Collection of CMS Results for ICHEP

Jets, QCD, Forward Physics

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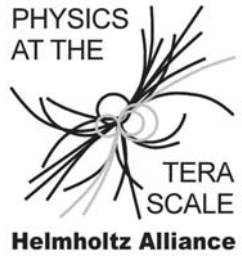
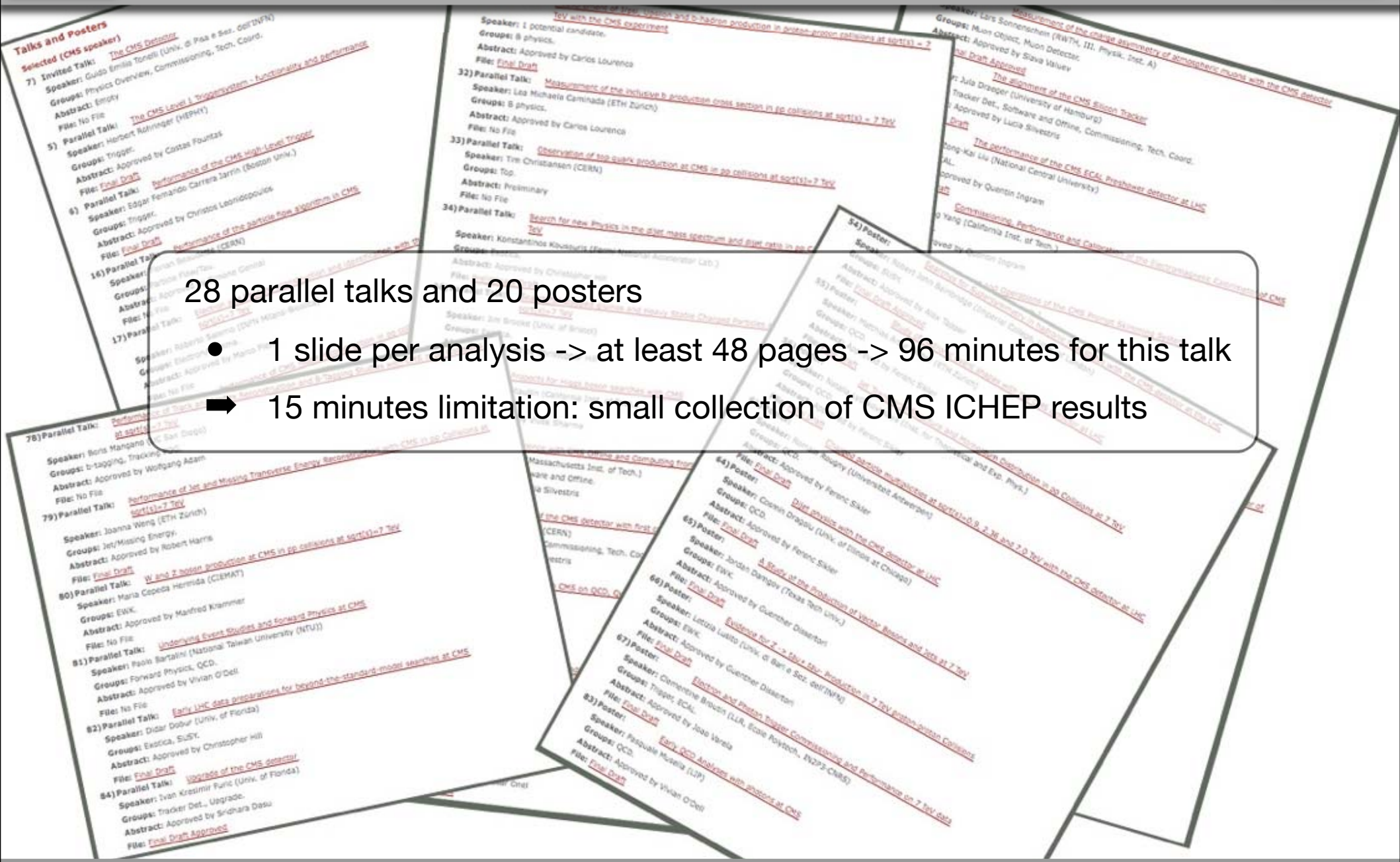
DESY





