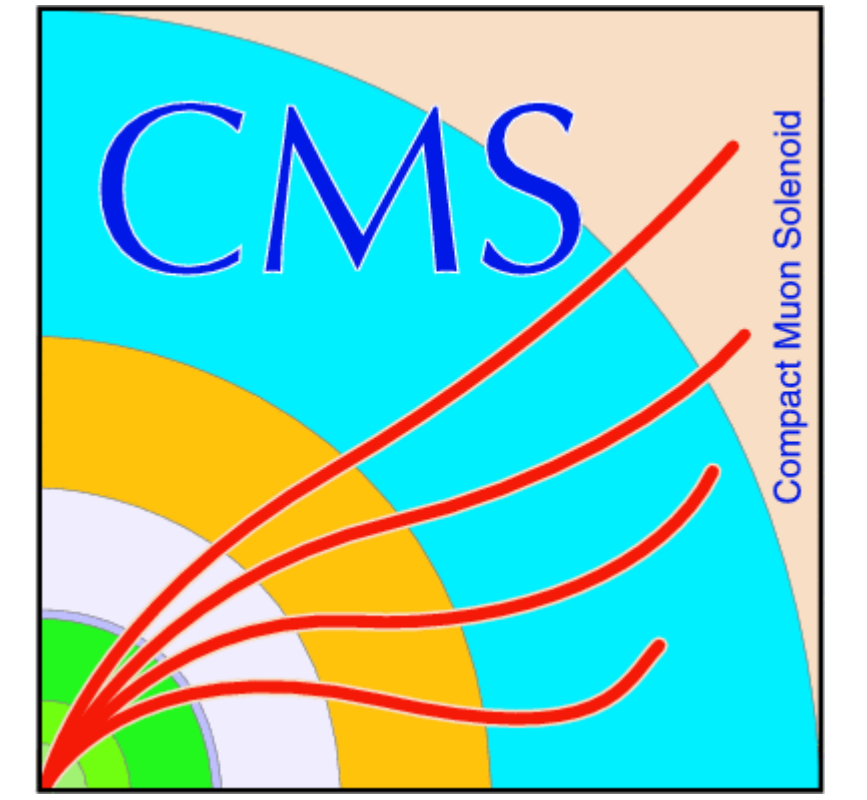


The Underlying Event with the Jet Area/Median approach in CMS

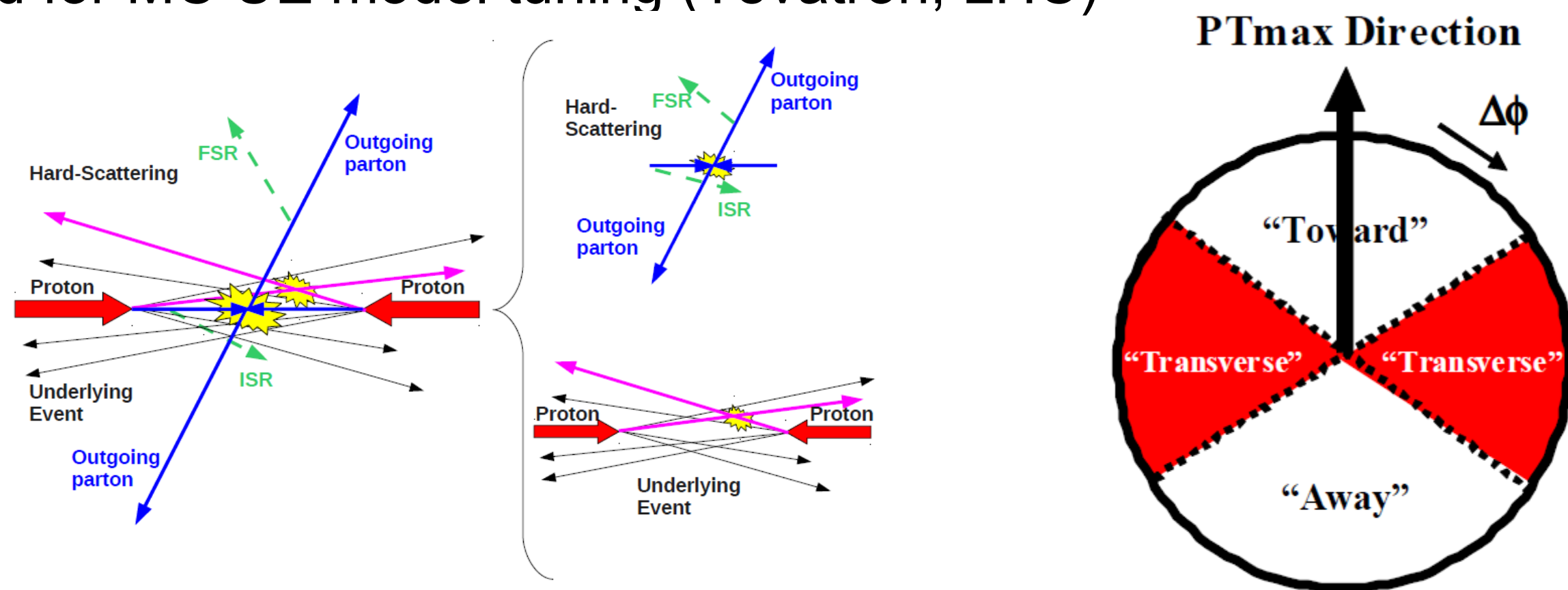


Michael Heinrich, Danilo Piparo, Günter Quast, Klaus Rabbertz

The Underlying Event in Hadron Collisions

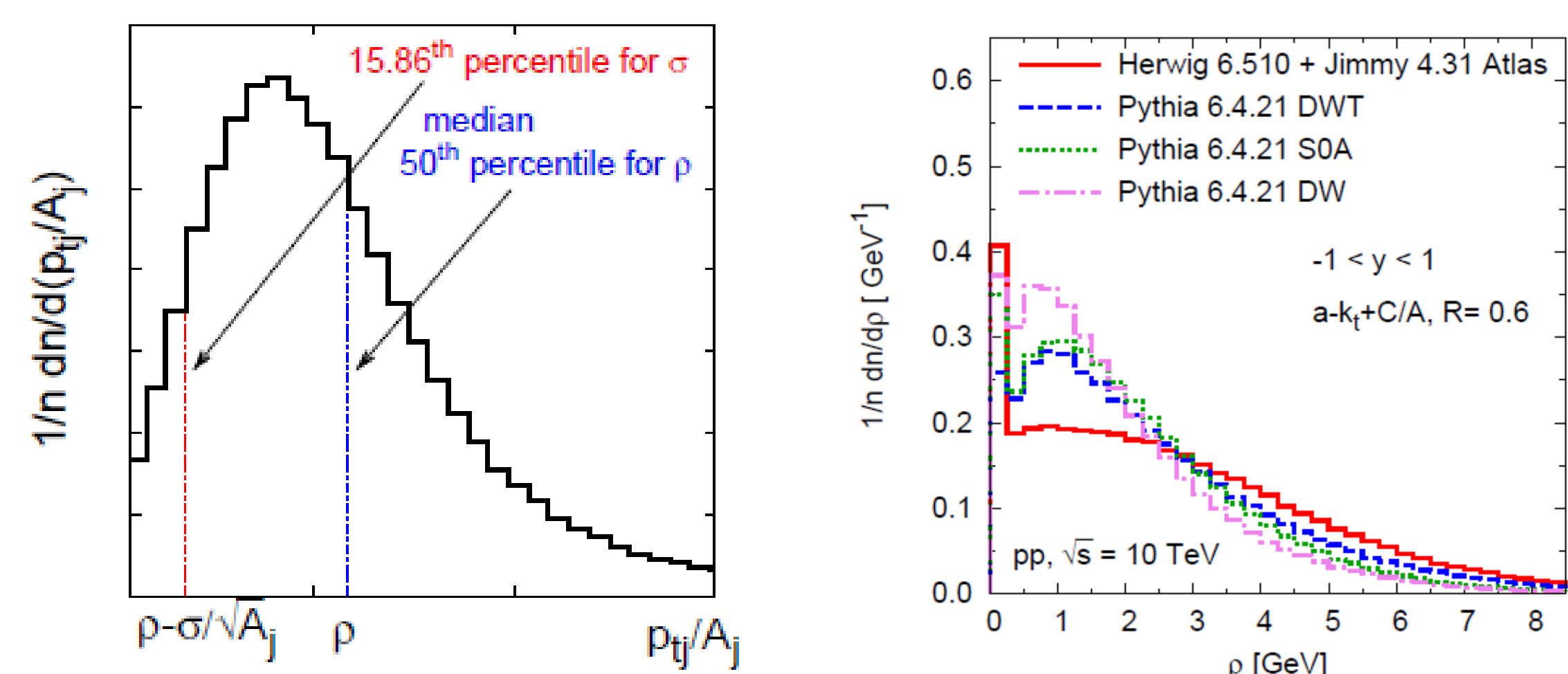
Traditional Approach

- Additional activity apart from hard scattering is called Underlying Event
