Tracking efficiency in high pT (400-1000 GeV) jets with highly displaced vertices

ID software weekly, 24th August, 2007

Marcel Vos, IFIC Valencia

Tracking efficiency CSC samples

Determine tracking efficiency by association to MC truth.

Use TrackParticleTruthCollection on AOD:

- **invert truth map (MC -> reco)**
- **query with stable (end of decay chain) MC pions of pT > 1 GeV/c**
- **require an association probability of 80%**
- **require tracks to originate in a well-defined vertex (origin, or B/D decay vertex)**
- **no requirement on number of hits, etc.**

NOTE: the result is a highly idealized efficiency for tracks that suffer no accidents.

Allows to isolate effects due to jet ET and/or decay vertex

compare two classes of tracks

from beam spot (R_{origin} < 10 mm, square markers)

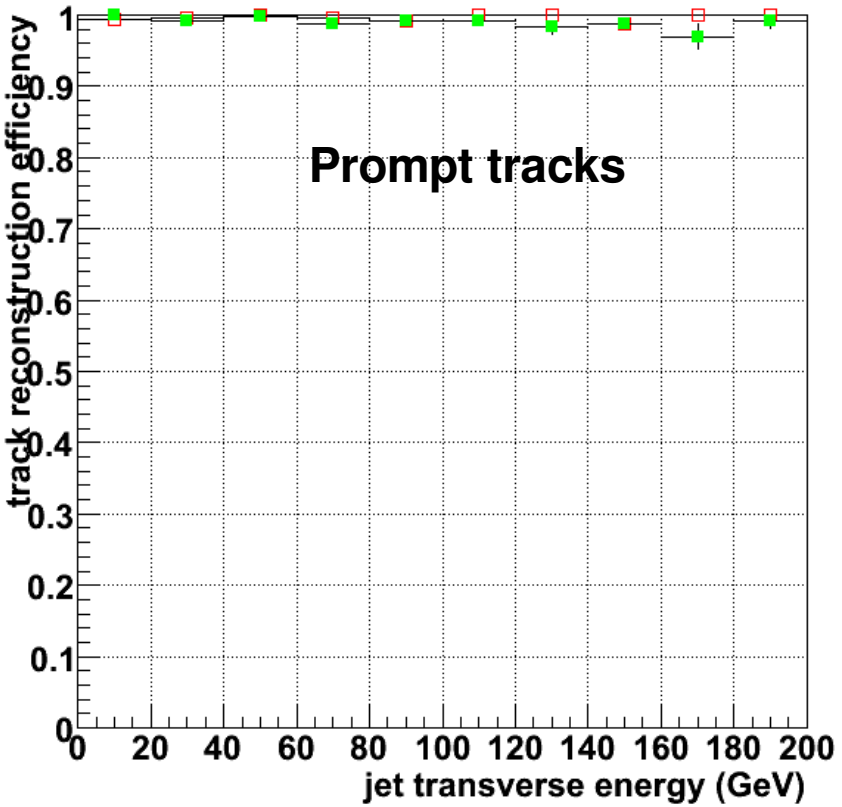
from B/D hadron decay vertex ($R_{origin} - R_{B/Dvtx}$ < 10 mm, round markers)