28 parallel talks and 20 posters

- 1 slide per analysis -> at least 48 pages -> 96 minutes for this talk

➡ 15 minutes limitation: small collection of CMS ICHEP results

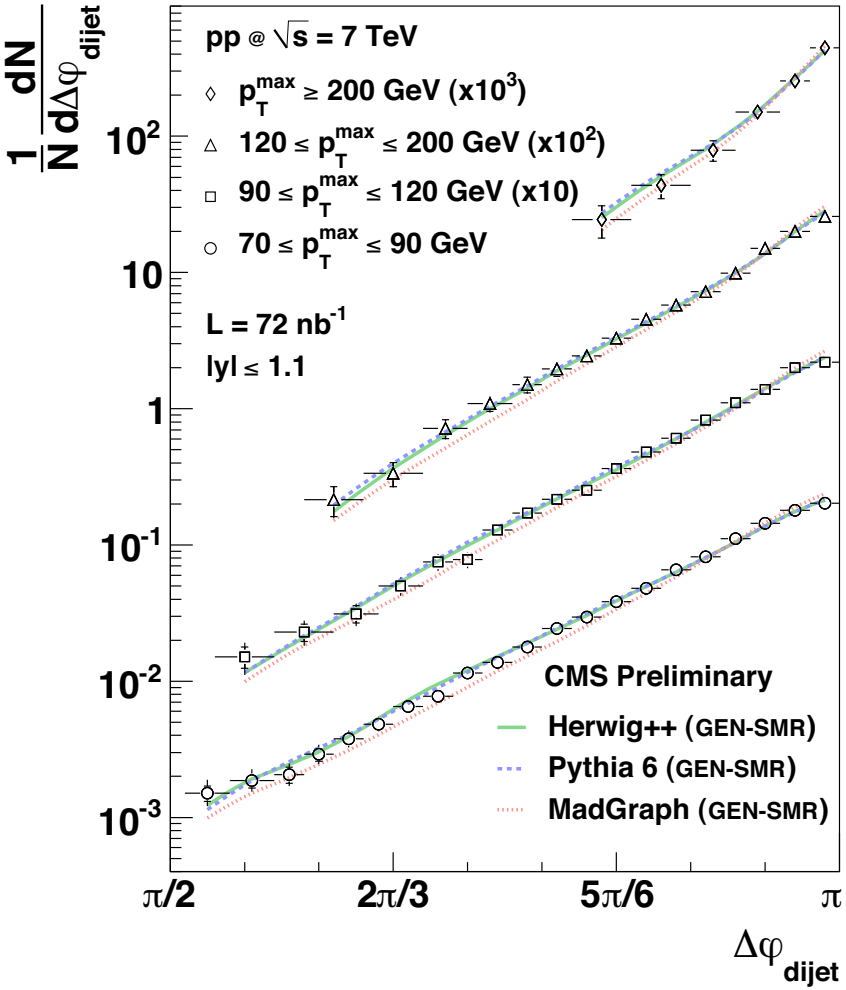
Jet Physics

Angular Decorrelations of Dijets

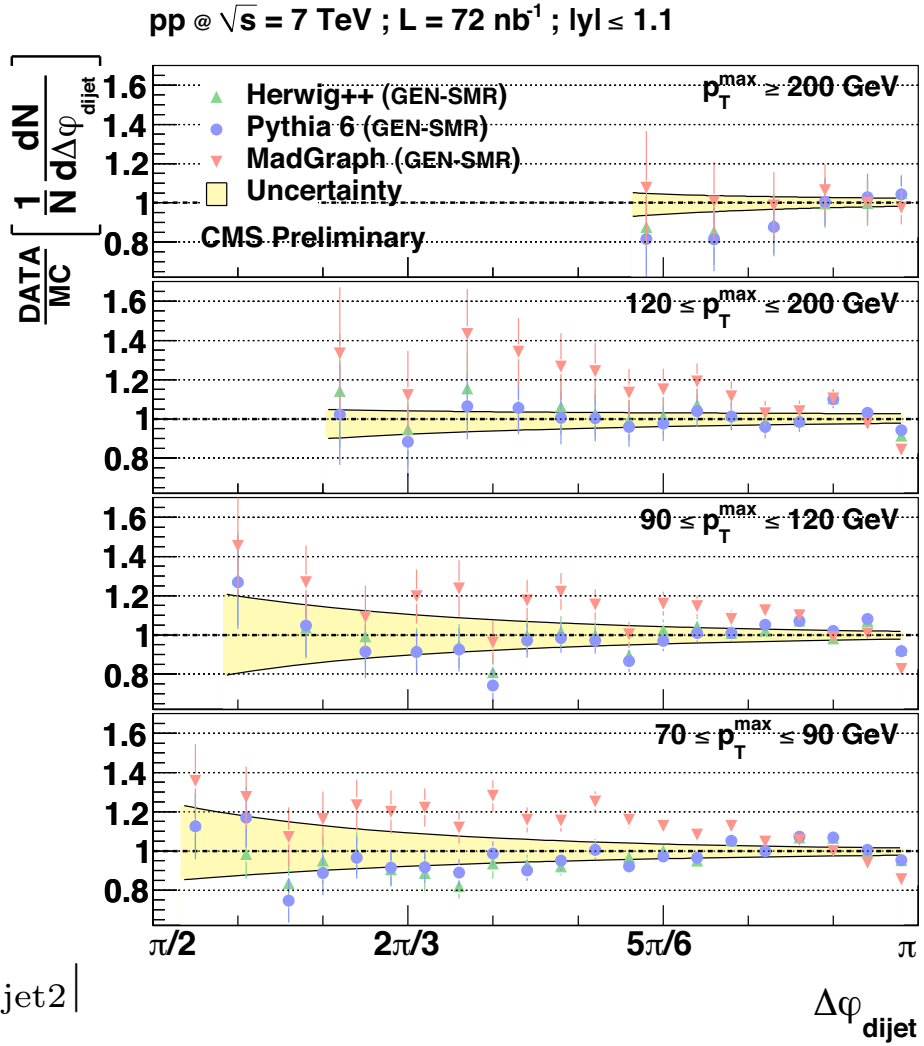
CMS PAS QCD-10-015:
Dijet Azimuthal Decorrelations and Angular Distributions in pp Collisions at sqrt(s)=7TeV

- First preliminary measurement of dijet azimuthal decorrelations and dijet angular distributions in pp@7TeV
  - ideal testing ground for pQCD
  - offers a way to study the transition between soft and hard processes
  - study higher order QCD radiation effects without explicitly reconstruct additional jets
  - sensitivity of the dijet azimuthal distributions to phenomenological parameters

Angular Decorrelations of Dijets



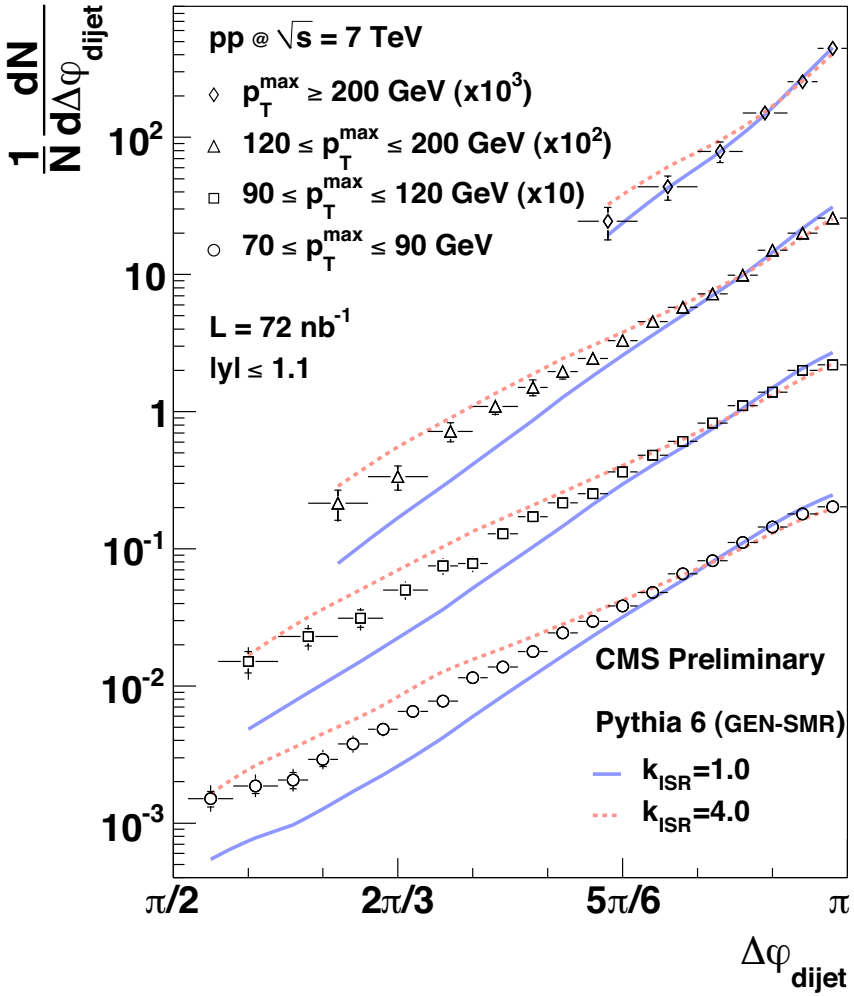
Less agreement found for MADGRAPH at low p_T



Reasonable agreement with PYTHIA and HERWIG++ is found for $\Delta\varphi_{\mathrm{dijet}} = |\varphi_{\mathrm{jet1}} - \varphi_{\mathrm{jet2}}|$

