INSTITUTO DE FÍSICA CORPUSCULAR

Centro mixto U. de València (Estudi General) - CSIC

Track reconstruction performance for charged pions in high p_T jets with Athena 14.2.20

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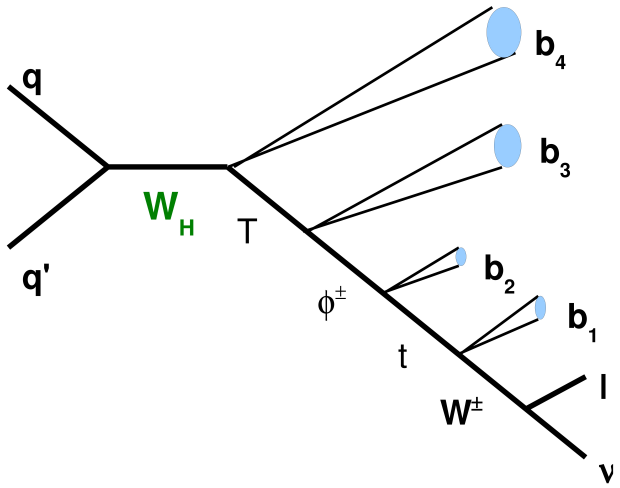
Importance of High p_T b-tagging

Twin Higgs: $W_H(1.25 TeV/c^2) \rightarrow Tb$

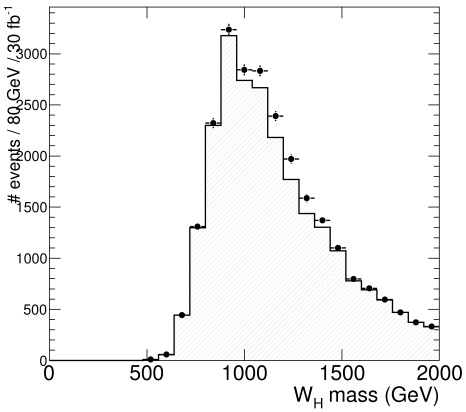


- In last Atlfast study high p_T b-tagging greatly improved our results.

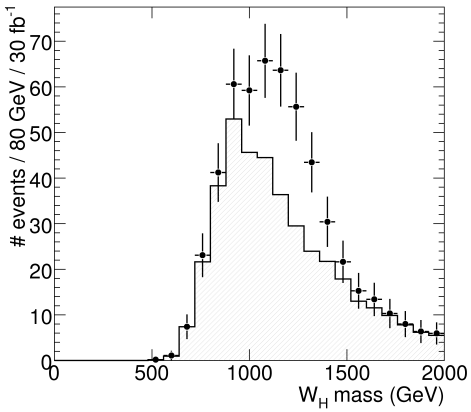
	Atlfast	
selection	no b-tag	b-tag
signal	1058	138
$t\bar{t}$	23500	392
$S/\sqrt{B}$	6.9	7.0
S/B	0.05	0.4

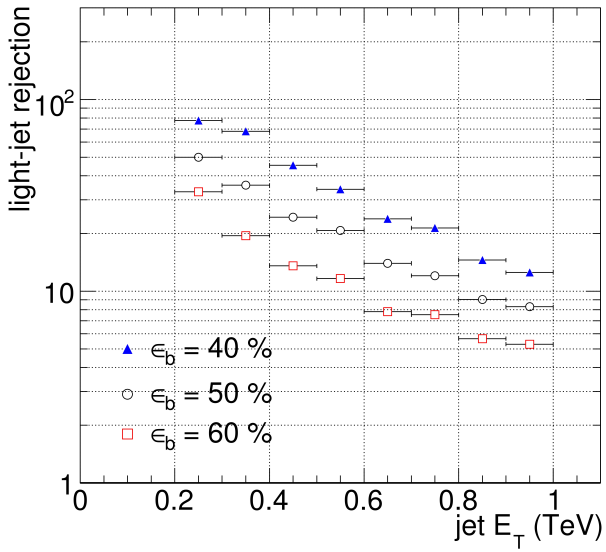
- b-tagging relies heavily on tracking on jets.