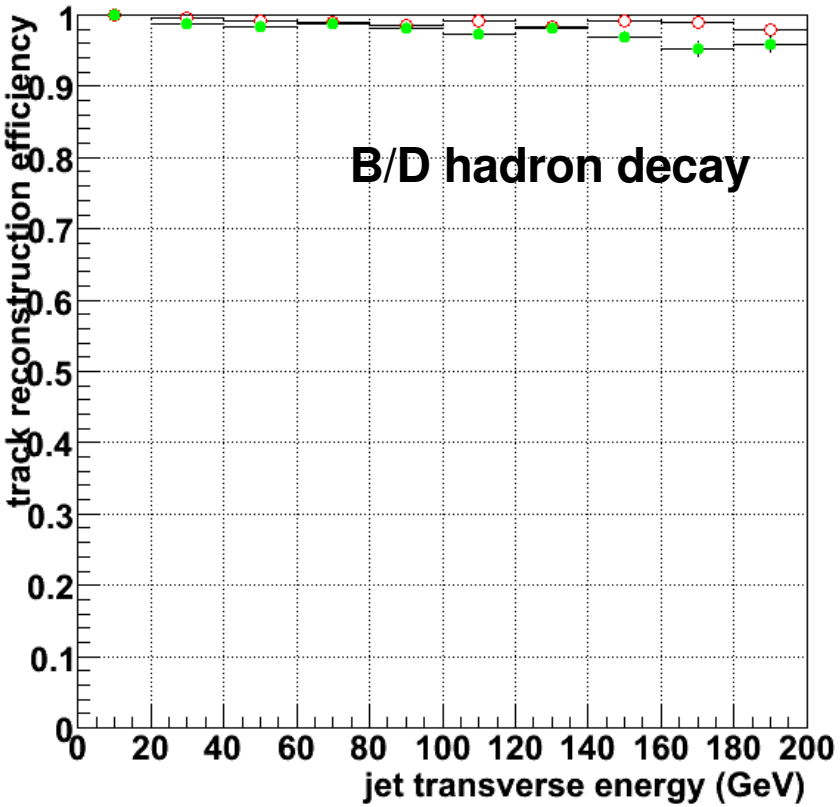
compare two reconstruction algorithms

IpatRec (open red markers)

New Tracking (filled green markers)

Results: low pT (WH_{120},WH_{400})