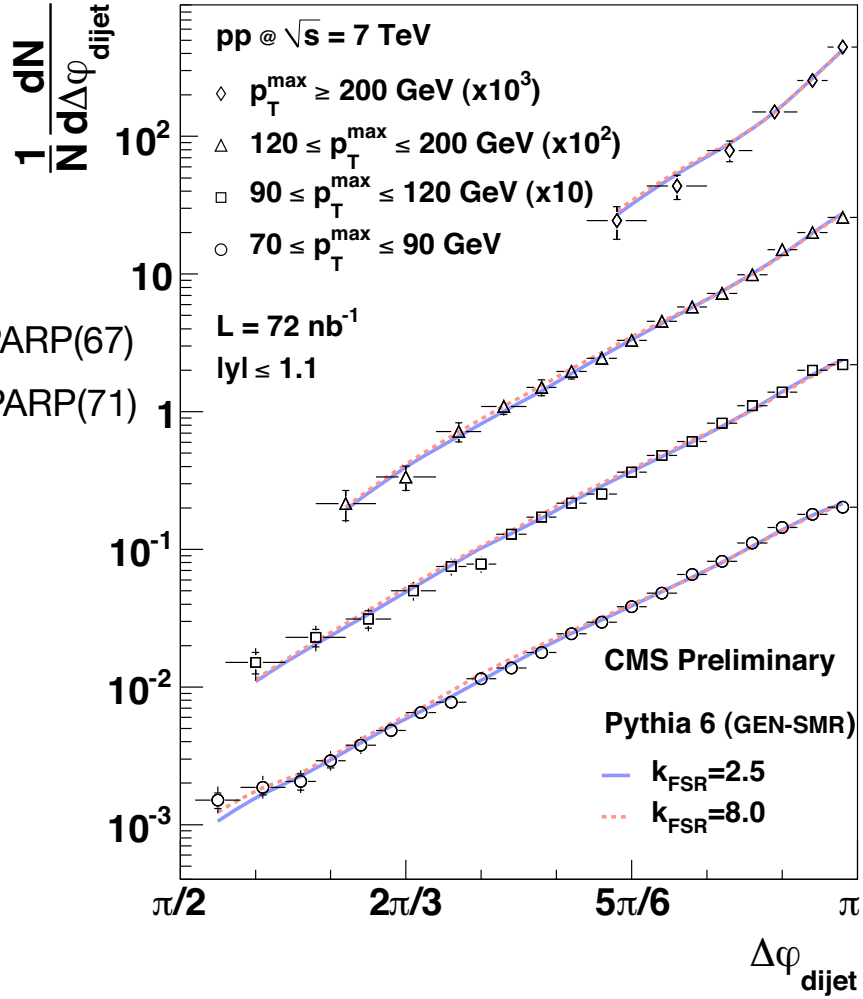
Angular Decorrelations of Dijets

- Dependence on initial state radiation (ISR), no sensitivity to final state radiation (FSR)
- Reasonable agreement with PYTHIA default parameters: k_{ISR}=2.5, k_{FSR}=4.0, but still room for improvement



k_{ISR}=PARP(67)

k_{FSR}=PARP(71)

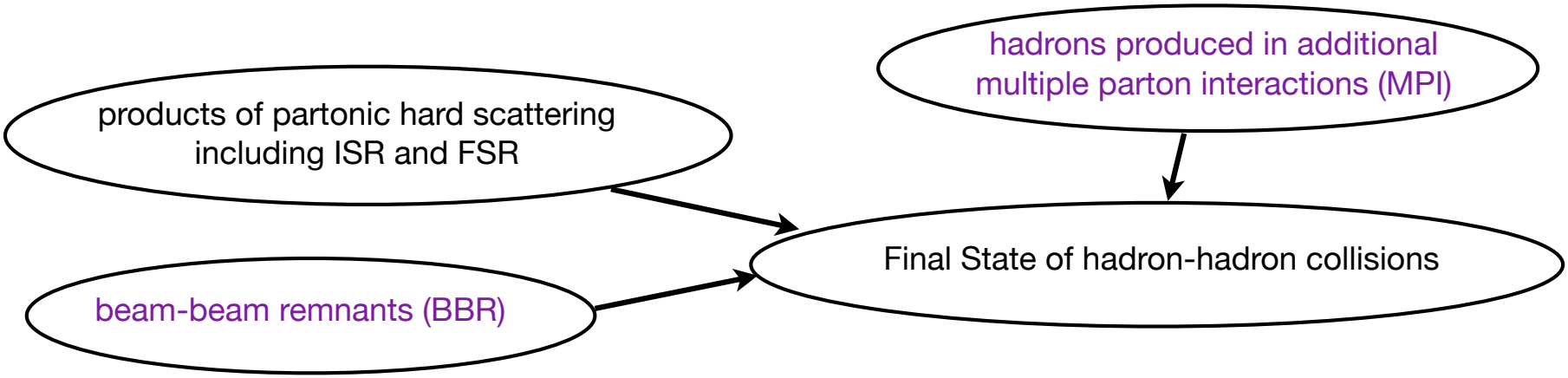


QCD Physics

Underlying Event Activity

CMS PAS QCD-10-010:
Measurement of the Underlying Event Activity at the LHC with sqrt(s)=7TeV and Comparison with sqrt(s)=0.9TeV

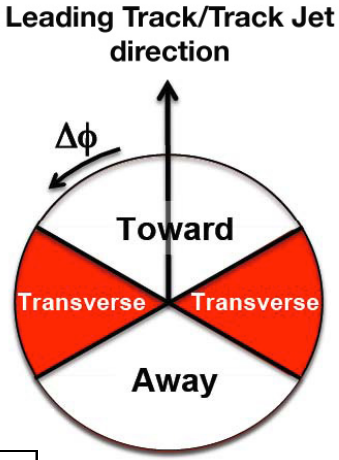
- Underlying Event (UE) Measurements in the presence of a hard process (leading track or track-jet):

