bb final state studies

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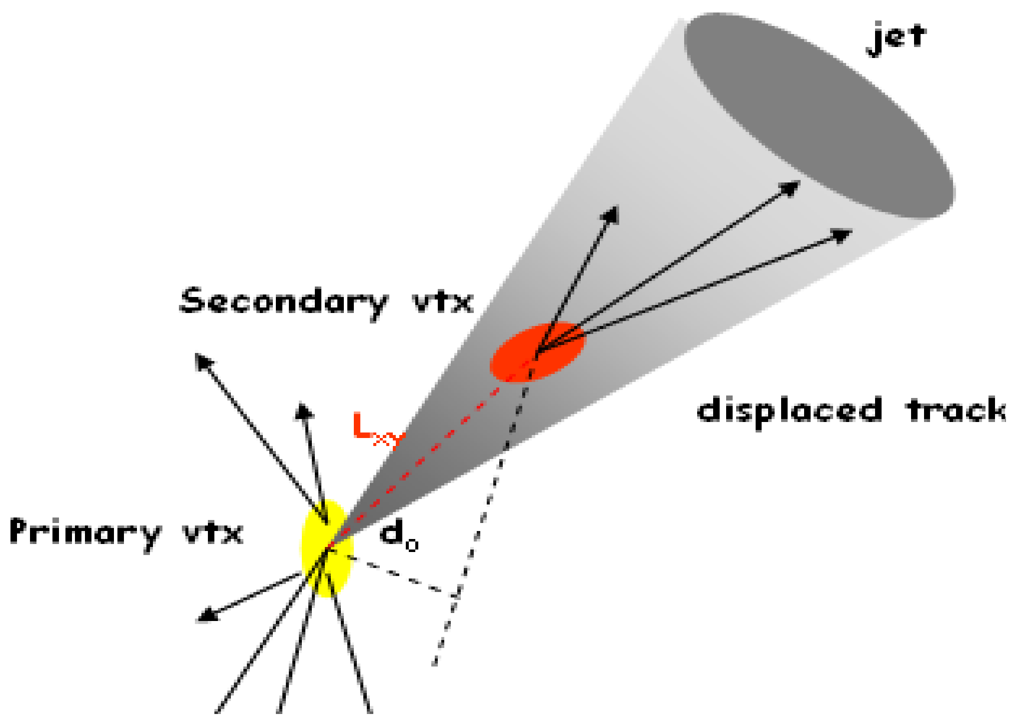
b-jet features

B hadron travels some millimeters before decaying.

A **jet** of particles produced by the decay of a B hadron has

• a secondary **vertex displaced** from primary on

• tracks with **high impact parameter**



The dijet b-tag trigger

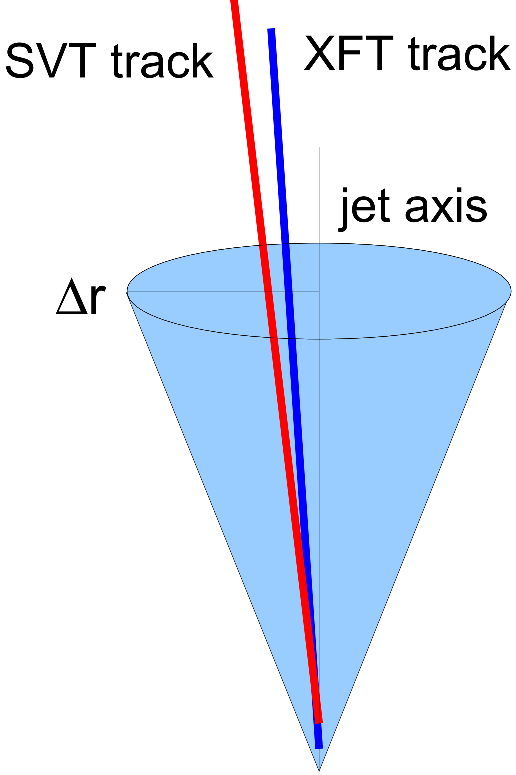
GOAL: select **double b-jet final state events** (trigger optimized for Hbb search) looking for displaced tracks in jets

