Azimuthal correlation in high p_t dijet events at 13 TeV

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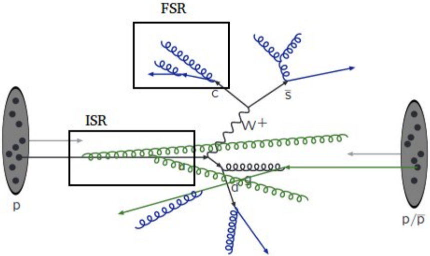
Introduction

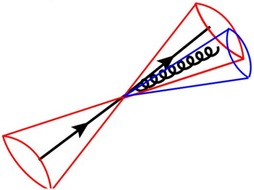


In a pp collision a bunch of particles are produce as jets.

Why not an exact back to back configuration?

- QCD radiation (Parton Shower)
- Additional hard jets are emitted as correction beyond the LO

Introduction



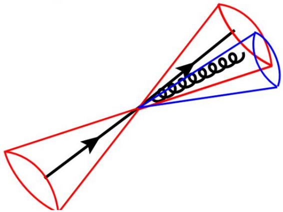
Soft gluon emissions

- The cross section for soft gluon radiation tends to infinity as the p_t of the emitted gluon tends to 0
- The Soft gluon resummation formalism is needed to solve the divergence

Why could the back to back region be interesting?

- Soft emissions affect the p_t of the dijet system $\rightarrow$ sensitive to soft gluon resummation
- Specially if the $p_{Tlead} > 3TeV$ (and sublead), soft emissions could be considered as $p_t \sim 30GeV$ (detectable)

Introduction



We will focus on the scenarios where the two leading jets have $p_t > 3\,TeV$ and also in the almost back to back configuration $175^\circ < \Delta\phi < \pi$

PYTHIA

In Pythia only $2 \rightarrow 2$ processes are considered (LO) with Parton Shower (LL)

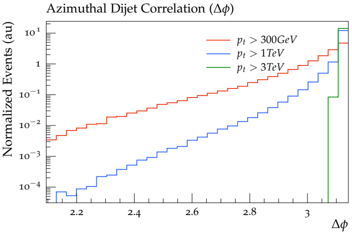
What we have now in Data

- $p_t > 1\,TeV \approx 500K$ events
- $p_t > 2\,TeV \approx 2K$ events
- Resolution on $\Delta\phi$ of 0.5°

Mean features high p_t dijet system

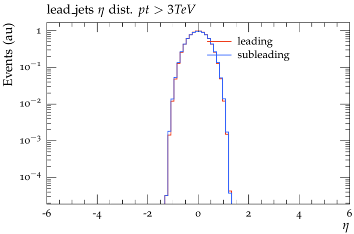
Using ANTIKT Algorithm $R = 0.4$

$\Delta\phi(\phi_{lead} - \phi_{sublead})$ distribution



High p_t jets system are closer to π

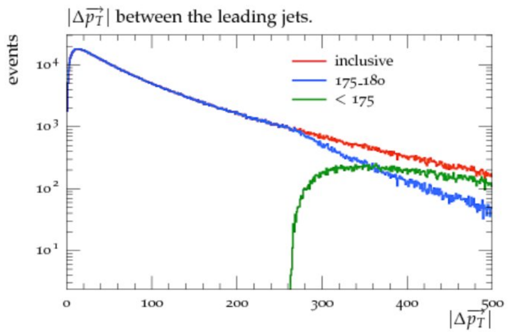
η distribution



Note that $|\eta| < 1.5$

$|\Delta \overrightarrow{p_t}|$

$$|\Delta \overrightarrow{p_t}| = |\overrightarrow{p_t}_{\,lead} + \overrightarrow{p_t}_{\,sublead}|$$



$$\phi' = \pi - \Delta\phi$$

$$\phi' \sim 5^\circ \ (p_t > 3\,TeV)$$

Around 250 GeV are needed to separate the leading jets more than $\phi' \sim 5^\circ$

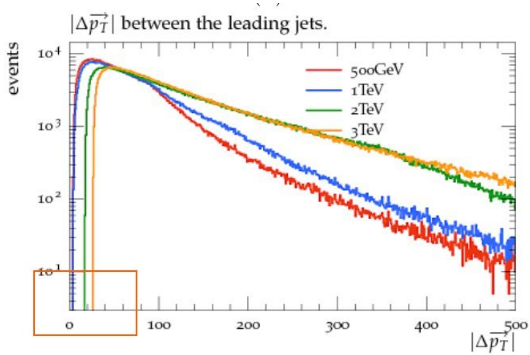
$|\Delta \vec{p_t}|$

$$\phi' = \pi - \Delta\phi$$

$\phi' \sim 0.5^\circ$,
$170^\circ < \Delta\phi < 179.5^\circ$

$\sigma / p_t \sim 0.04$
$3\,TeV \pm 0.1\,TeV$

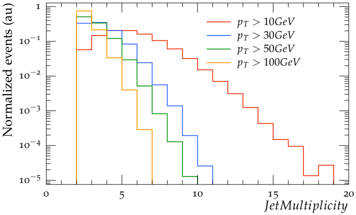
There is at least $30\,GeV$ of imbalance in the case of $p_t > 3\,TeV$



