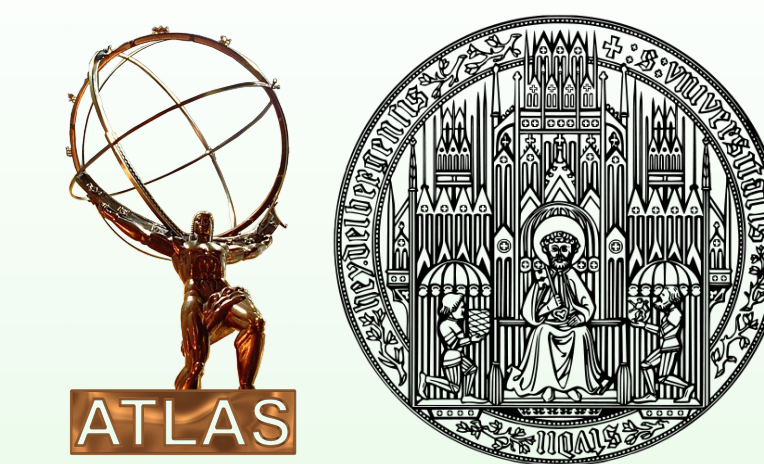


Preparing the ATLAS Jet Trigger for High Luminosity

Gregor Kasieczka on behalf of the ATLAS Collaboration

gregor.kasieczka@cern.ch

University of Heidelberg, Germany



Jet Trigger

Level 1 (L1) [1]:

- Use calorimeter segmented in Trigger Towers (TT) with size: $\Delta\eta \times \Delta\phi = 0.1 \times 0.1$
- Reconstruct jets using 4×4 TT with sliding window algorithm
- Define Region of Interest (RoI) if E_T above threshold

Level 2 (L2):

- Look in $\Delta\eta \times \Delta\phi = 1.0 \times 1.0$ window centered on L1 RoI
- Build jets with simple $\Delta R = 0.4$ cone algorithm

Event Filter (EF):

- When EF jet trigger is executed, read out the full calorimeter (fullscan)
- AntiKt algorithm (R=0.4) on topological clusters for jet finding

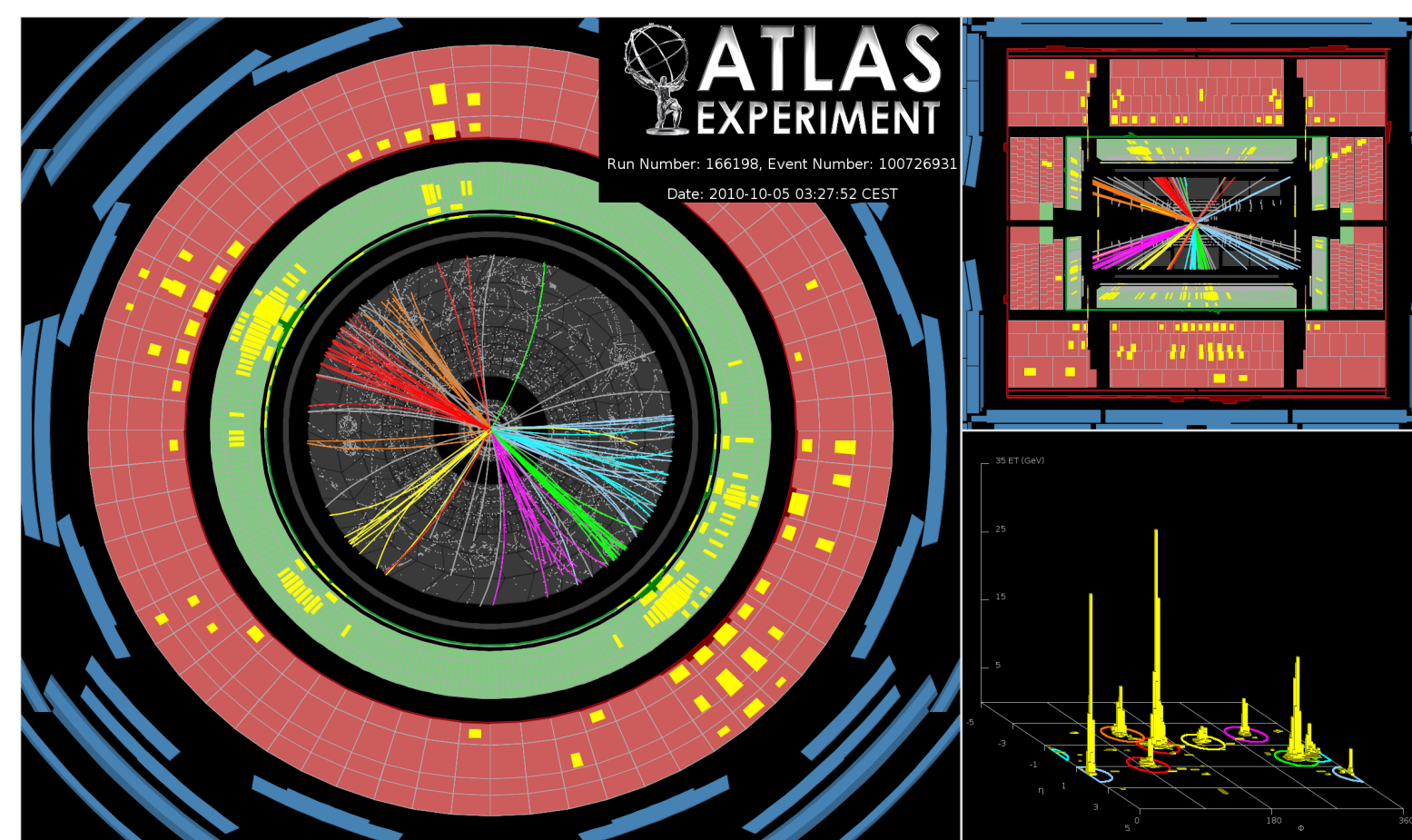


Fig. 1: High multiplicity jet event from pp collisions recorded in 2010.