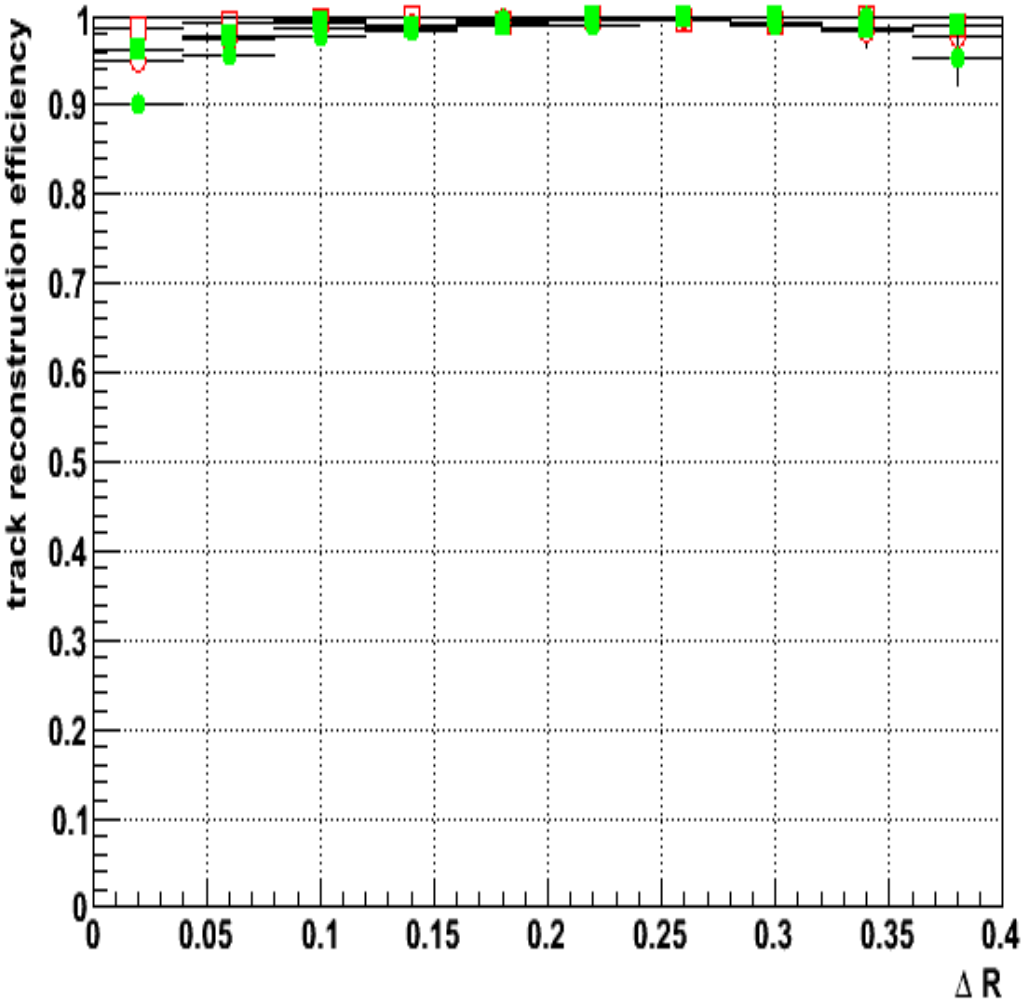


Combined WH samples cover jet ET range from 30 to 200 GeV

Overall efficiency close to 100 % (as expected)

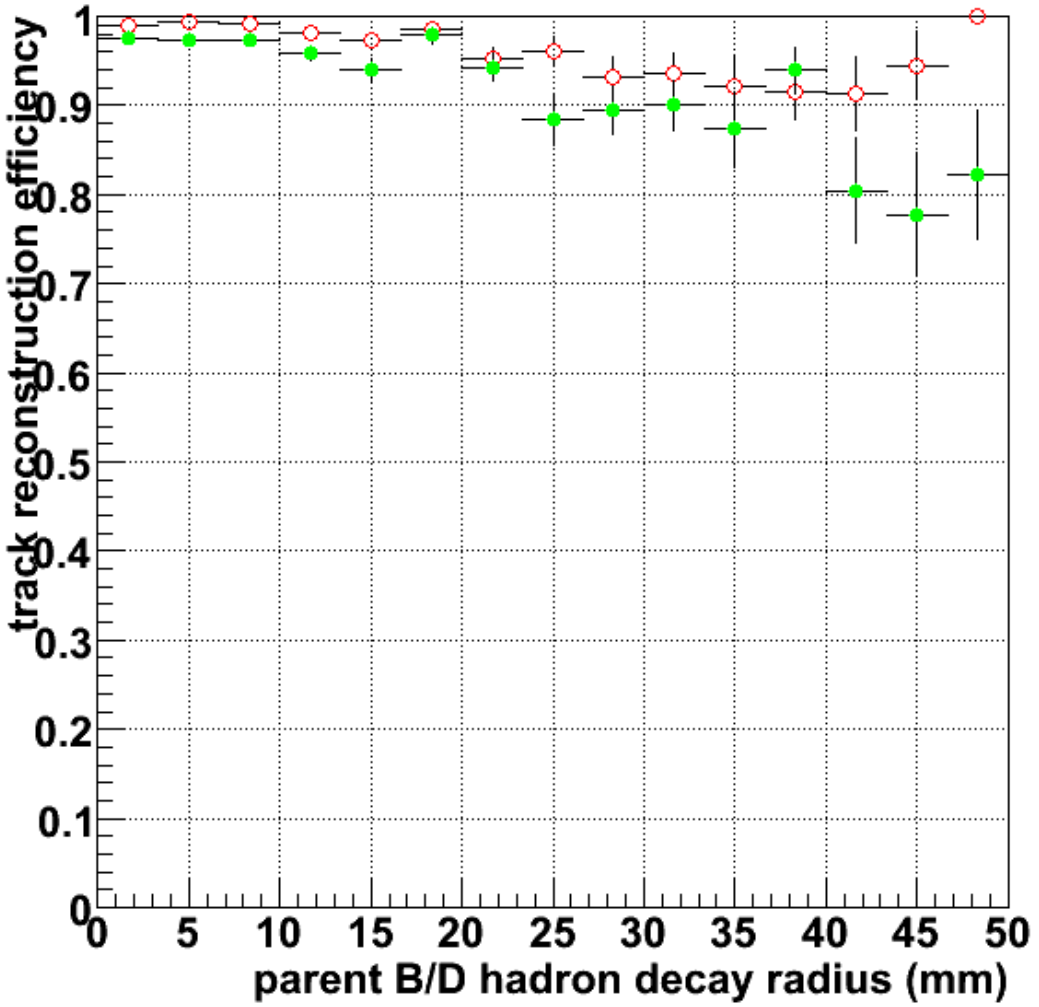
No significant variation of performance observed