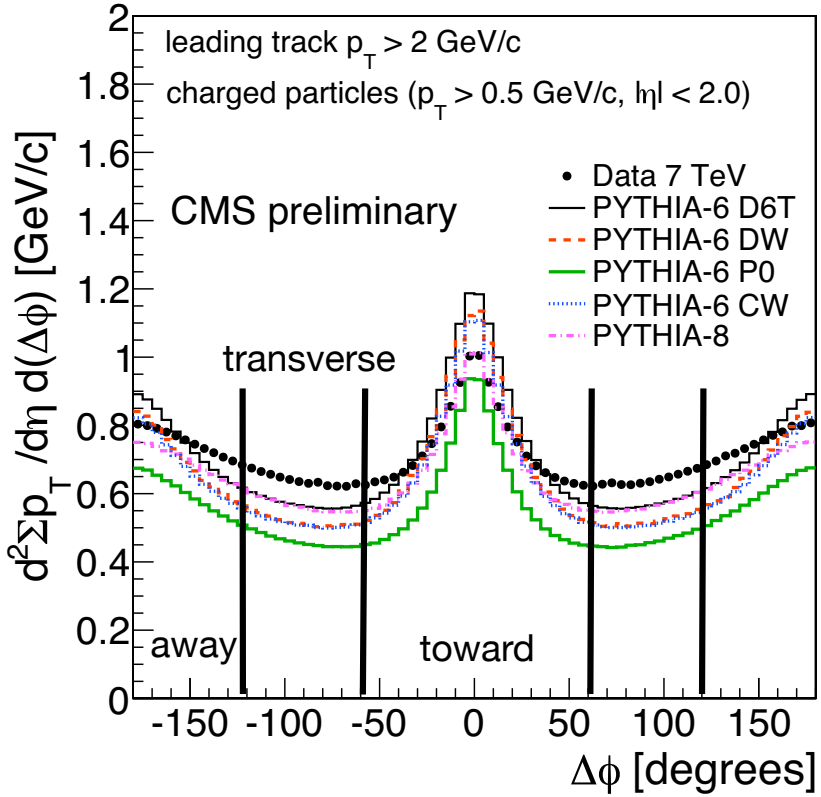


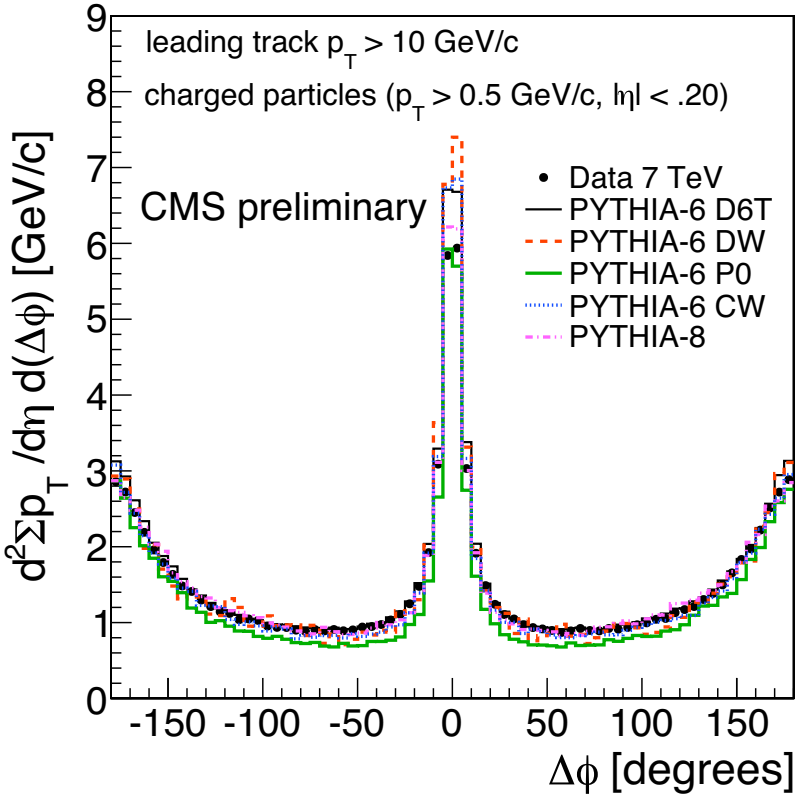
  - good description of UE properties is crucial for precision measurements of the Standard Model and for search of new physics at LHC
  - UE dynamics are not fully understood, especially the center-of-mass energy dependence

Underlying Event Activity

- $\sum p_T$ of charged particles per unit of pseudorapidity and per radian vs. azimuthal angular difference relative to leading track
- all models strongly underestimate the hadronic activity in the transverse region -> detailed studies performed
- description much better for a higher scale



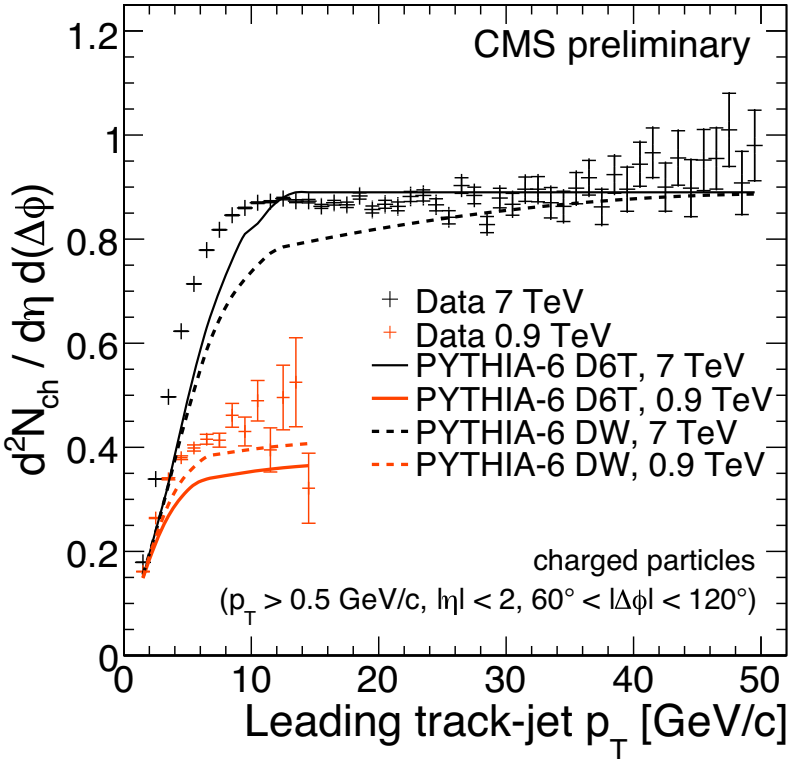


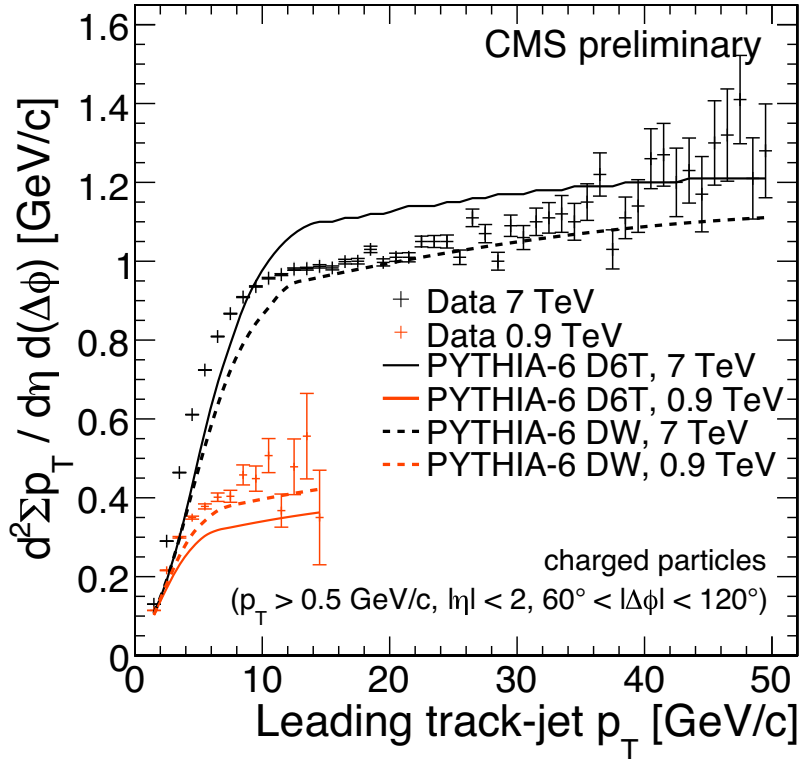


Underlying Event Activity

- center-of-mass energy dependence of hadronic activity in the transverse region
- fast rise attributed to increase of MPI activity followed by plateau-like region

➡ relatively strong sqrt(s) dependence of p_{T0} favoured, as in tune DW ($\epsilon = 0.25$), compared to tune with lower value D6T ($\epsilon = 0.16$)