On all stages jets are selected using E_T corrected only for the Energy scale of the EM calorimeter.

Jet Trigger Efficiency

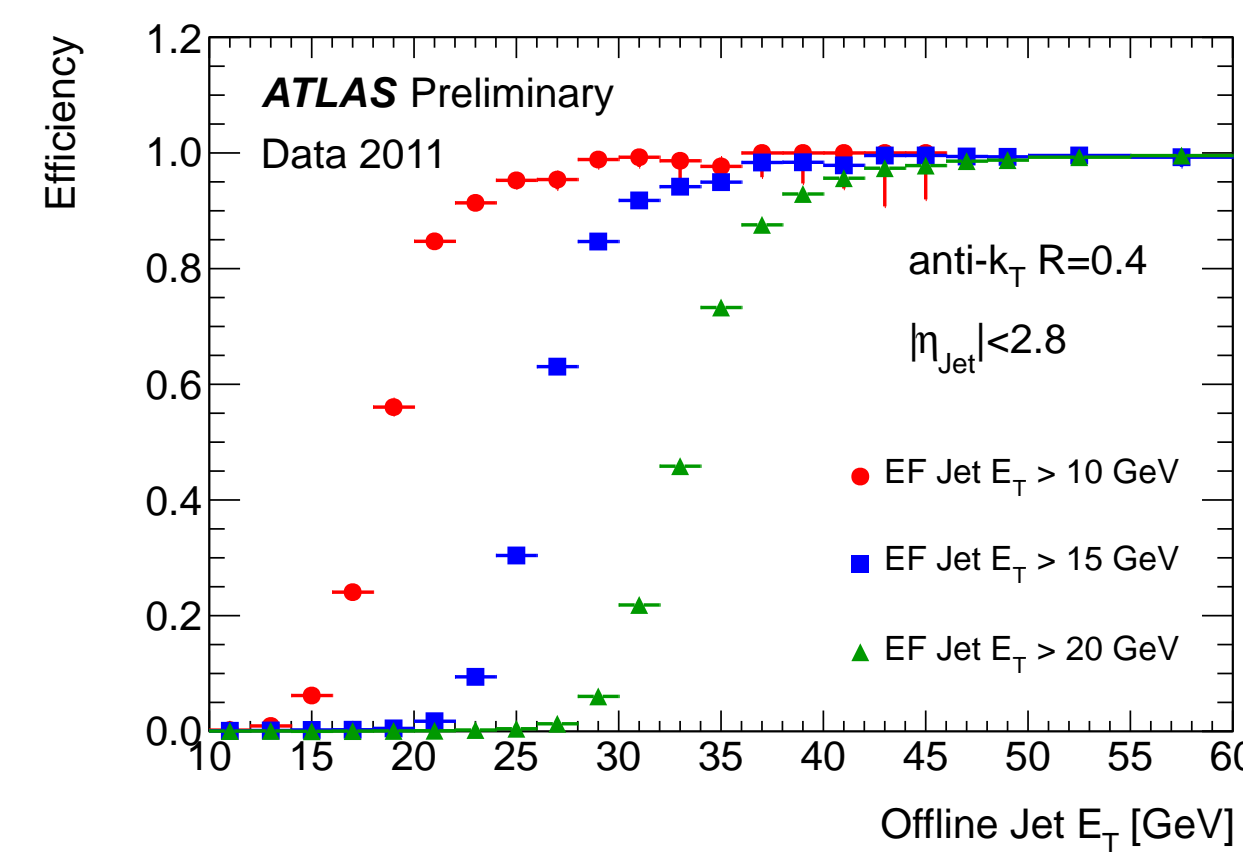


Fig. 5: Low threshold EF central jet chains seeded from random triggers.