Results: low pT (WH_{120},WH_{400})



WH samples show quite uniform performance wrt ΔR distance to the jet core, only a slight degradation towards the center of the jet (expect the same result for standard validation sample)

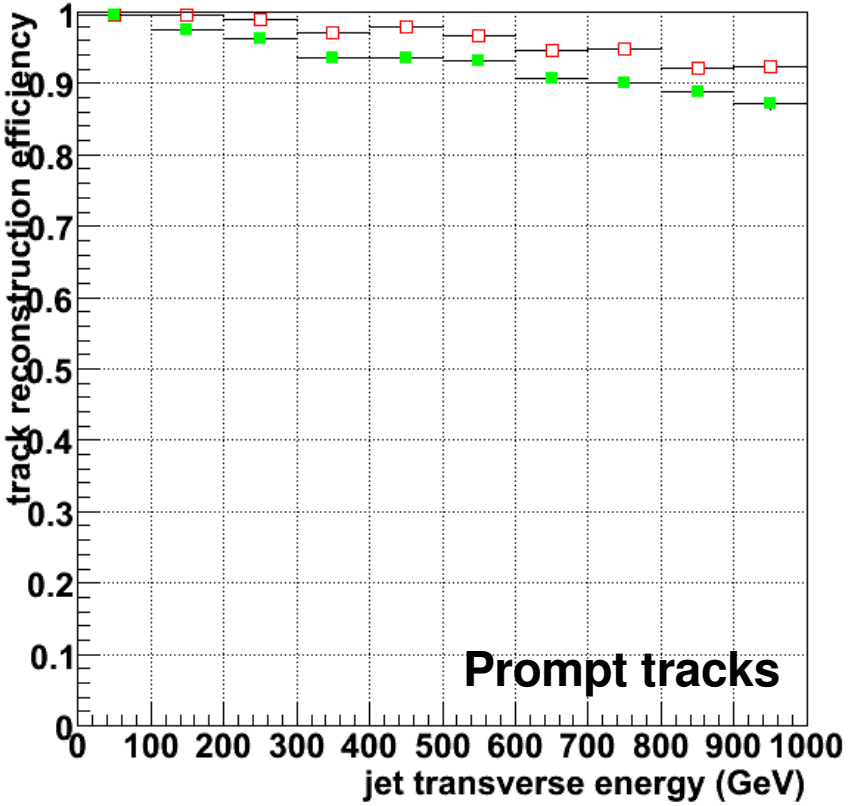
Results: low pT (WH_{120},WH_{400})