Before b-tagging



After b-tagging

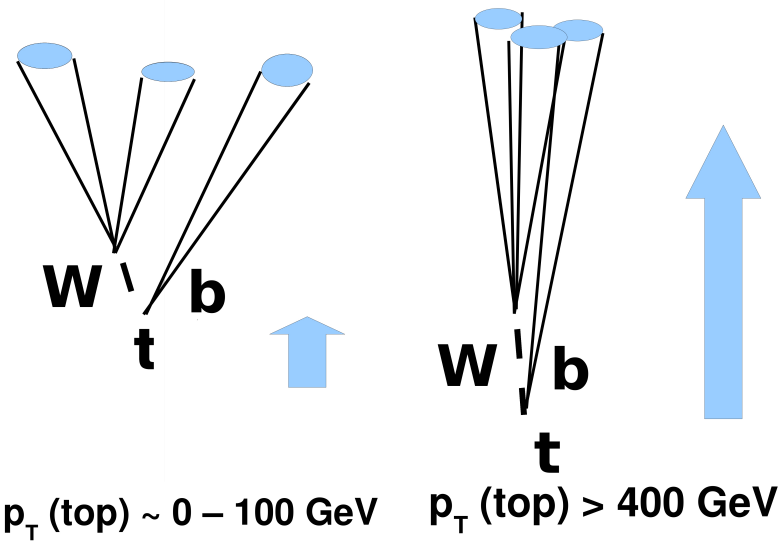


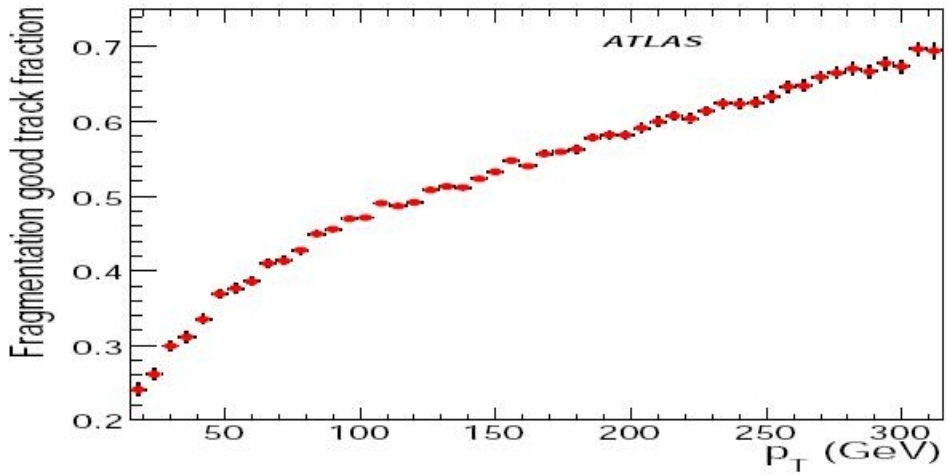


"Looking for signatures of the Left-Right Twin Higgs model with the ATLAS detector at the LHC" - Ferrag, S; González de la Hoz, S; March, L; Ros, E; Rijpstra, M; Vos, M; Vreeswijk, M - ATL-PHYS-PUB-2008-004; ATL-COM-PHYS-2008-050 - 2008

Why are high p_T jets so hard?