Drift Chamber tracks (XFT)

- polar angle θ (pseudo-rapidity η)
- z position

Silicon tracks (SVT)

- impact parameter d_0
- curvature
- azimuthal angle φ



XFT-SVT match = hybrid track

3D track available at trigger level + **d_0 information**

hybrid track–jet 3D match

$$\sqrt{(\Delta\eta^2 + \Delta\phi^2)} < \Delta r$$

The dijet b-tag trigger

Absolute efficiencies

	data (%)	hbb (%)	phibb (%)	zbb (%)
L1	3.5	69.2	71.2	38.0
L2	0.02	13.7	12.1	5.9
L3	0.02	**12.7**	**11.2**	**5.4**

Official since May 2008
More than 3 fb^{-1} of data collected so far

Efficiency with respect to events having at least ONE b- tagged jet (Et > 15 GeV, |eta| < 1)

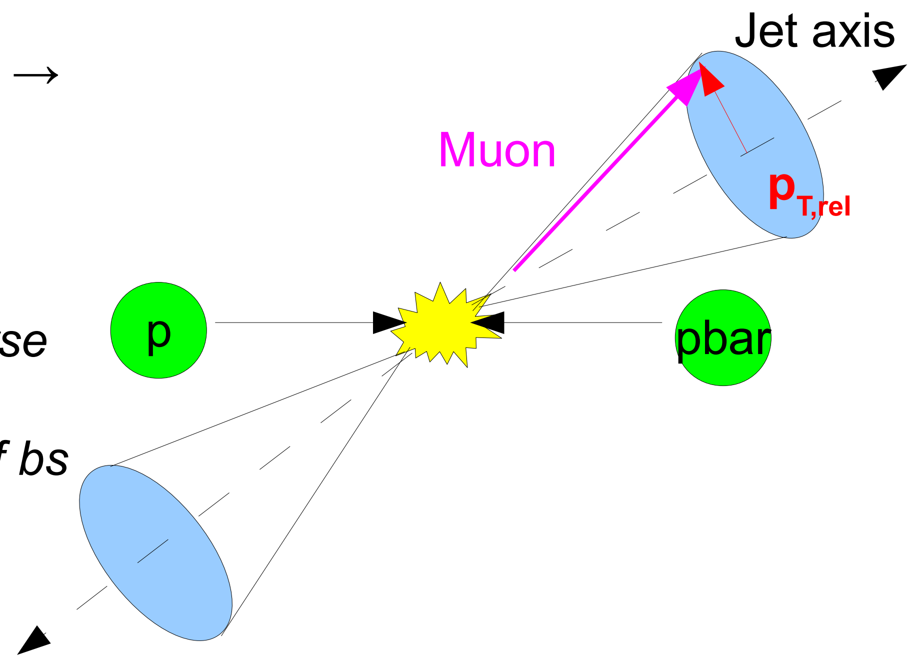
	hbb (%)	phibb (%)	zbb (%)
L1	87.1	88.0	71.5
L2	27.3	23.1	18.8
L3	**25.7**	**21.7**	**17.5**

Efficiency with respect to events having at least TWO b-tagged jets (Et > 15 GeV, |eta| < 1)

	hbb (%)	phibb (%)	zbb (%)
L1	98.1	98.0	94.6
L2	50.7	42.7	45.1
L3	**49.4**	**40.9**	**43.9**

Dijet B-tag trigger efficiency

Efficiency in MC is easy, more complicated in DATA → we need a sample or real b-jets.