Forward Physics

Forward Energy Flow

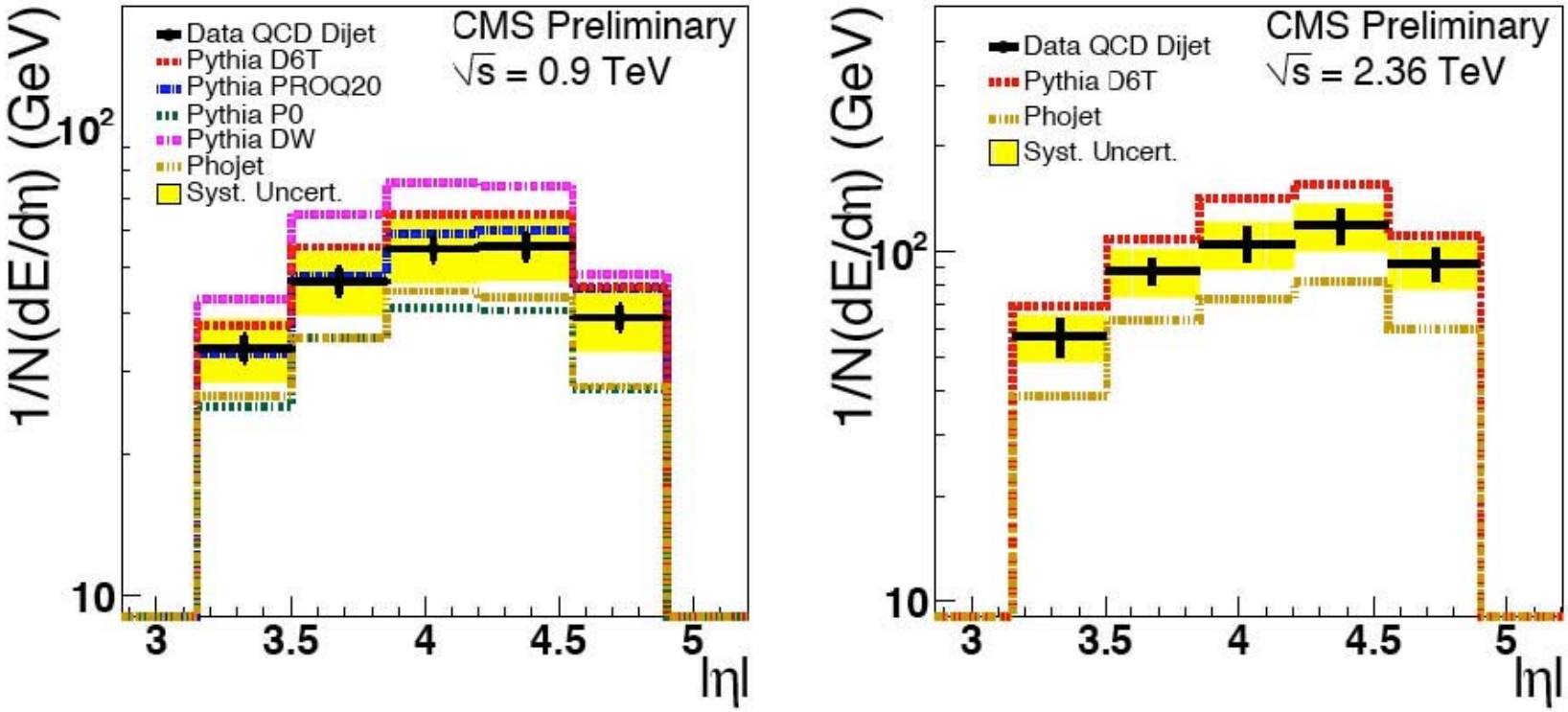
CMS PAS FWD-10-002:
Measurement of the energy flow at large pseudorapidity at the LHC at sqrt(s)=900, 2360 and 7000 GeV

- First investigation of central-forward correlations in pp @ 3 different energies:
  - select events in the central region for two event classes:
    Minimum Bias (MB), Dijets
  - measure energy flow in the forward region using the Hadronic Forward Calorimeter (HF) in $3.15 < |\eta| < 4.9$

$$E_{flow} = \frac{1}{N_{event}} \frac{d\sum E_i}{d\eta}$$

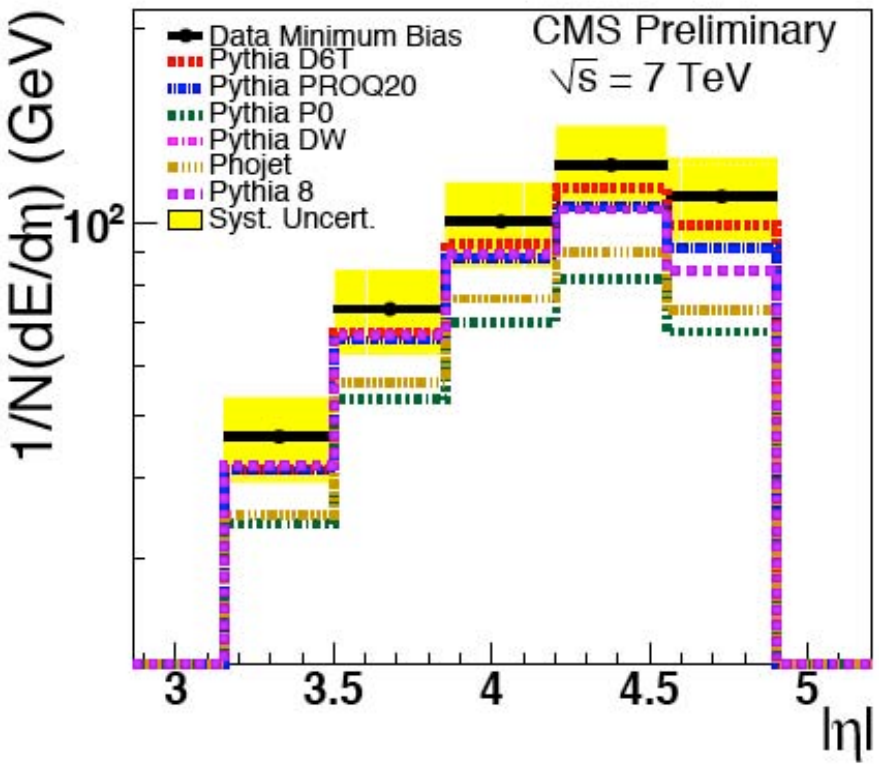
  - directly sensitive to amount of parton radiation and multiparton interactions
  - physics of underlying event (UE) is sensitive to comparison of MB sample and events with central jet activity