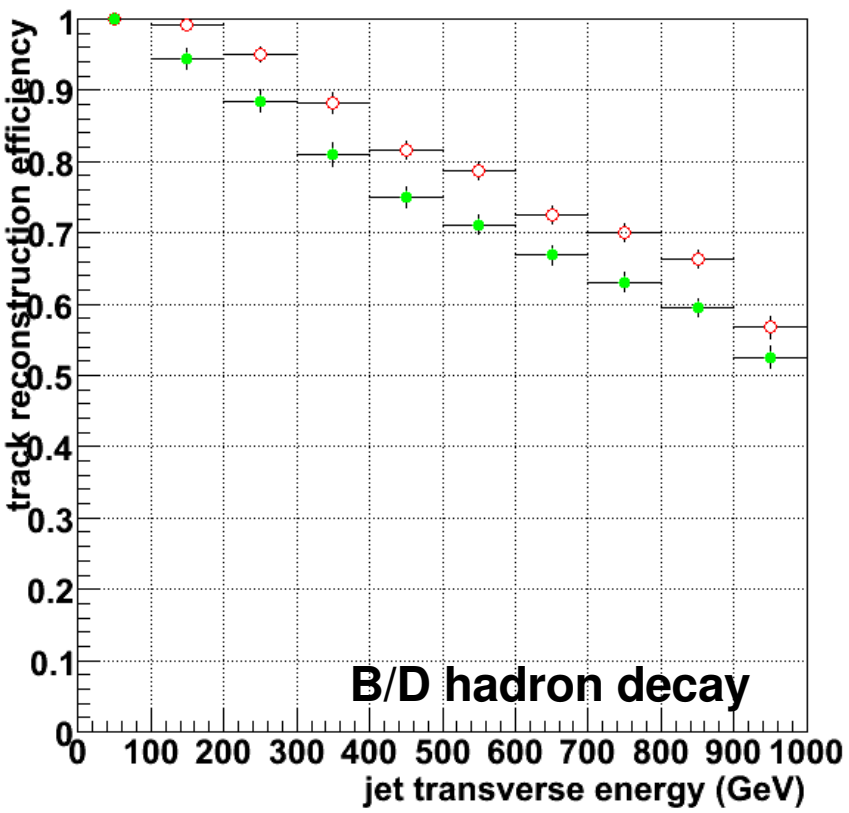


WH samples show comparable performance on prompt tracks and those originating from B/D hadron decay, and between both algorithms (expect the same result for standard validation sample)

A closer look (eff vs. decay radius parent particle) reveals a mild degradation.

Results: high pT (Z_H with m=2000 GeV)



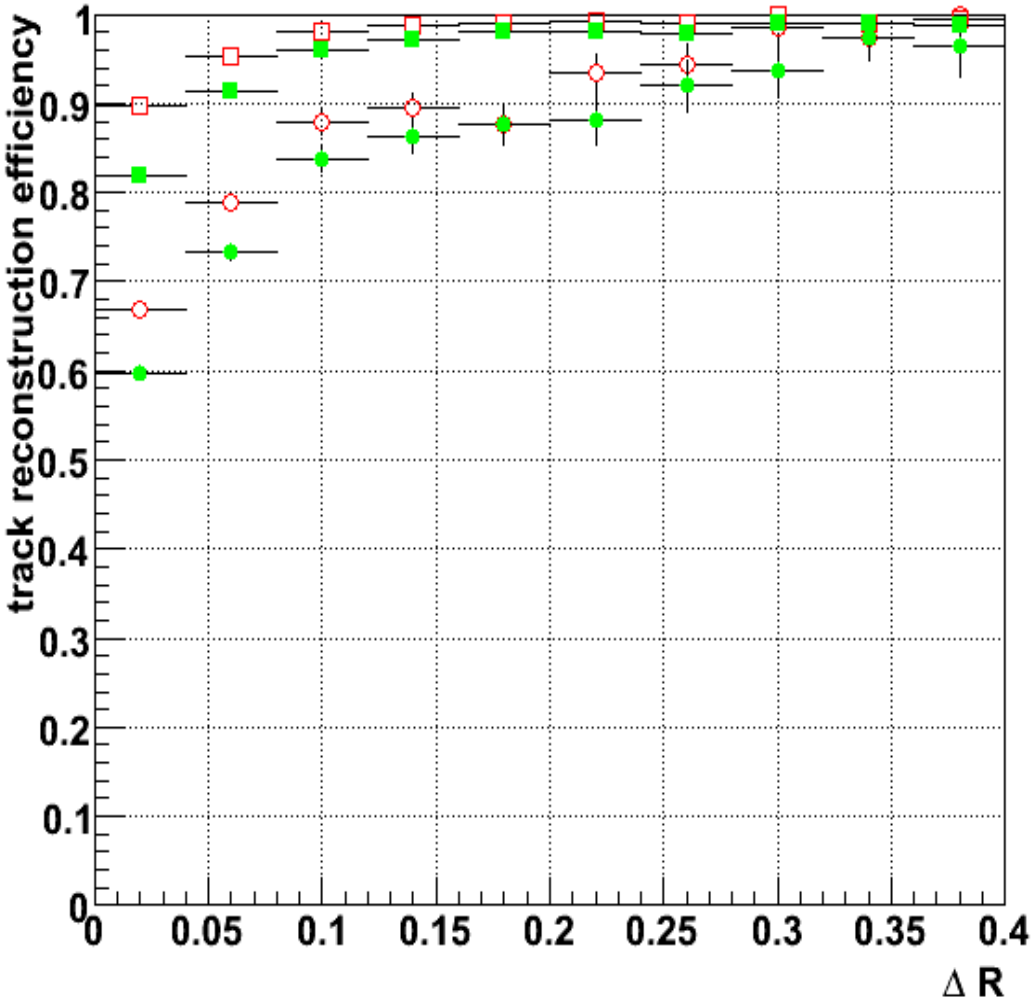


Z_H samples provide information from complementary range from 300 to 1000 GeV

Reconstruction efficiency for prompt tracks (from beam spot) degrades to ~ 90 % for highest energy