Idea: Muons from b-decays will have larger transverse momentum ($p_{T,rel}$) relative to jet axis

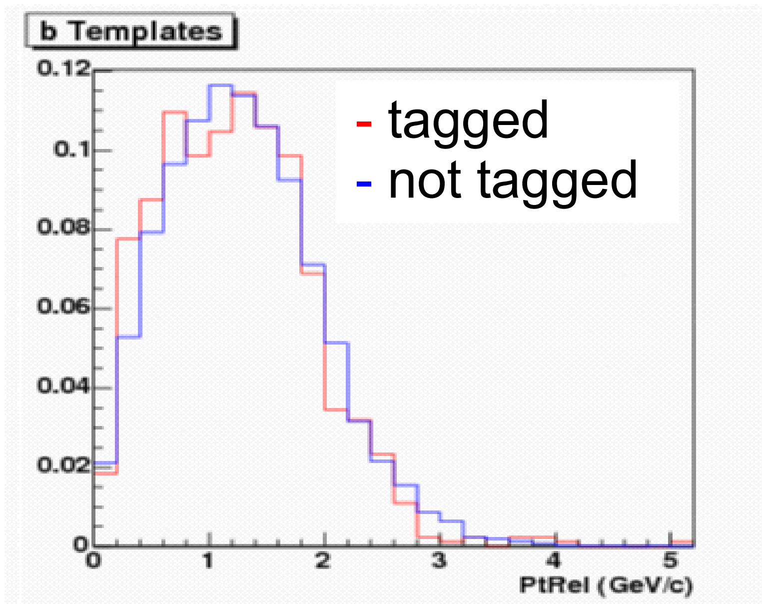
→ use muon $p_{T,rel}$ spectra to calculate the number of bs

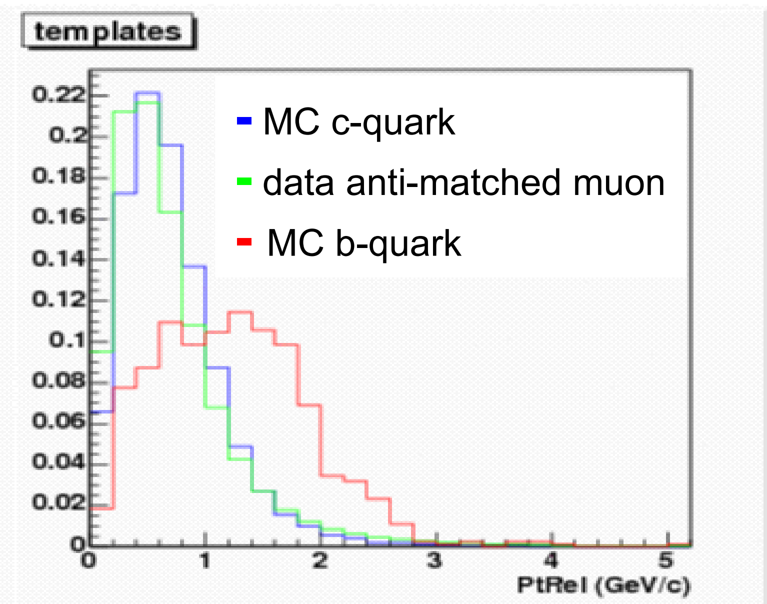
Use **muon filtered dijet samples** in DATA and MC
Increase b fraction → require an away jet back to back

Efficiency in MC: find the number of muon jet b's at generator level before and after tagging and divide.
Efficiency in DATA: divide data into tag and not-tagged muon jet samples, find the number of b's in each sample, efficiency given by

