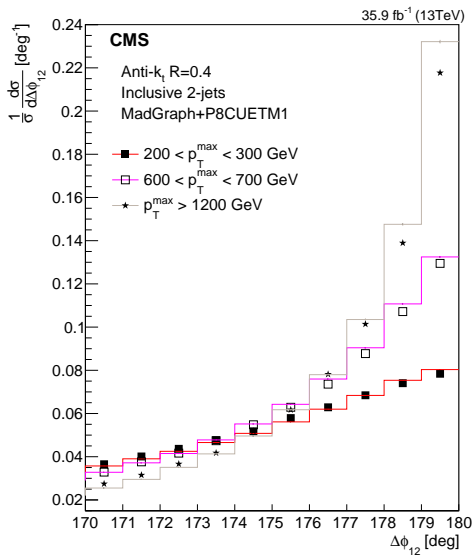
p_T^{max} [GeV]	x
1000	~ 0.15
2000	~ 0.30
3000	~ 0.46
4000	~ 0.61
5000	~ 0.77



EPL 88 61001 (5pp)

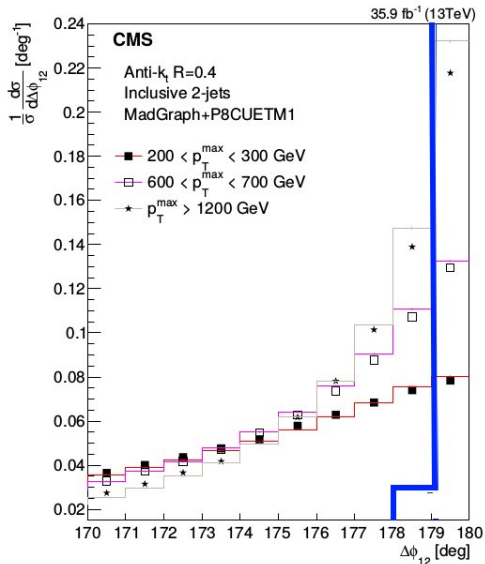
What do we have so far?

- Back-to-back region increasingly important with p_T^{\max}
- $\Delta\phi$ resolution $\sim 0.5^\circ$



What we would like to see

- Back-to-back region increasingly important with p_T^{\max}
- $\Delta\phi$ resolution $\sim 0.5^\circ$
- **Going to the extremes**



Conclusions and outlook

- Pencil-like high- p_T jets of up to 5 TeV
- Probing large fractions of proton momentum
- Probing truly perturbative resummation effects
- Testing factorization, factorization breaking?

Thank you for your attention.