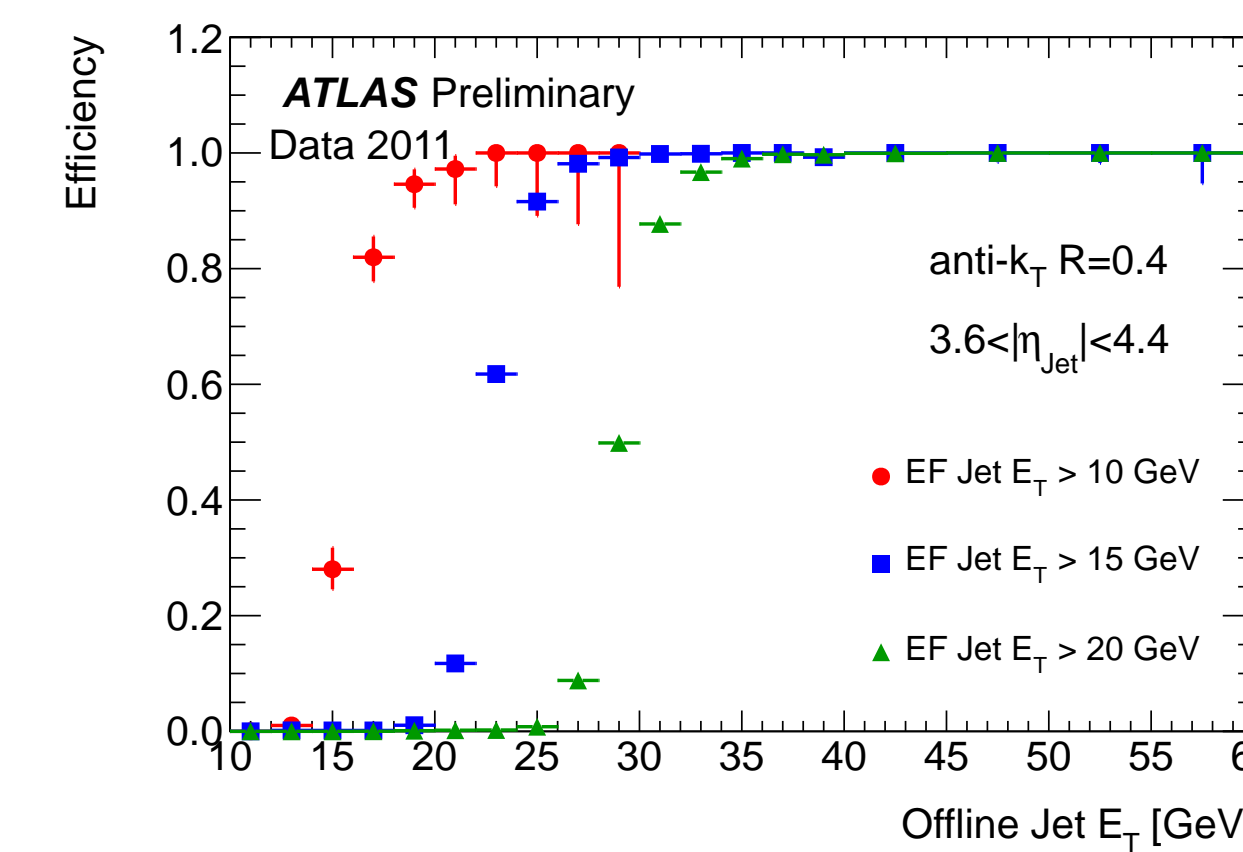


Fig. 6: Low threshold EF forward jet chains seeded from random triggers.

Figure 5 (central) and Fig. 6 (forward) show turn-on curves for low threshold EF jet triggers seeded by random triggers instead of L1/L2-based calorimeter triggers. This increases the acceptance for low p_T jets.

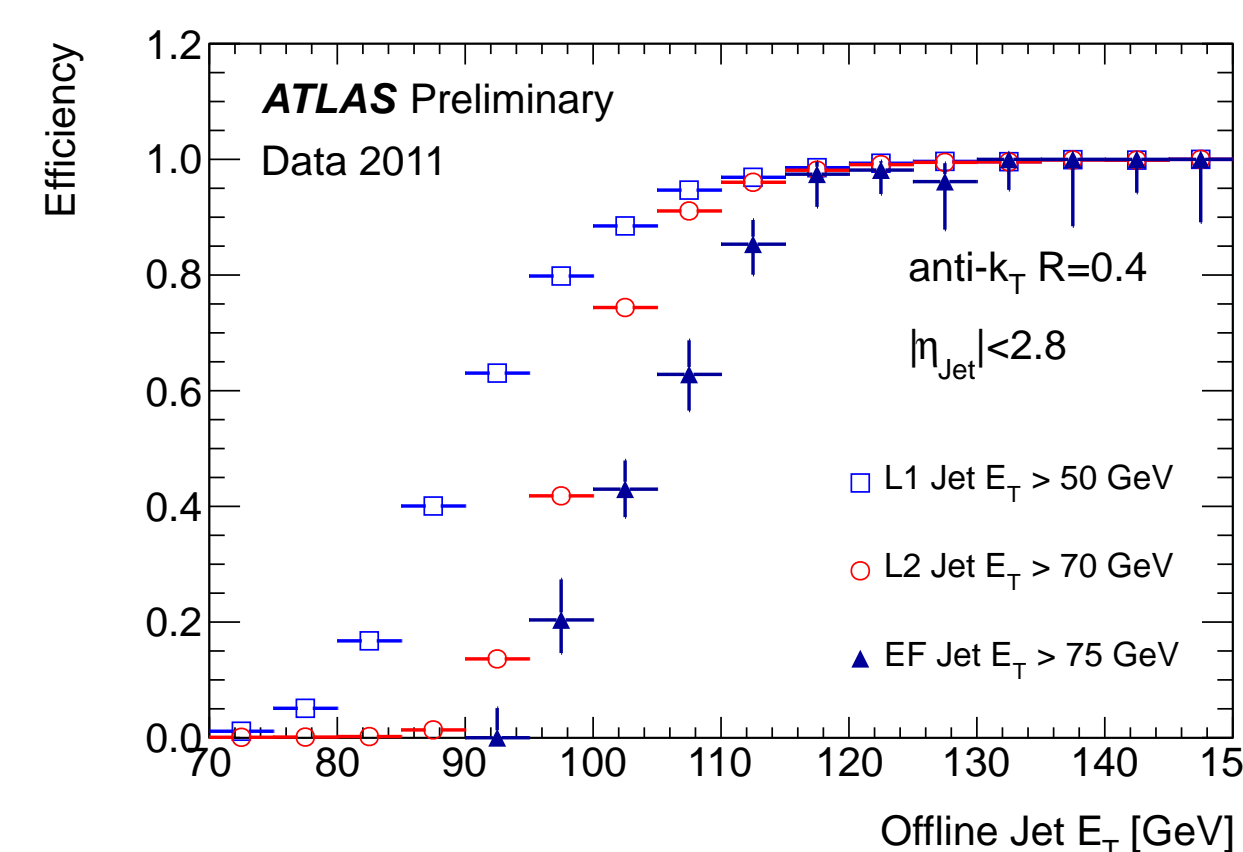


Fig. 7: Medium threshold central jet chain at all three trigger stages.