- Previously UE has been measured by evaluating region transverse to leading object (CMS-PAS-QCD-10-001, CMS-PAS-QCD-10-010)
- Used for MC UE model tuning (Tevatron, LHC)



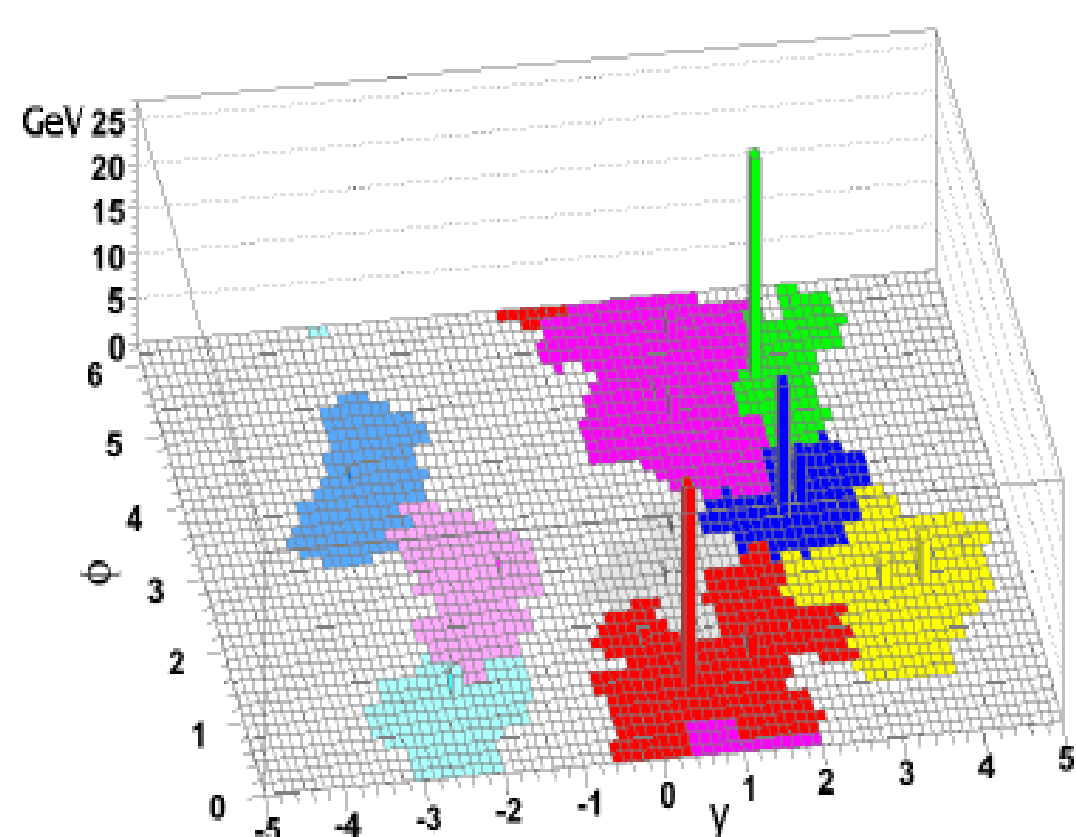
New Approach: Jet Area/Median

- Discussed in JHEP 04 (2010) 065 on generator level
- Median of pt/area of all jets in an event is a measure for UE activity → new observable ρ
- Suppresses influence of hard objects
- Suitable for different event topologies



Active Area Jet Clustering

- kt type algorithms do not produce fixed jet geometries
- Non-intuitive jet areas → broad area distribution
- Method: Add a large number of very soft artificial „ghost particles“ to physical input particles
- Number of ghosts clustered into a jet determine its area