Reconstruction efficiency for tracks from B/D hadron decay steadily degrades as jet ET increases, reaching ~55 % for ET=1000 GeV

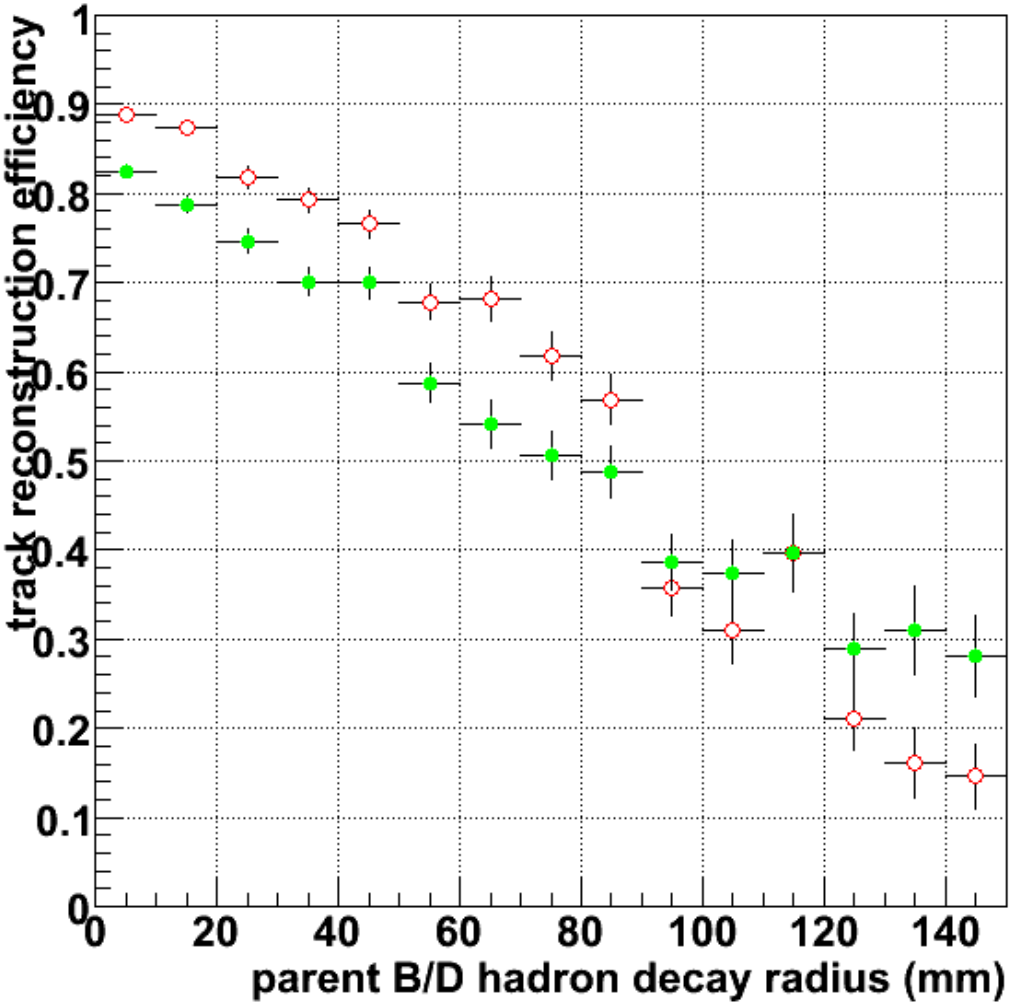
Results: high pT (Z_H with m=2000 GeV)



IpatRec (open, red markers) performs better than New Tracking (filled green) for high pT jets

For both algorithms: Efficiency degrades signficantly in the jet core, i.e. for ΔR<0.1.
For prompt tracks (squares) the degradation is limited, the efficiency is always better to 90% (82 %). For good-quality tracks from B/D decay that originate far from beam spot the effect is much stronger.