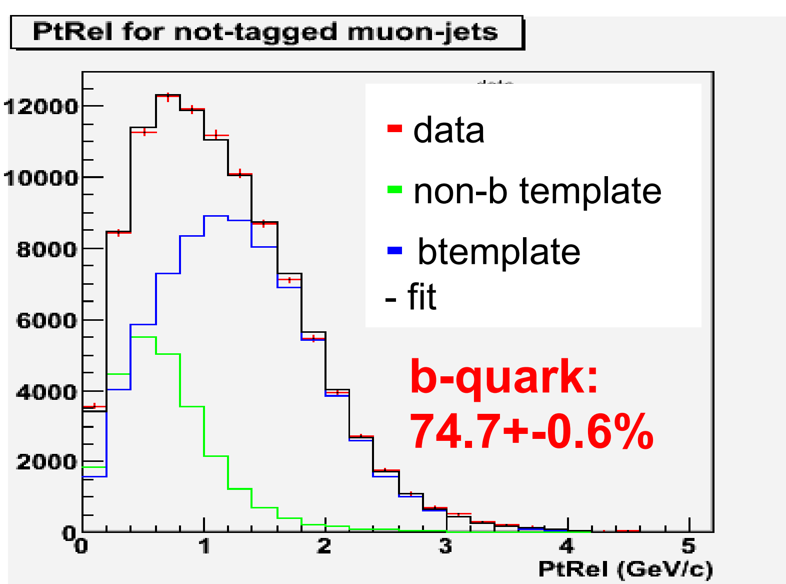
$$\varepsilon = \frac{N_{b,\,tag}}{N_{b,\,\overline{\mathrm{tag}}} + N_{b,\,\mathrm{tag}}}$$

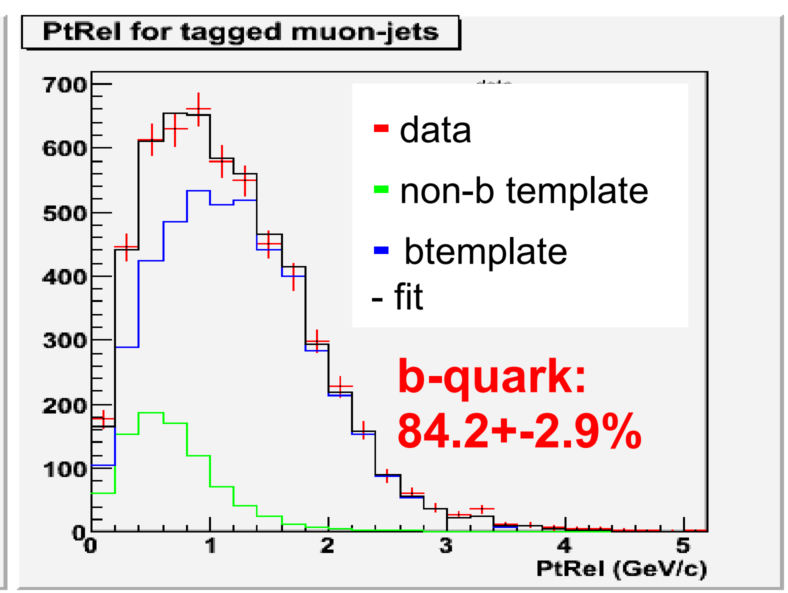
The dijet b-tag trigger: efficiency estimation