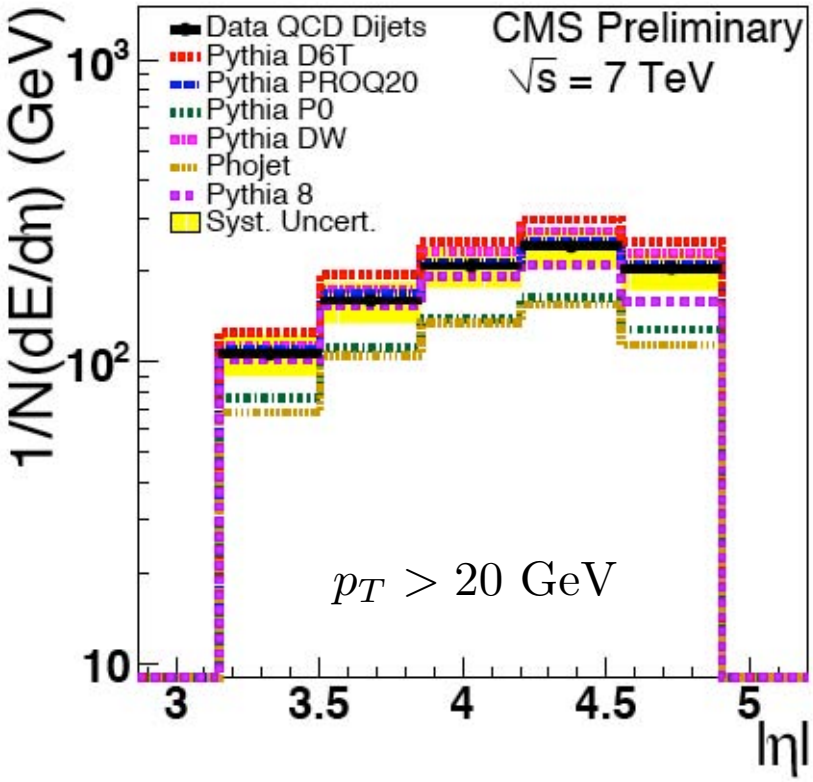
Forward Energy Flow for Dijets



- at least two leading ParticleFlowJets with $p_T > 8\ \mathrm{GeV},\ |\eta| < 2.5,\ |\Delta\phi(j_1, j_2) - \pi| < 1.0$
- detector level only, no hadron level corrections are applied
- yellow band: systematic uncertainty; dominated by energy scale
- PHOJET & P0 too low, PROQ20 gives best description, D6T & DW too high

Forward Energy Flow @ 7 TeV





- MB: all predictions underestimate the forward energy flow
- Dijets: PHOJET & P0 too low, PROQ20 & Pythia8 give best description, D6T & DW too high
- Interesting: DW tune describes best the charged particle spectra at central rapidities for UE studies (see e.g. CMS PAS QCD-10-001, CMS PAS QCD-10-010)

Summary

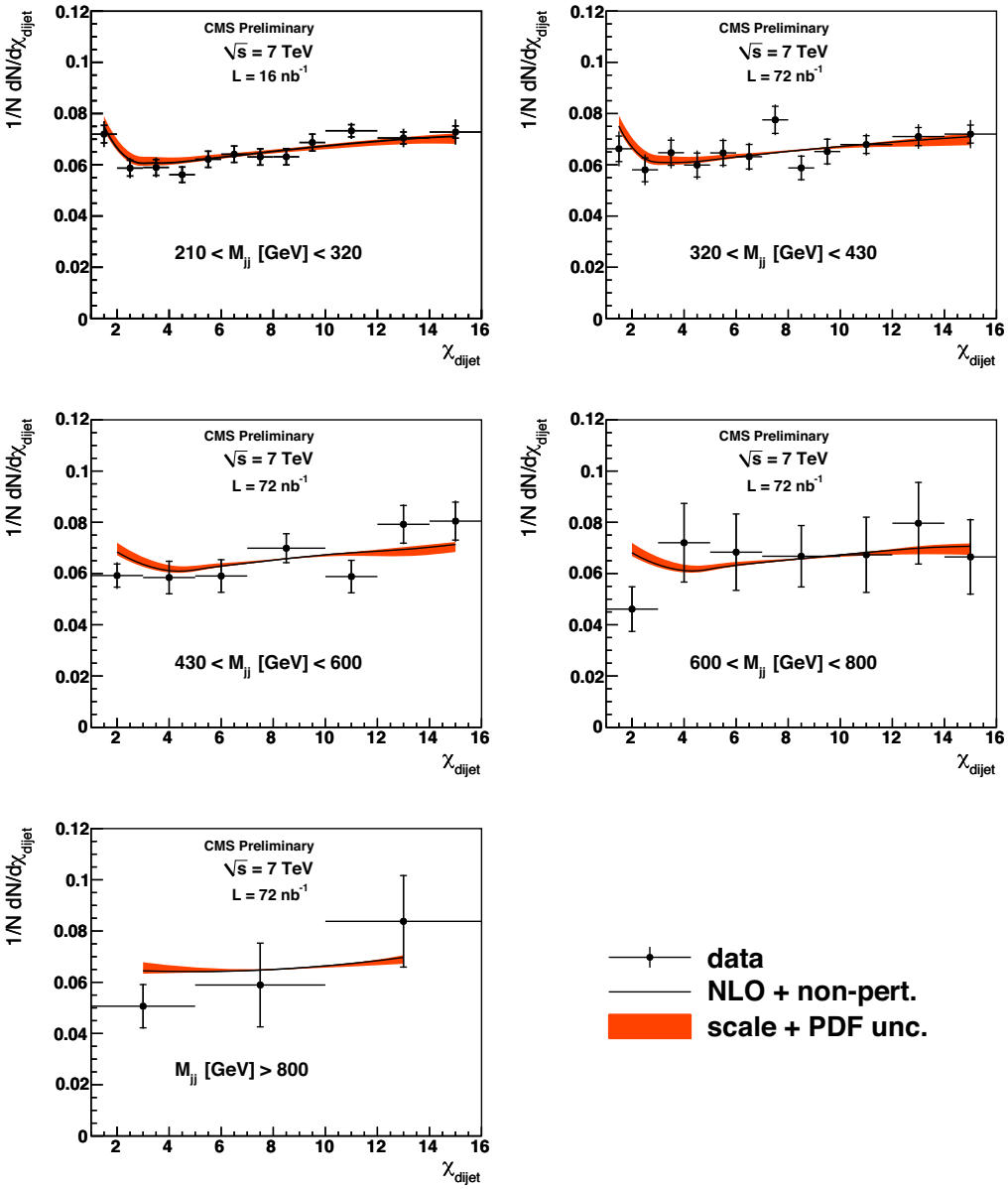
- presented 3 out of many interesting CMS results for ICHEP:
  - Dijets: CMS PAS QCD-10-015 (see ICHEP talk by Mikko Voutilainen)
  - UE Activity: CMS PAS QCD-10-010 (see ICHEP talk by Paolo Bartalini)
  - Forward Energy Flow: CMS PAS FWD-10-002 (see ICHEP talk by Paolo Bartalini)
- CMS detector simulations already show in general good agreement with data
- MC models tuned to LEP and Tevatron data already work reasonably at LHC and there is still some room for improvement
- especially the presented measurements reveal nice opportunities for MC tuning:
  - parton showers
  - MPI