Results: high pT (Z_H with m=2000 GeV)



IpatRec (red) performs better than New Tracking (green) for high pT jets

For both algorithms: Efficiency for good-quality tracks that originate far from beam spot (but with small impact parameter) very poor.

Results 12.0.6 vs 13.0.10

It was suggested that the z-scan using in 12.0.6 in seeding the track reconstruction could be at the heart of the reduced efficiency for tracks from displaced vertices.

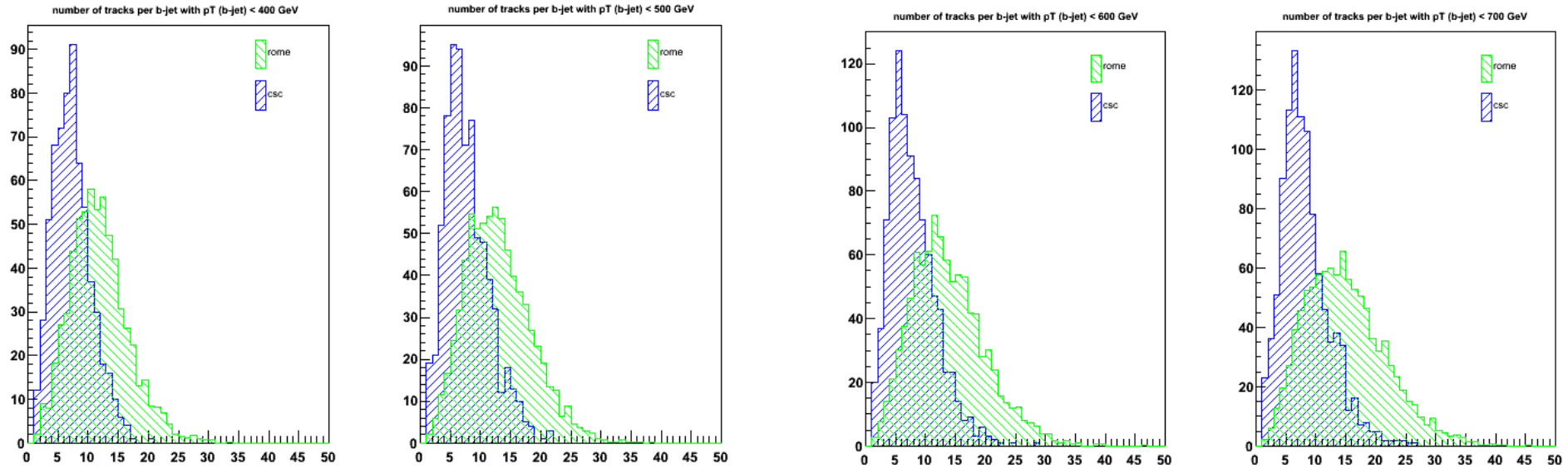
Simulated, digitized and reconstructed 1000 events with 13.0.10

Result: no change!

Preliminary conclusions

- **The good news: Small degradation of reconstruction efficiency for prompt tracks in very high pT jets: even in the jet core, good performance is maintained.**
- **The bad news: Tracks originating from displaced vertices (B/D hadron decay) much more affected -> tracking performance likely to be the origin of degradation b-tagging**
- **Rome b-tagging performance (based on IpatRec) much better than CSC (only due to extra material/misalignment?)**

CSC Tracking in high pT b-jets



Z' -> bb sample with m(Z')= 2 TeV, b-jets with ET from 300 GeV to 1 TeV.

Reconstructed track multiplicity (after quality cuts) for high p_T jets much reduced with respect to Rome samples (iPatRec, 11.0.1)

Track parameter distributions (chi-squared, N hits in pixel, silicon, B-layer) do not seem to provide hints