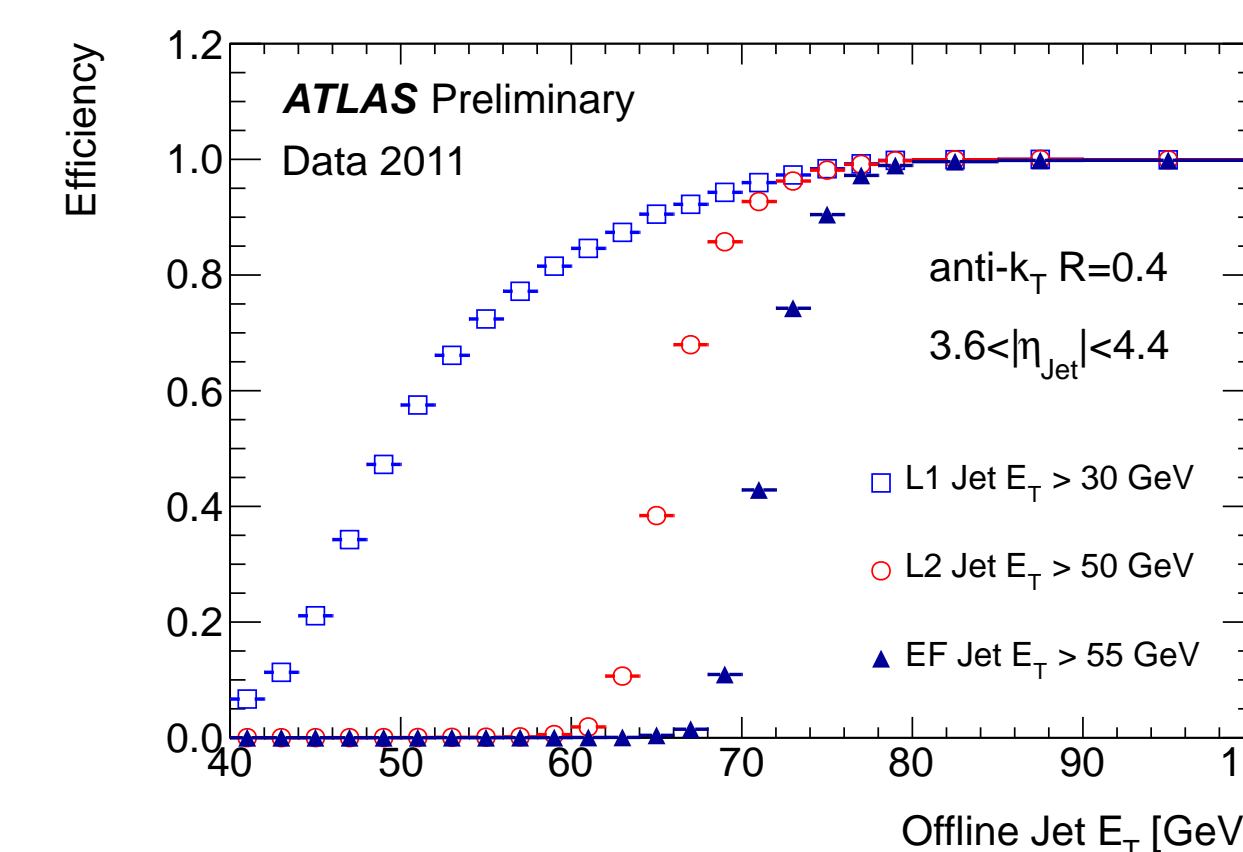


Fig. 8: Medium threshold forward jet chain at all three trigger stages.