JHEP0804:005,2008
The Catchment Area of Jets
• Perspectives also towards subtraction of pile-up and area based jet energy corrections

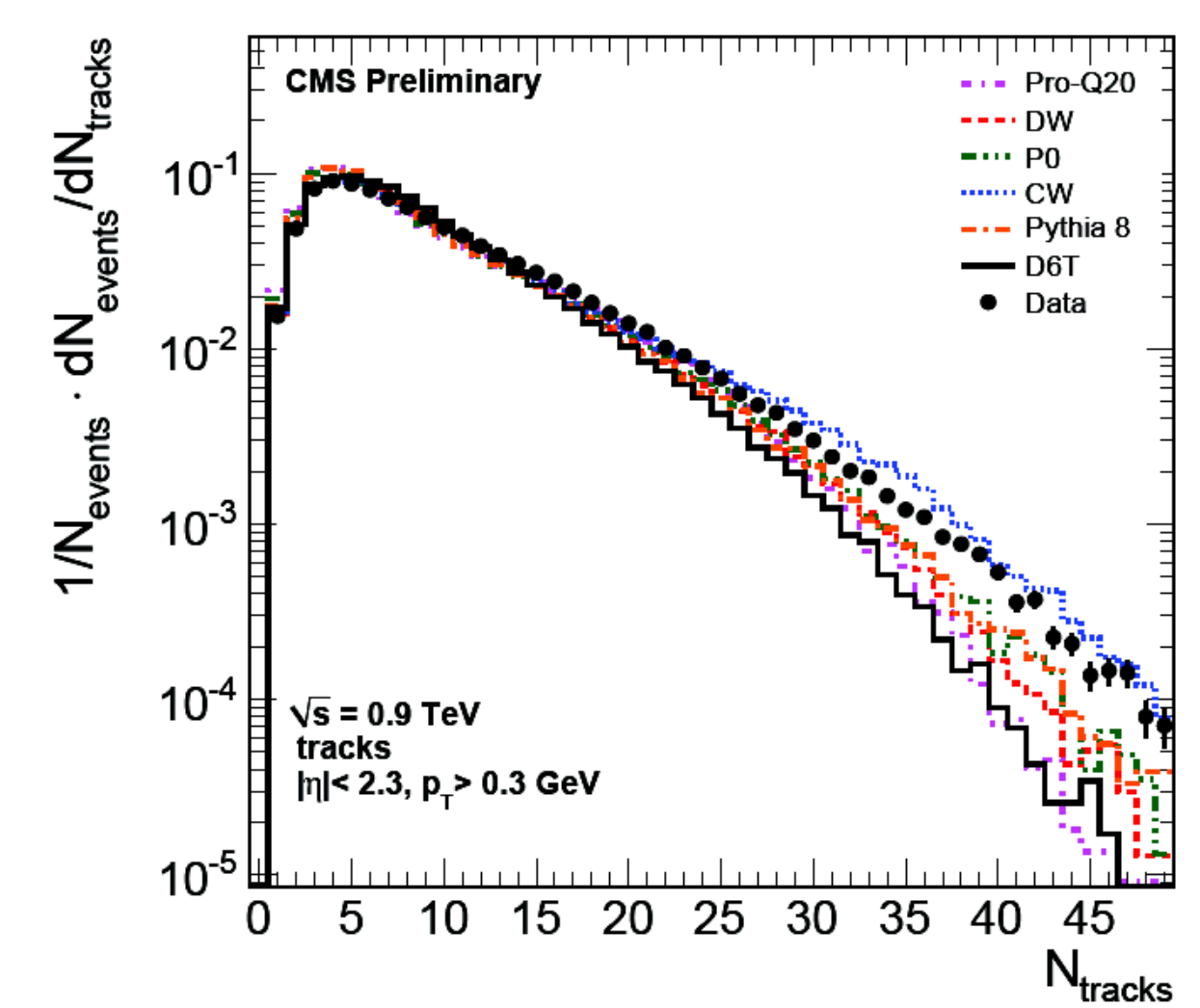
Figure 4: Active area for the same event as in figure 3, once again clustered with the k_t algorithm and $R = 1$. Only the areas of the hard jets have been shaded — the pure „ghost“ jets are not shown.