Charged multiplicity in cone

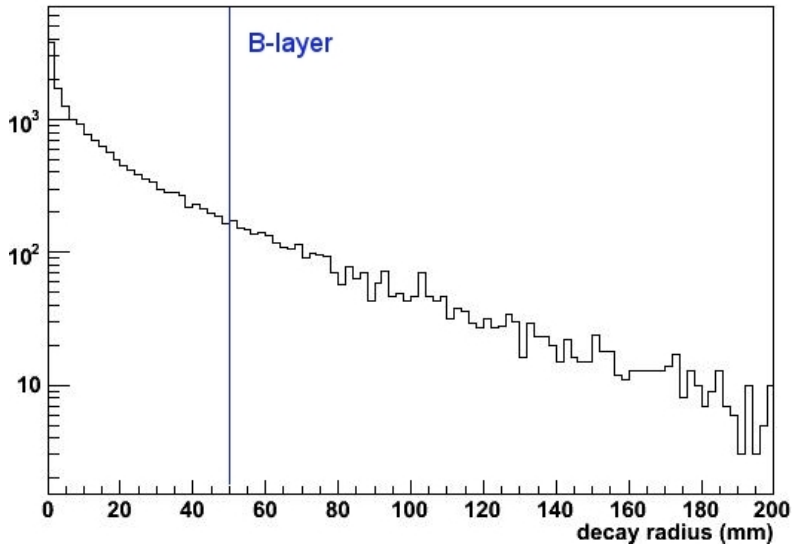


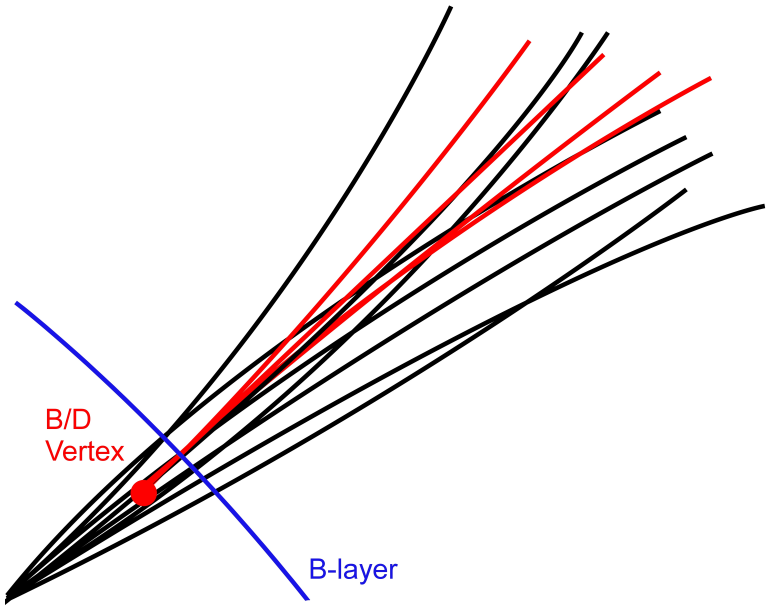


- Number of tracks in b-jet (core) increases with jet E_T
- As # tracks from B-decay is constant its relative weight decreases.

Why are high p_T jets so hard?

Displaced vertex





	$R_B R > 2.9(\%)$	$R_B R > 5.1(\%)$
$E_T > 100 GeV$	12.2	3.9
$E_T > 200 GeV$	21.1	7.9

- Average decay radius of B hadrons: $L = c\tau\gamma$
- For $Z_H(2TeV)$ L no longer $<<$ B-layer radius.
- B/D decays “right in front” of the B-layer: tracks from secondary/tertiary vertex have no “time” to separate.

High p_T b-tagging

Efficiency definition

Sample:

- $Z_H(2TeV) \rightarrow b\bar{b}, u\bar{u}$

Particle selection:

- every charged particle that has no daughters
- must originate in a well-defined vertex (ie, the interaction point)
- we study only charged pions with $p_T > 1GeV$
- MC truth particle is considered efficiently reconstructed if a track is associated to the particle with a probability of at least 80%

Two classes of particles are distinguished:

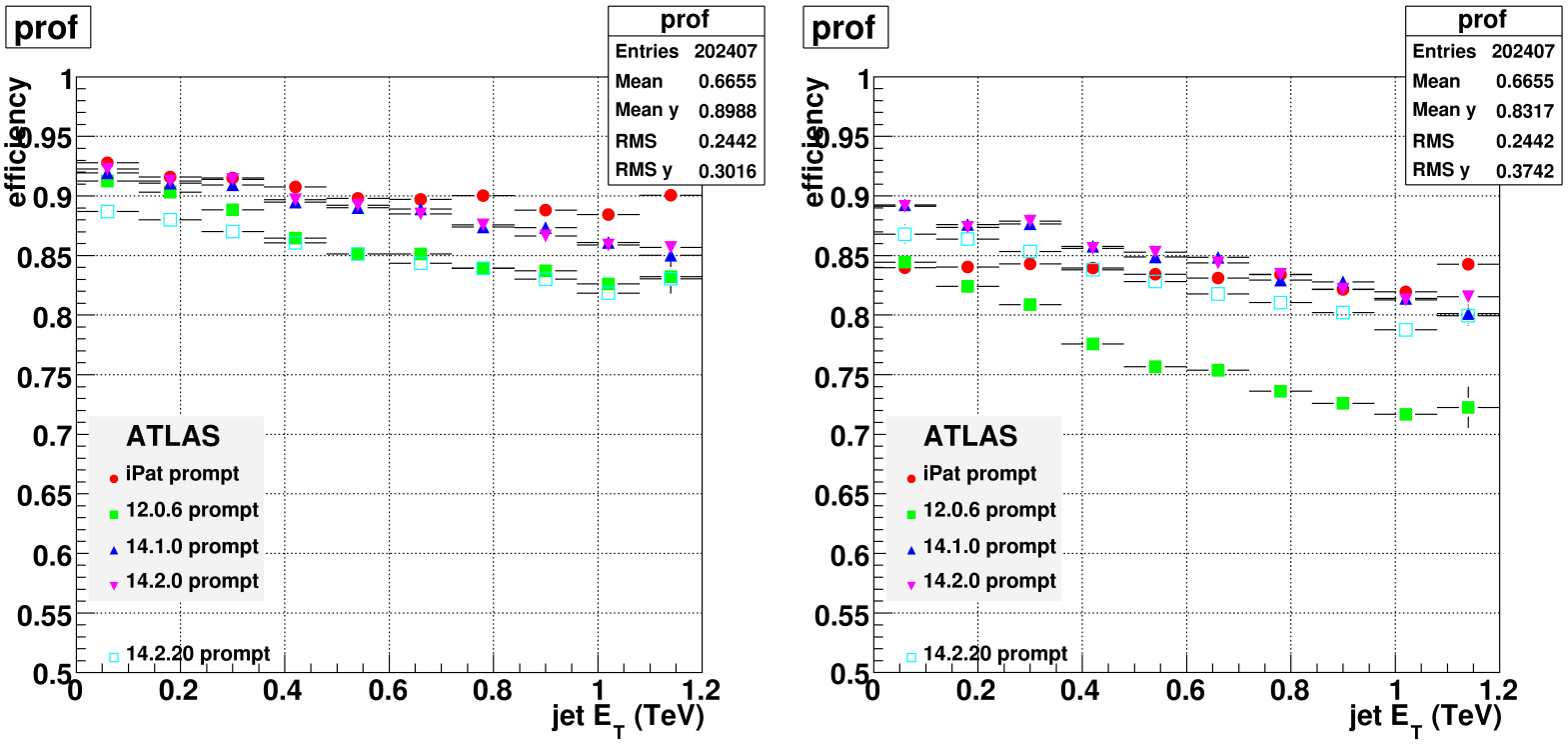
- **Prompt tracks:** the origin vertex of the MC truth particle is required to be within 10mm of the interaction point
- **B-/D-decay tracks:** the origin vertex of the MC truth particle is required to be within 10mm of B-/D-decay vertex