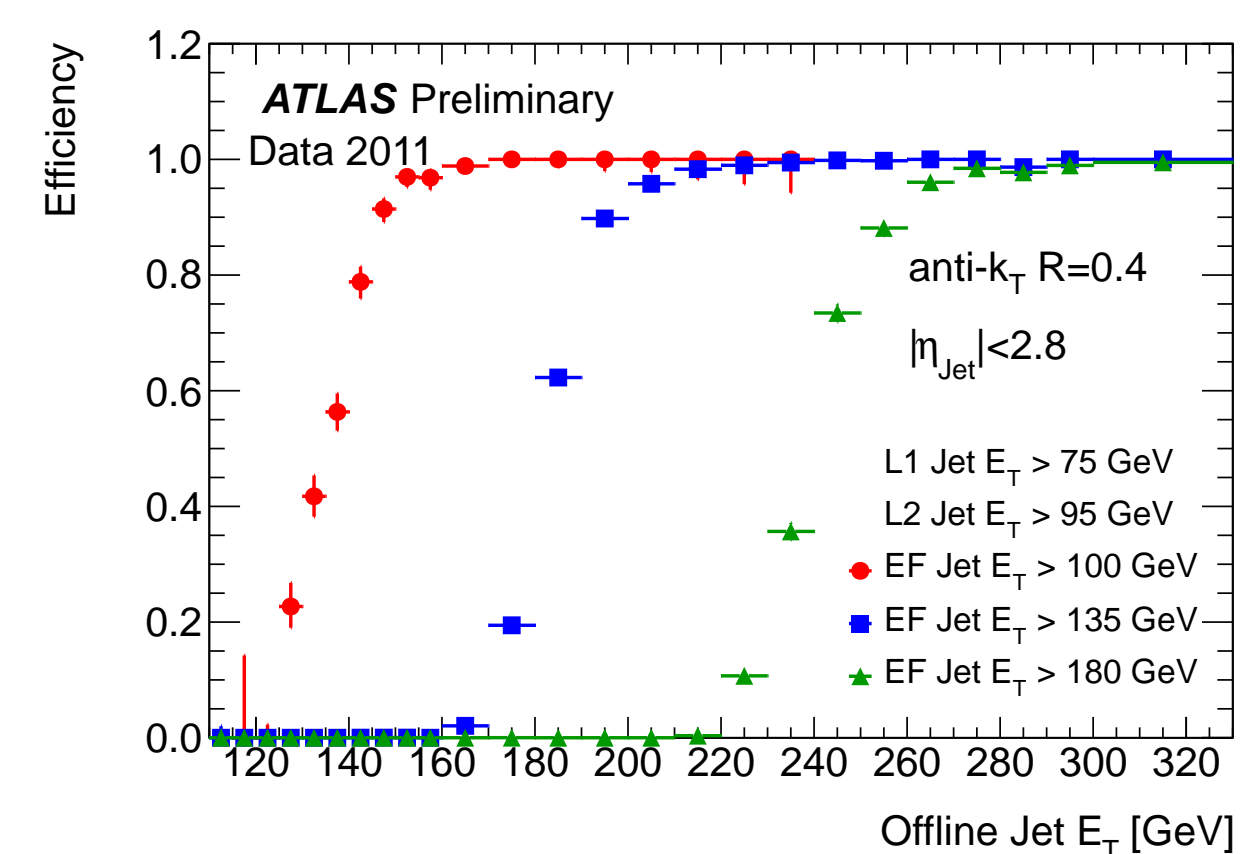


Fig. 9: Three different high threshold central jet chains.

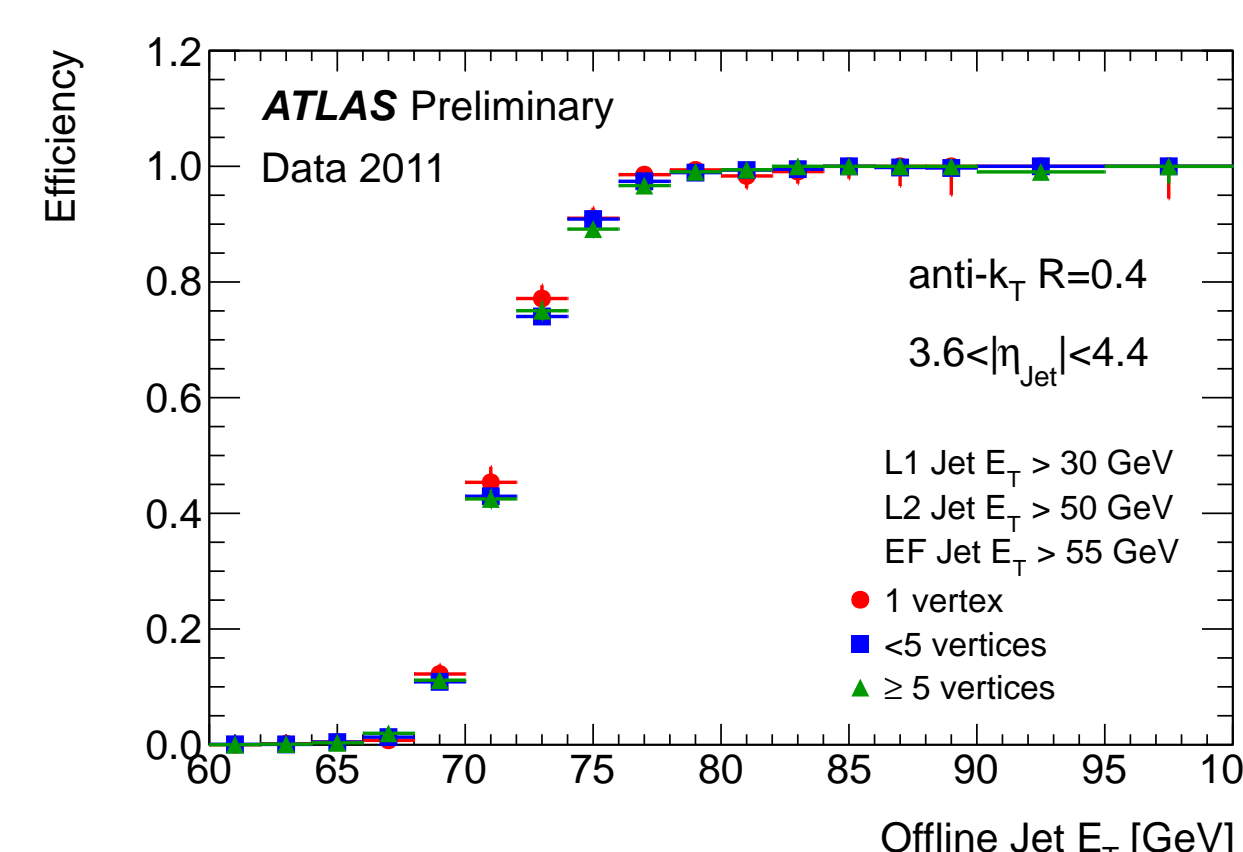


Fig. 10: Effect of pile-up on the 55 GeV forward jet trigger.

A Better Jet Trigger . . .