Backup

Pythia Tunes/Parameters

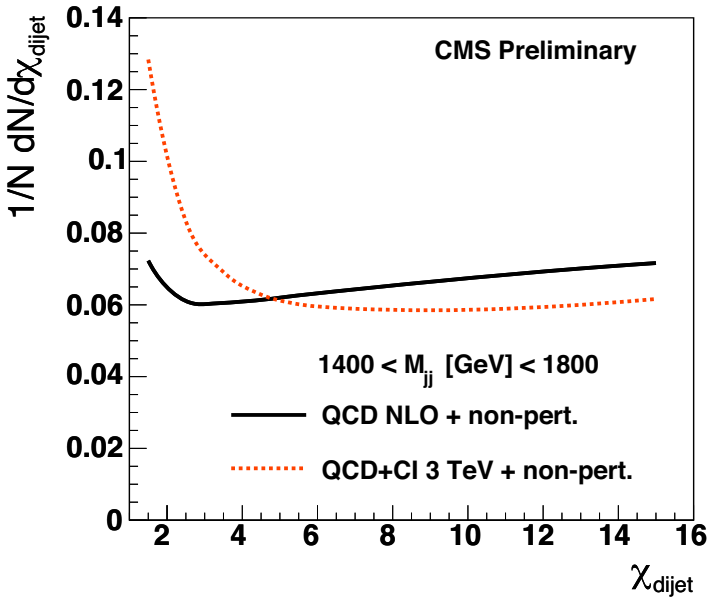
- Virtuality ordered showers, old MPIs
  - Pythia 6 tunes DW(T), D6(T), CW
  - ProQ20: Professor, LEP fragmentation
- New MPIs with interleaved pT-ordered showers
  - Perugia-0 (consider Professor tunes): P0
  - Pythia 8: different model
- epsilon = PARP(90)
  - DWT, D6T: $\epsilon = 0.16$
  - DW, D6, ProQ20, P0, Pythia8: $\epsilon = 0.25$
  - CW: $\epsilon = 0.3$

Angular Distributions of Dijets



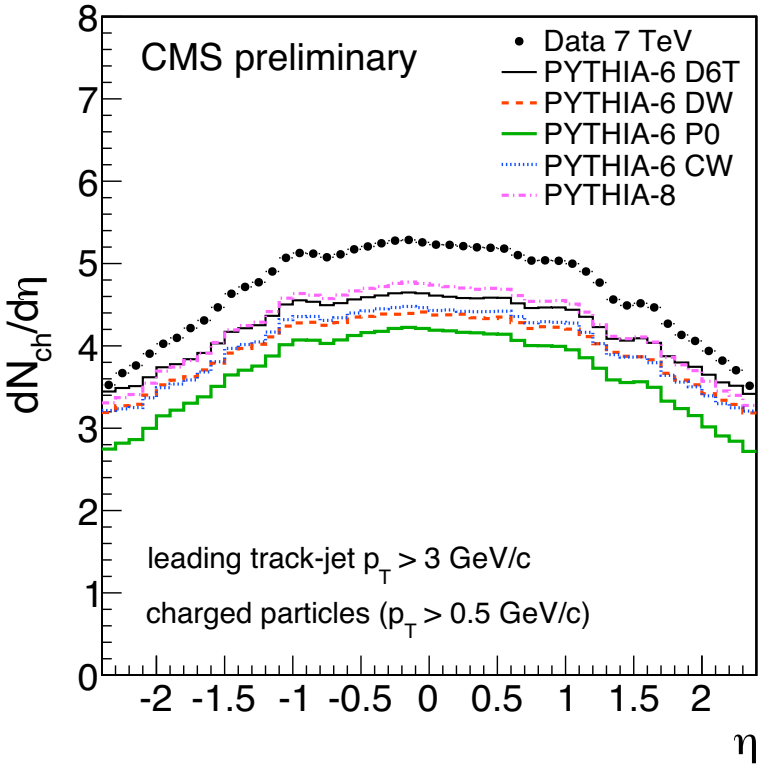
Dijet angular distributions very insensitive to many systematic effects: especially little dependence on variation of the energy scale

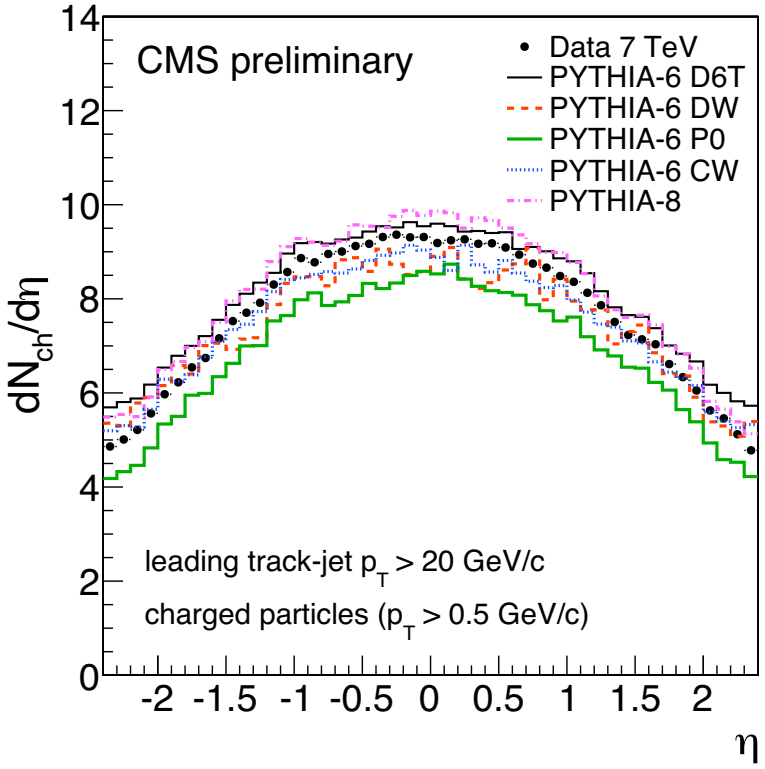
$$\chi_{\mathrm{dijet}} = \exp(|y_1 - y_2|)$$



Underlying Event Activity

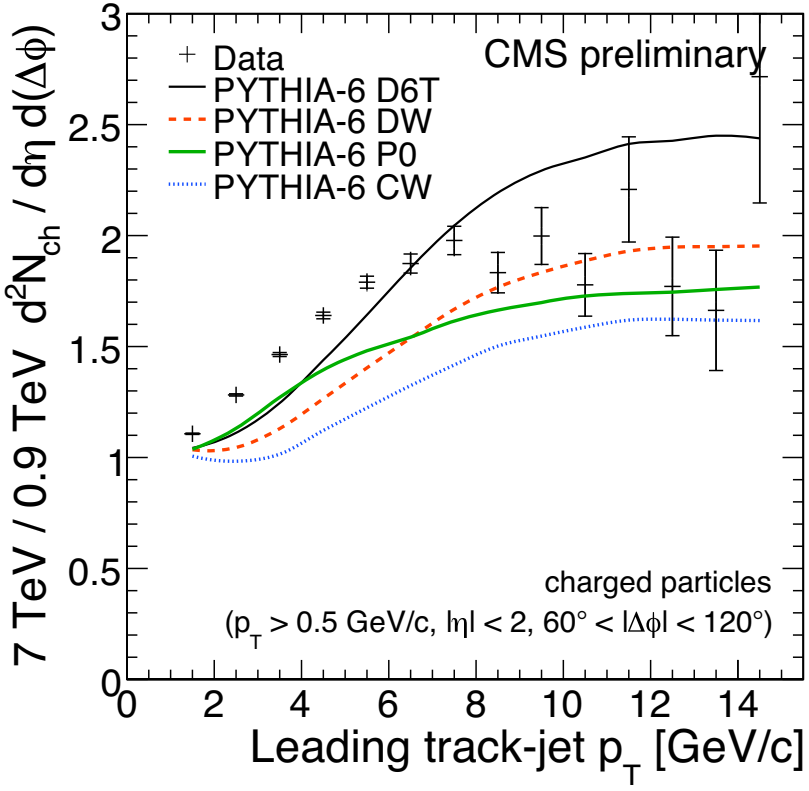
- general description for charged particles, hard scale: leading track-jet
- description much better for a higher scale