Templates for the b and not-b components





Fit to events where the muon-jet satisfies (or not) the trigger requirements

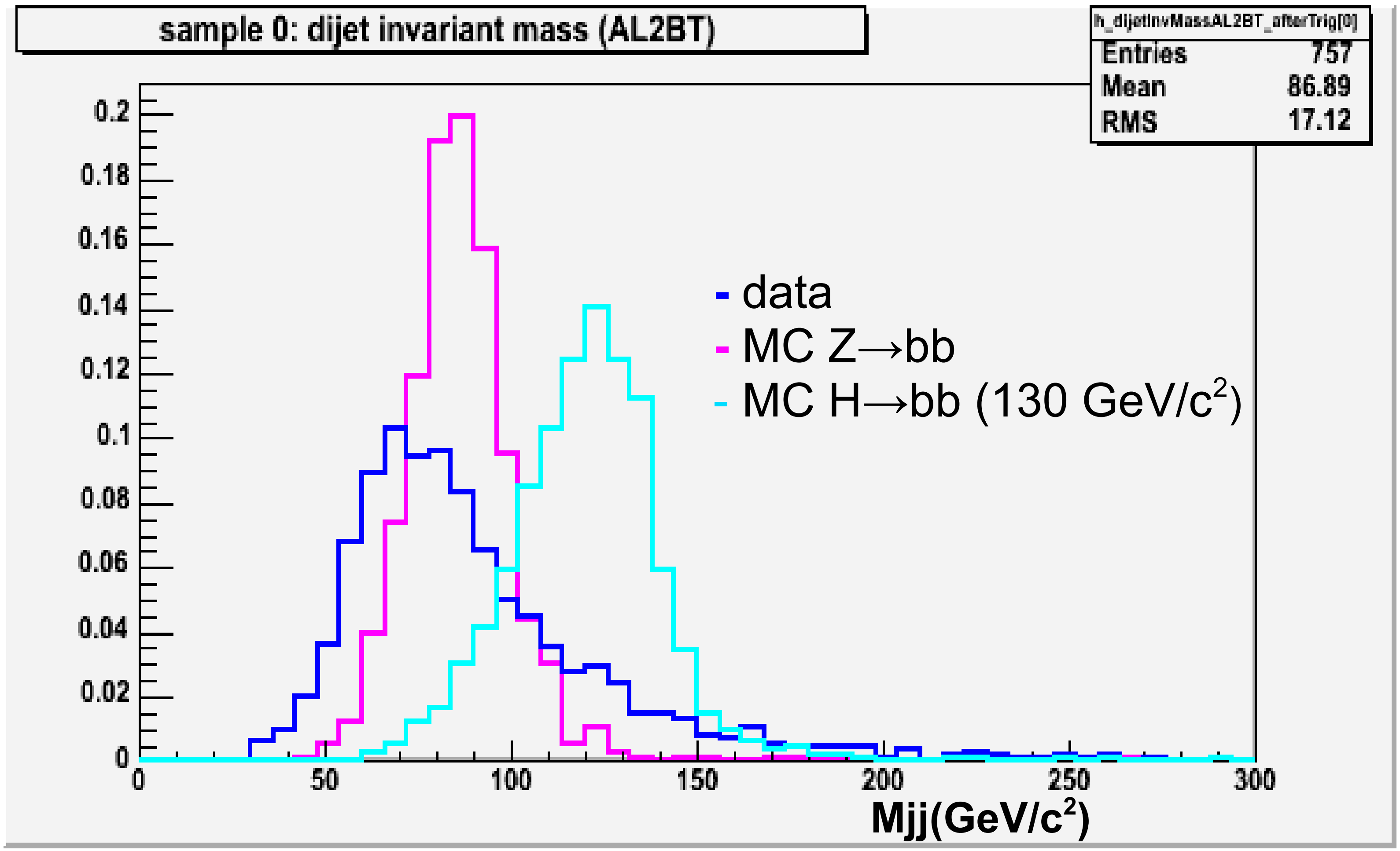
The dijet b-tag trigger: efficiency estimation

$$\varepsilon(DATA) = \frac{N_{tagged} \times bfrac_{tagged}}{N_{tagged} \times bfrac_{tagged} + N_{not-tagged} \times bfrac_{not-tagged}}$$

$$\varepsilon(MC) = \frac{N_{tagged}(b-matched)}{N_{tagged}(b-matched) + N_{not-tagged}(b-matched)}$$

Preliminary results:	efficiency in data:	5.7±0.2(stat)%
	efficiency in MC:	5.3 ±0.1(stat)%

Analysis ongoing: Z → bb & H → bb



Di-jet invariant mass distribution for double SecVtx tagged events, passing the DIJET_BTAG trigger selection

Analysis ongoing: $Z \rightarrow bb$ & $H \rightarrow bb$ Roadmap

- Completion of trigger efficiency studies:
  - turn-on curves
  - factorization of different trigger effects (tracking, calorimeter)

- Characterization of the different background sources;

- Development of multivariate techniques to separate signal from backgrounds: Neural Networks, Boosted Decision Trees.

- $Z \rightarrow bb$ extraction and b-jet energy scale definition

- $H \rightarrow bb$: limit from fit to dijet invariant mass or to multivariate output distributions

Plans

$Z \rightarrow bb$ analysis: Autumn 2011

$H \rightarrow bb$ analysis: on time for Winter 2012 Conferences