Fullscan instead of RoI based readout:

- No problem of overlapping RoI and duplicate jets
- Faster execution in busy environment
- Possible to use EF without seeding from L2 jet triggers

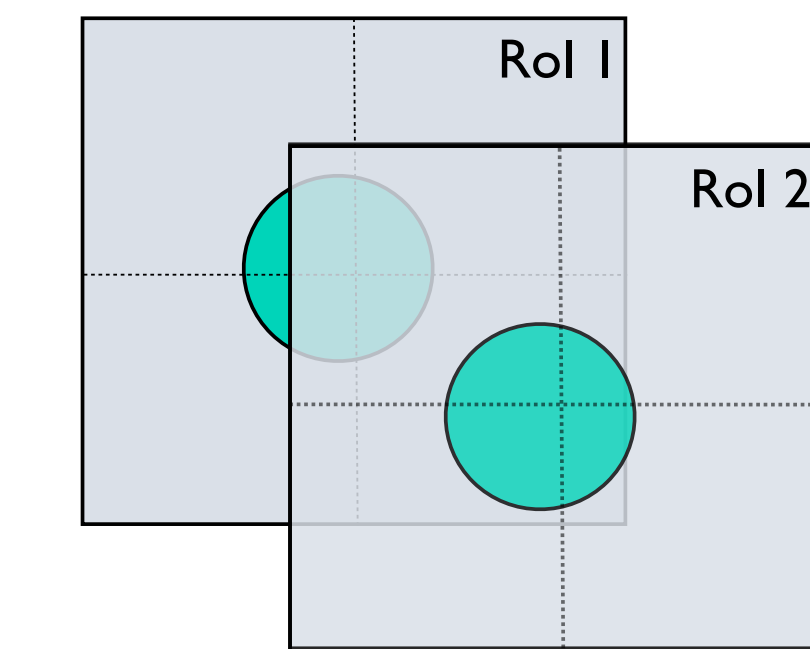


Fig. 11: Illustration of overlapping RoI leading to duplicate jets.

AntiKt instead of Cone algorithm:

- Better resolution with respect to Offline jet finding (also uses AntiKt)
- Superior theoretical properties (infrared safety)

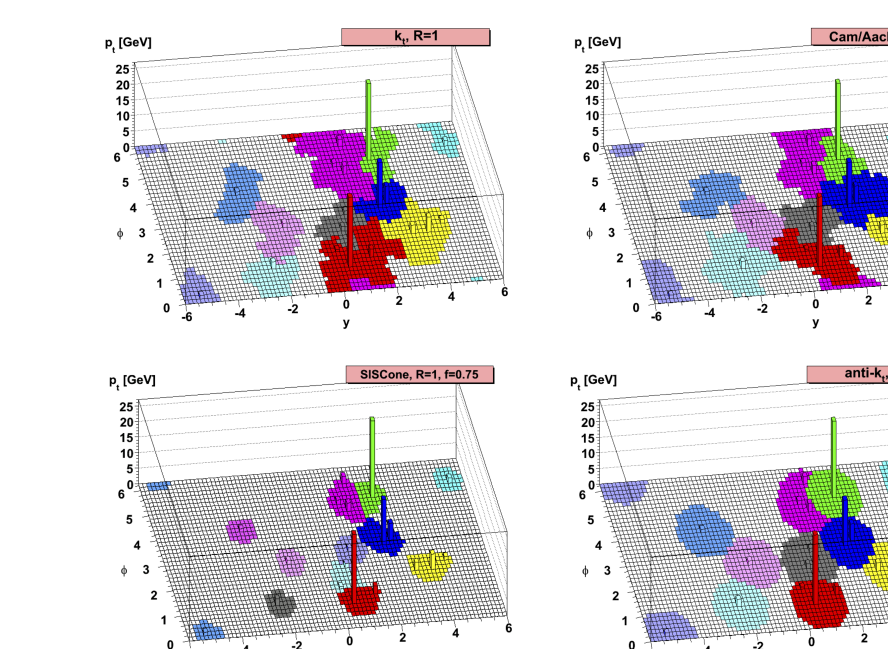


Fig. 12: Reconstructed jets with various algorithms [5].

Topological clusters instead of simple trigger towers:

- Better resolutions
- Increased stability in the presence of pile-up

Jet Trigger Menu

The ATLAS jet trigger can detect central ($|\eta| < 3.2$) and forward ($3.2 < |\eta| < 4.9$) jets. Triggering on different inclusive single and multijet configurations is possible on all trigger levels. More complex topological triggers and the combination with missing energy or lepton triggers are also available.

L1	L2	EF
random	random	10 GeV jet
random	random	10 GeV forward jet
10 GeV jet	25 GeV jet	30 GeV jet
muon	4 GeV muon	4 GeV muon and 10 GeV jet
75 GeV jet	95 GeV jet	135 GeV jet
3×50 GeV jet	3×70 GeV jet	3×75 GeV jet

Table 1: Example trigger chains from early-2011 ATLAS data-taking runs.

Towards Physics . . .