Quality selection cuts applied:

- At least 1 hit on pixel b layer (b-hit)
- At least 2 hits on pixel.
- At least 7 hits on PIX+SCT.

Track reconstruction for pions in high p_T jets

Prompt particles

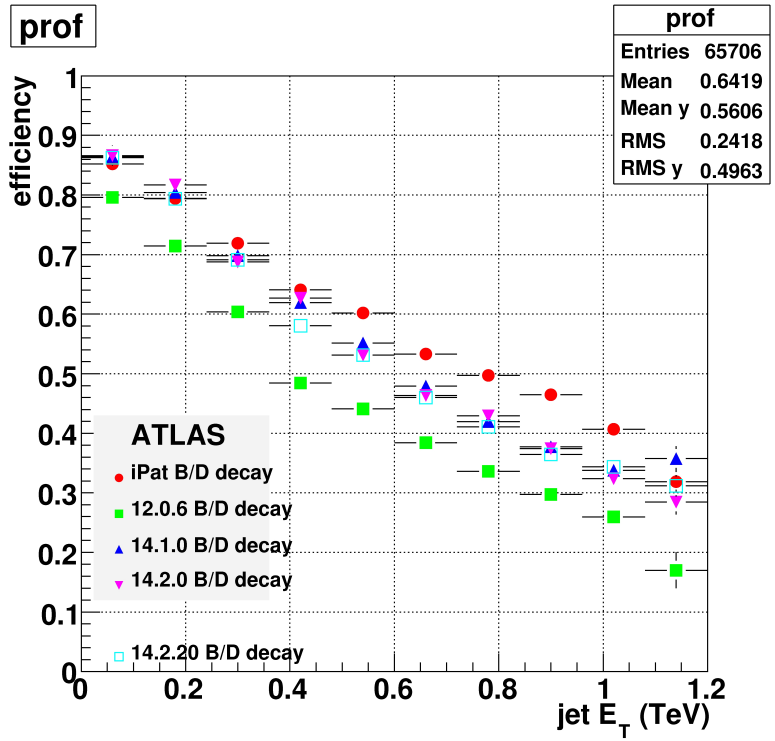


Track reconstruction efficiency versus E_T for prompt particles with quality selection cuts (right) and without them (left)

Track reconstruction efficiency does stand the high track density in the core of high p_T jets.

Track reconstruction for pions in high p_T jets

B-/D-decay particles



Track reconstruction efficiency versus E_T for B/D-decay particles with quality selection cuts.

Reconstruction efficiency drops signficantly for tracks that stem from displaced vertices while the ideal tracking for b-tagging would have 100% efficiency for tracks from B/D decay and 0% efficiency for prompt tracks.

Conclusion

b-tagging quality tracking efficiency remains stable in 14.2.20 compared to previous releases (even though raw efficiency was slightly worse)

Outlook

Pixel clustering studies should improve our results