Jet Input: Tracks

- Method requires maximum phase space coverage
- Tracks as input → only charged particles observed
- Track cuts: $p_T > 300\text{MeV}$, $|\eta| < 2.3$

Data: 2009 900GeV running and Pythia MC

- 900 GeV MinBias data
- Cuts on L1 trigger, good runs, require 1 vertex with >3 tracks
- 225,447 events in total
- Pythia6 tunes D6T, DW, CW, P0 and ProQ20
- Pythia8 default tune

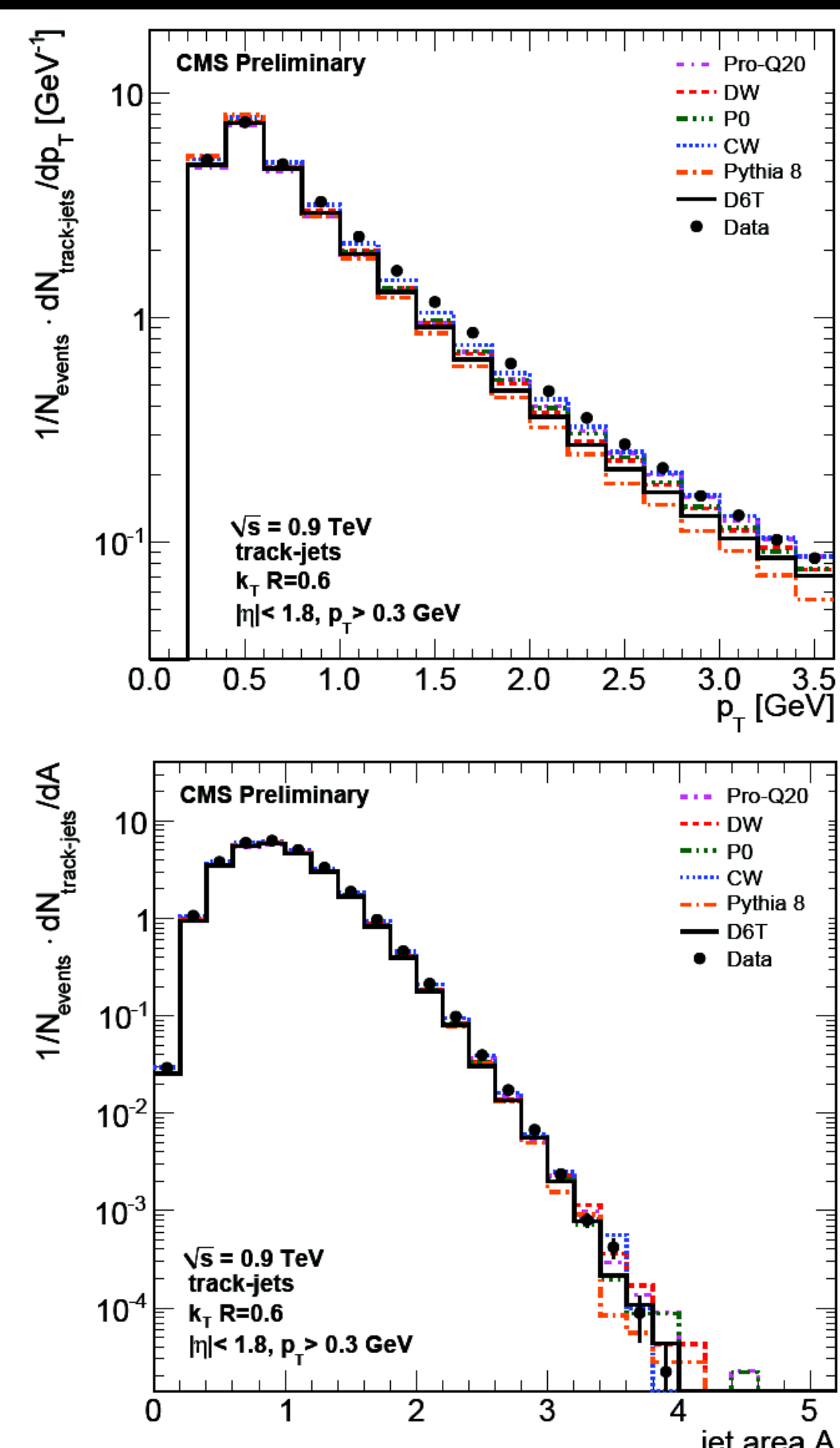


TrackJet Distributions

- Default jet algorithm: kt, $R = 0.6$
- Low jet multiplicity requires adjustment of ρ
- Take into account only physical jets, ignore jets made purely of ghost
- Weight median with event occupancy (sum of all physical jet areas divided by detector area)
- New observable ρ'