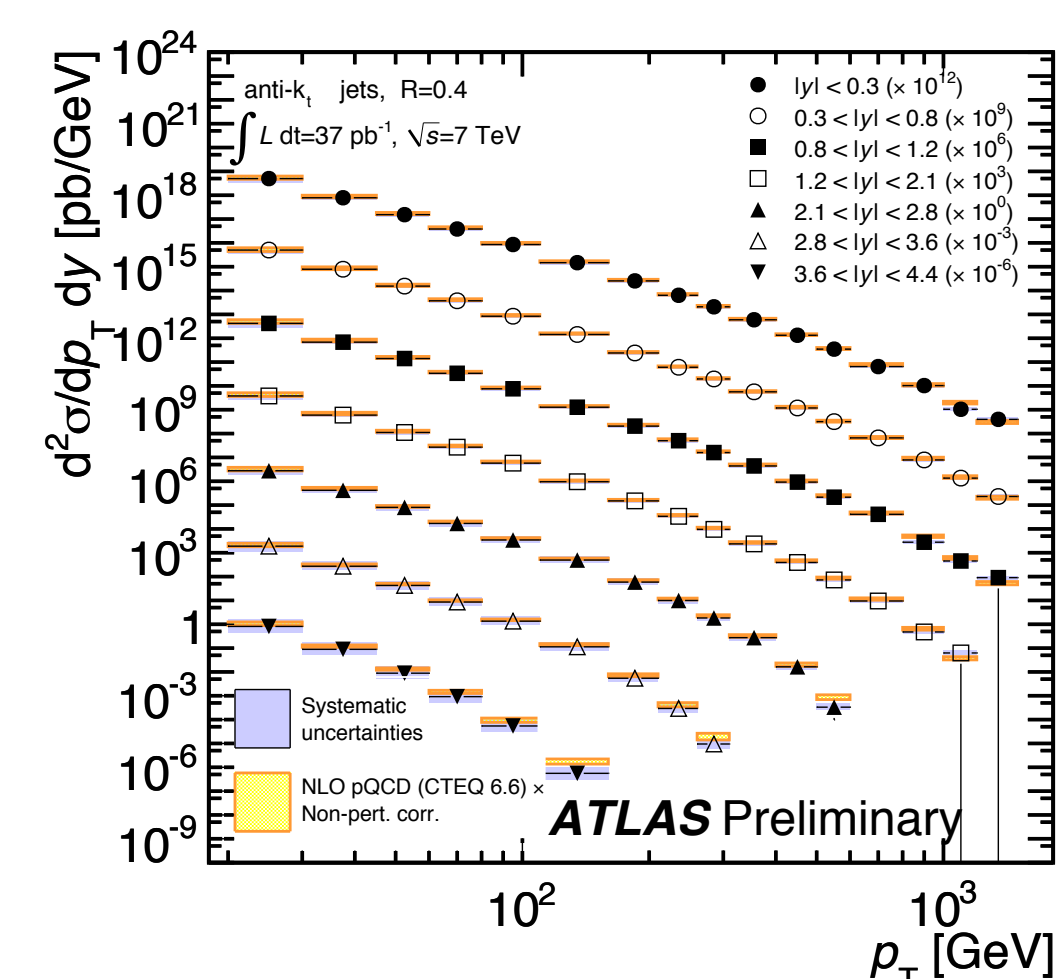


Fig. 2: Inclusive jet double-differential cross section as a function of jet p_T [2].