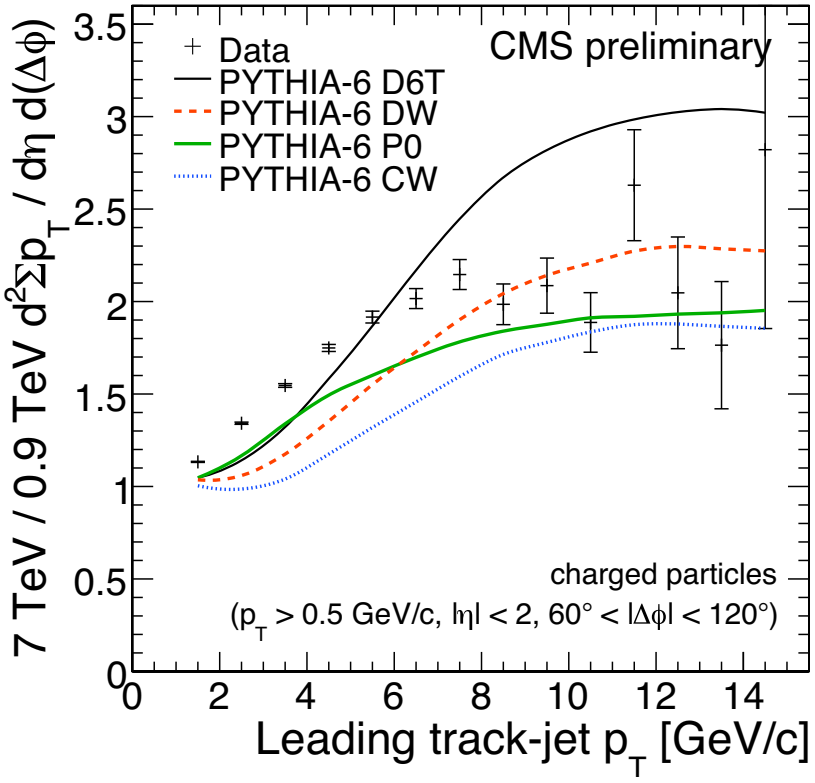




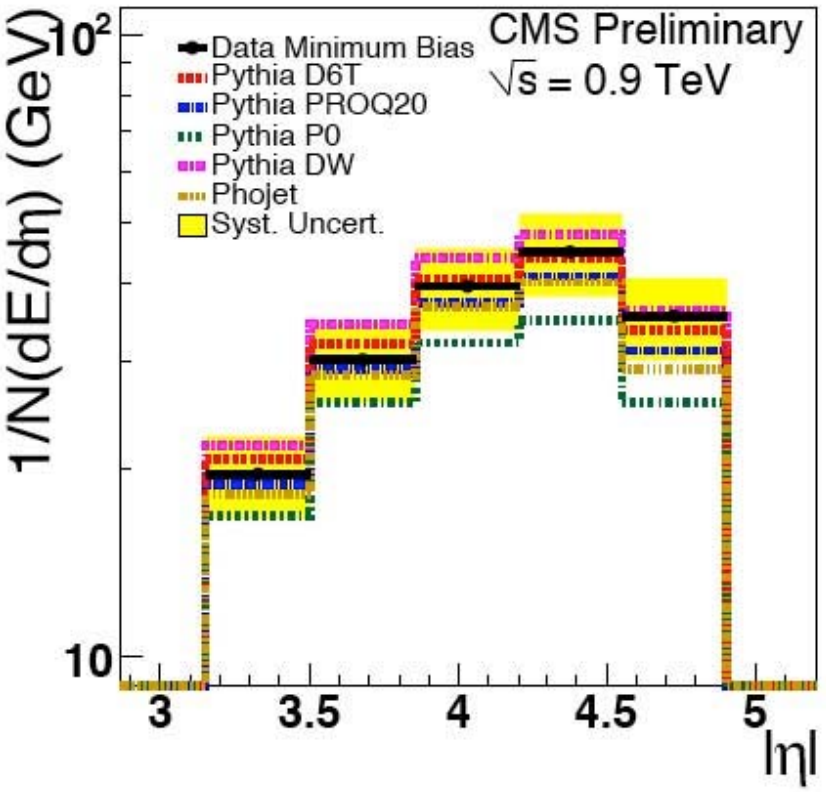
Underlying Event Activity

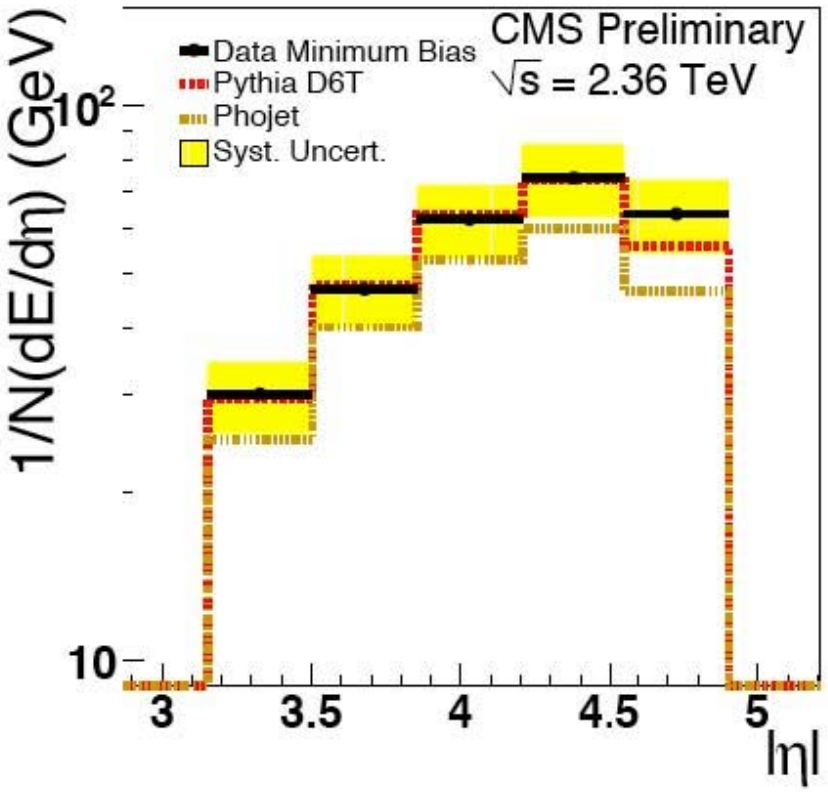
- center-of-mass energy dependence of hadronic activity in the transverse region
- fast rise attributed to increase of MPI activity followed by plateau-like region
- Ratio of 7 TeV/0.9 TeV





Forward Energy Flow for MinBias





- Situation different than for 7 TeV
- tune D6T gives the best description