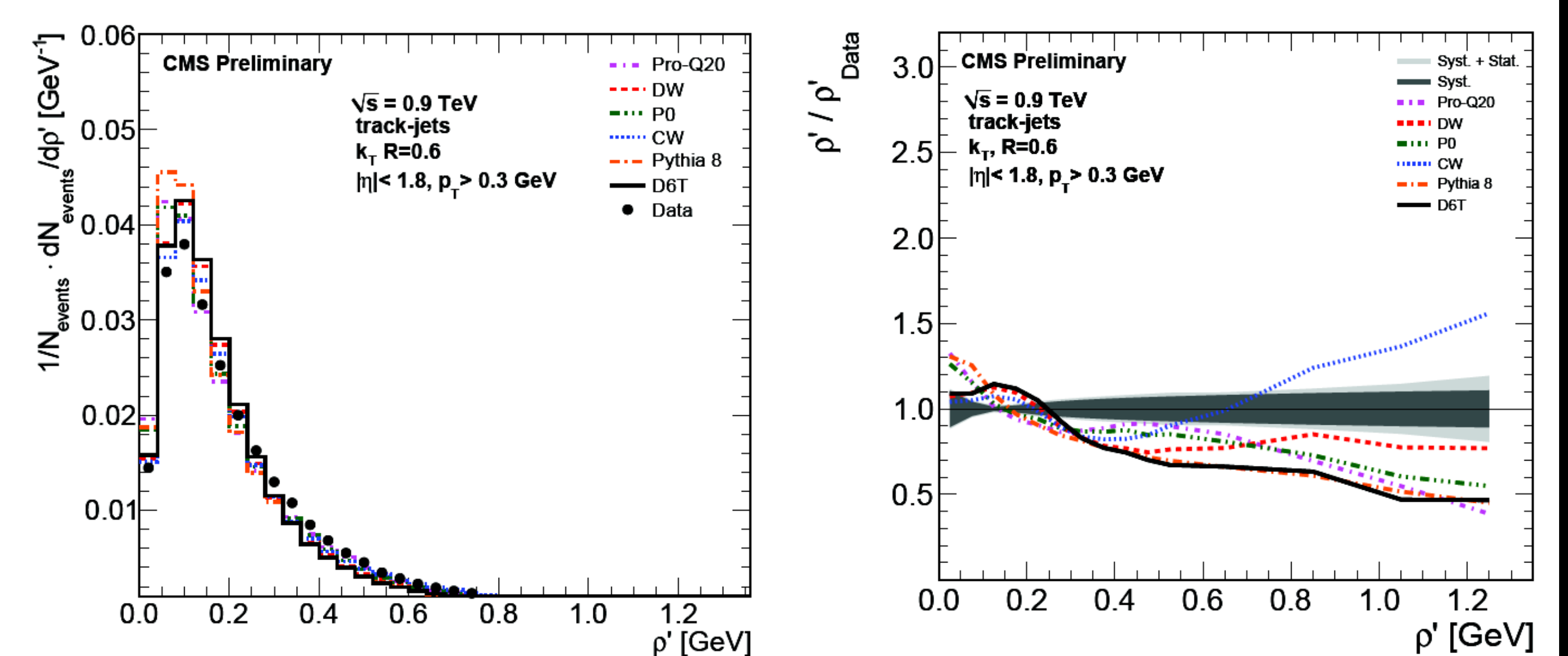
$$\rho' = \text{median}_{j \in \text{physical jets}} \left[\left\{ \frac{p_{Tj}}{A_j} \right\} \right] \cdot C$$

$$C = \frac{\sum_{j \in \text{physical jets}} A_j}{A_{\text{tot}}}$$



Results

- Sensitivity demonstrated for Track Jets
- Apart from CW, all tunes underestimate charged activity



First ever application of jet area/median approach offers a new perspective to the UE