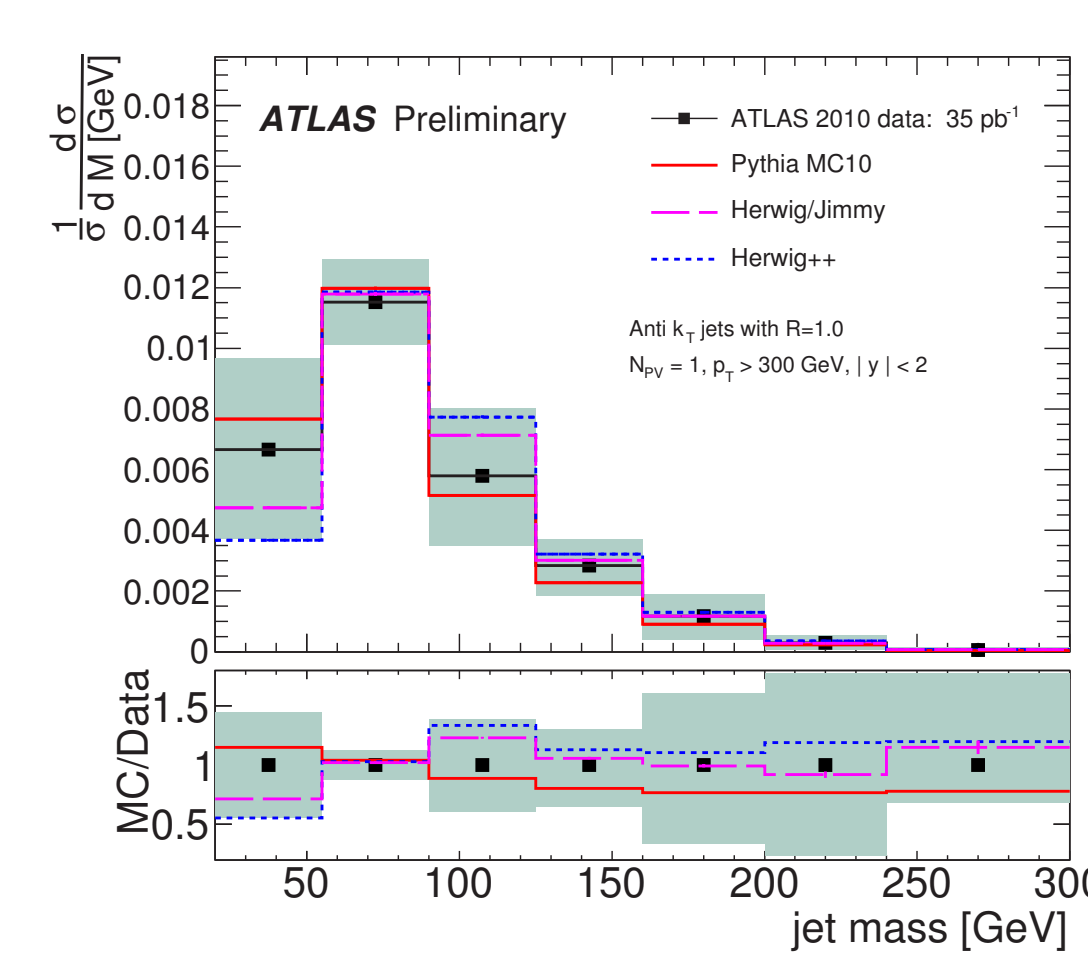


Fig. 3: Mass spectrum of AntiKt (R=1.0) jets with $|y| < 2.0$ and $p_T > 300$ GeV [3].

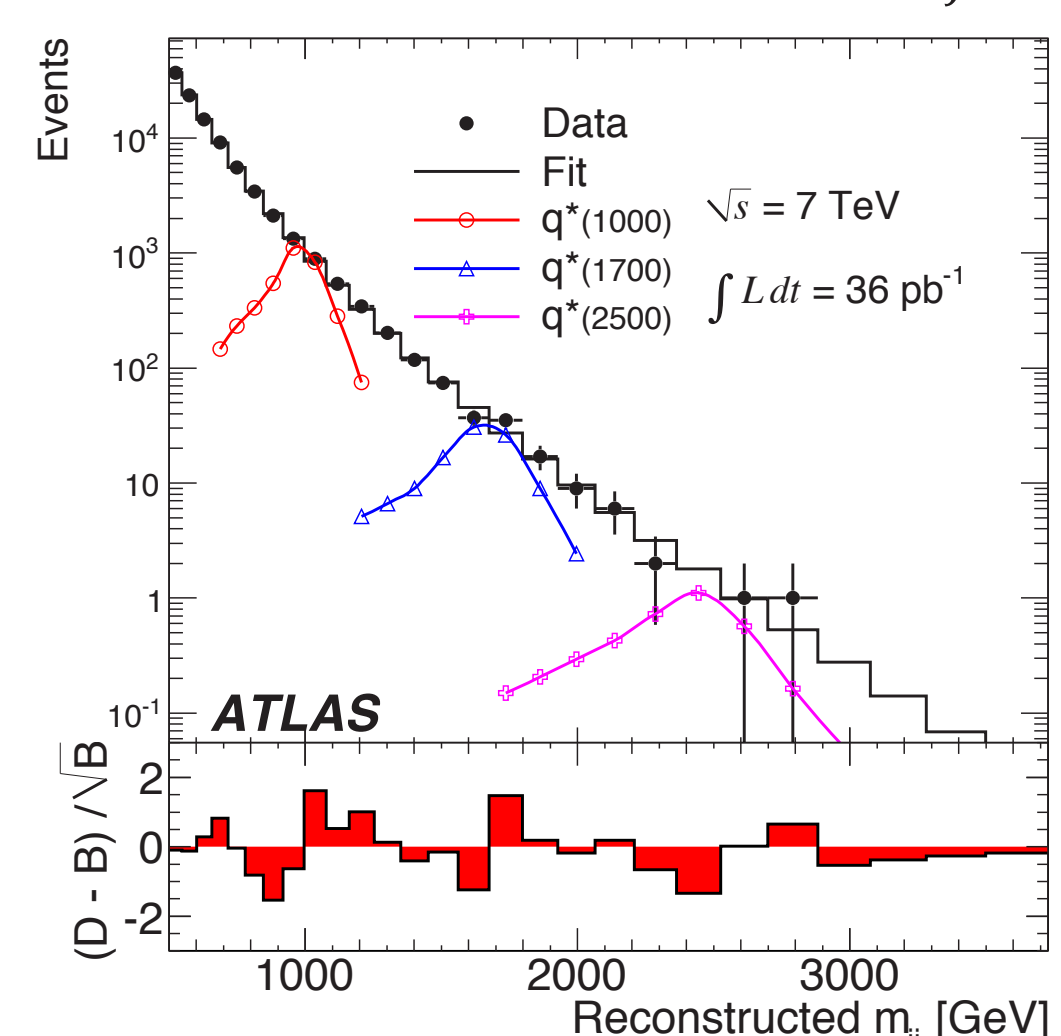


Fig. 4: Observed dijet mass distribution and predicted q^* signals [4].

The jet trigger is essential for detailed studies of QCD and in searches for new physical phenomena.

References

- [1] ATLAS Collaboration *The ATLAS Experiment at the CERN Large Hadron Collider* JINST 3 (2008) S08003.
- [2] ATLAS Collaboration *Measurement of inclusive jet and dijet cross sections in proton-proton collision data at 7 TeV centre-of-mass energy using the ATLAS detector* ATLAS-CONF-2011-047
- [3] ATLAS Collaboration *Measurement of Jet Mass and Substructure for Inclusive Jets in $\sqrt{s} = 7$ TeV pp Collisions with the ATLAS Experiment* ATLAS-CONF-2011-073
- [4] ATLAS Collaboration *Search for New Physics in Dijet Mass and Angular Distributions in pp Collisions at $\sqrt{s} = 7$ TeV Measured with the ATLAS Detector* New J. Phys. 13 (2011)
- [5] M. Cacciari, G. Salam, G. Soyez *The anti-kt jet clustering algorithm* JHEP 0804 (2008) 063, arXiv:0802.1189.