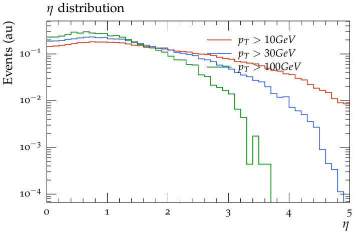
Additional jets

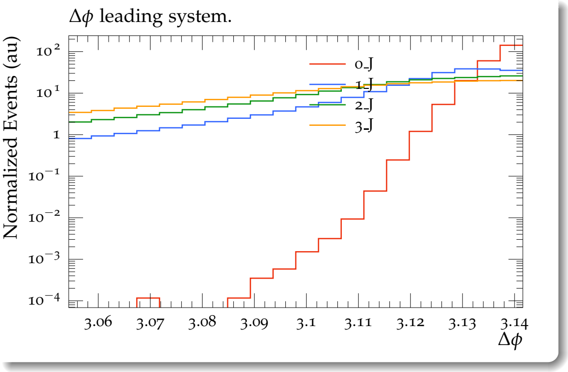
Additional jets in the event are studied taking into account events with the two leading jets above 3TeV and $175^\circ \Delta\phi < \pi$

Jet Multiplicity



η distribution



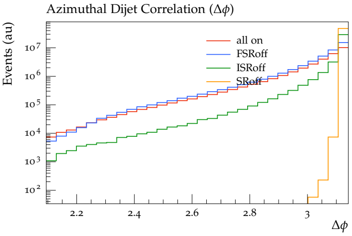


We are considering the $\Delta\phi$ distribution of the leading system when:

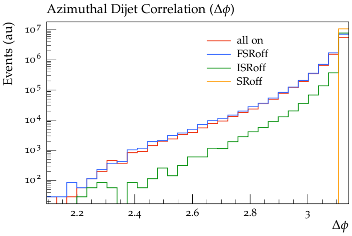
- there are no jets above $30 GeV$
- there is only one
- there are exactly 2
- there are exactly 3

Initial and Final State Radiation

$p_t > 300\,GeV$



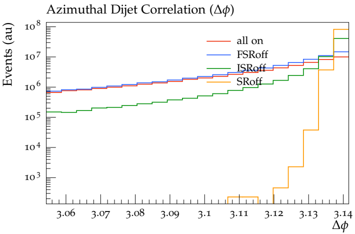
$p_t > 1\,TeV$



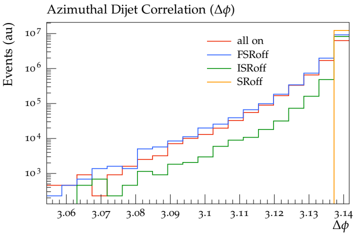
- In both cases additional Radiation (ISR and FSR) plays an important role in the azimuthal decorrelation of the leading jets
- Initial state radiation plays a major role.

Initial and Final State Radiation

$p_t > 1 TeV$



$p_t > 3 TeV$



These scenarios are sensitive to TMD since ISR have the major contribution.

New variable: ϕ^*

In analogy to Drell Yan production: two leptons in the back to back configuration.

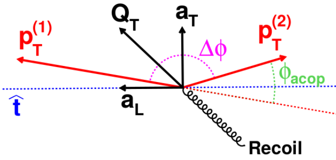
$$\hat{\mathbf{t}} = (\mathbf{p}_T^{(1)} - \mathbf{p}_T^{(2)})/|\mathbf{p}_T^{(1)} - \mathbf{p}_T^{(2)}|$$

$$a_T = \frac{2p_T^{(1)}p_T^{(2)}}{p_T^{(1)}+p_T^{(2)}} \sin\Delta\phi$$

$$Q = \sqrt{2p^{(1)}p^{(2)}(1-\cos\Delta\theta)}$$

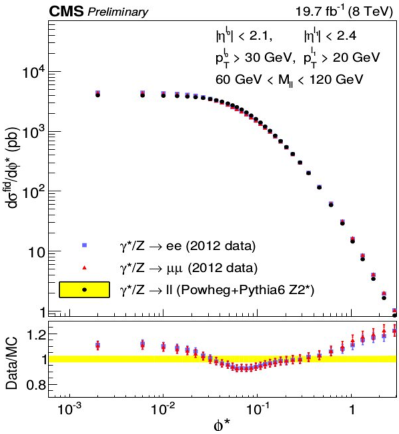
$$\phi_{acop} = \pi - \Delta\phi, \ \cos\theta_\eta^* = \tanh(\Delta\eta/2)$$

$$\phi* = a_T/Q = \tan(\phi_{acop}/2)\sin\theta_\eta^*$$



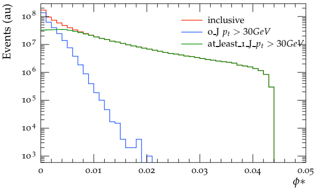
New variable: ϕ^*

CMS PAS SMP−15−002

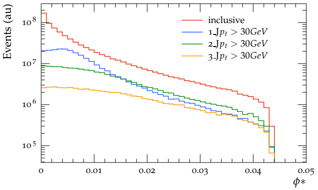


ϕ^* observable when the leading jets are above $3\,TeV$ and in the back to back region ($175^\circ \Delta\phi < \pi$)

ϕ^*



ϕ^* exclusive case



For small ϕ^* values the major contribution is given when there are no jets above $30\,GeV$ while for bigger values it is needed jets above $30\,GeV$

Summary

- High p_t jet scenarios may give us the possibility to study soft gluon resummation and TMD effects.
- We already observe those events at the LHC but we need more statistics.
- Leading system within the tracker acceptance region.
- Significant p_t imbalance ($\sim 30 GeV$) is needed to have a decorrelation of $\sim 0.5^\circ$.
- ϕ^* is a good observable for studying decorrelation effects

Outlook

- Comparisons with data as soon as we get more luminosity.

Thanks for your attention!!!