Simulation Study on VXD Design Parameters in $e^+e^- \to t\bar{t}$

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Introduction

The task:

optimisation of design parameters for the LC-VXD with a TESLA standard process

- MAPS (Monolithic Active Pixel Sensors) option
- top-production

The way:

a) development and tests of a simple analysis method with a fast MC (SGV)
   - Is analysis reliable?
   - Does it reproduce variations in detector parameters?

b) optimise detector parameters using full simulation (GEANT4) and reconstruction

The Reference Process

Signature

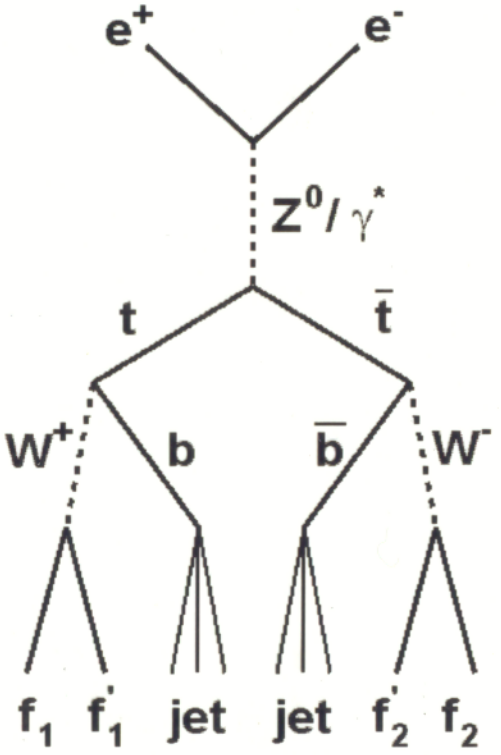
Process signature:

a) 3 basic signatures:

- 6 jets
- 4 jets + 1 lepton/neutrino pair
- 2 jets + 2 lepton/neutrino pairs

b) secondary vertices in 2 (b–)jets

c) low thrust



The Reference Process

Expected Background

initial partons	σ [pb] @ 500 GeV	after pre-selection	expected fraction
tt~	**0,58**	**97%**	**31%**
ff~	25	43%	43%
W+W-	7,7	5%	23%
Z0Z0	0,65	9%	3%

pre–selection cuts:

a) # tracks ≥ 20

b) E, E–pz, E+pz ≥ 100 GeV

c) thrust ≤ 0.8

SGV - A Fast Simulation Tool

Basics

advantages:

a) fast , but complete
b) developed for DELPHI, but adapted to TESLA now (generic tool)

Disadvantage:

very simple detector description ... but:

advantage:

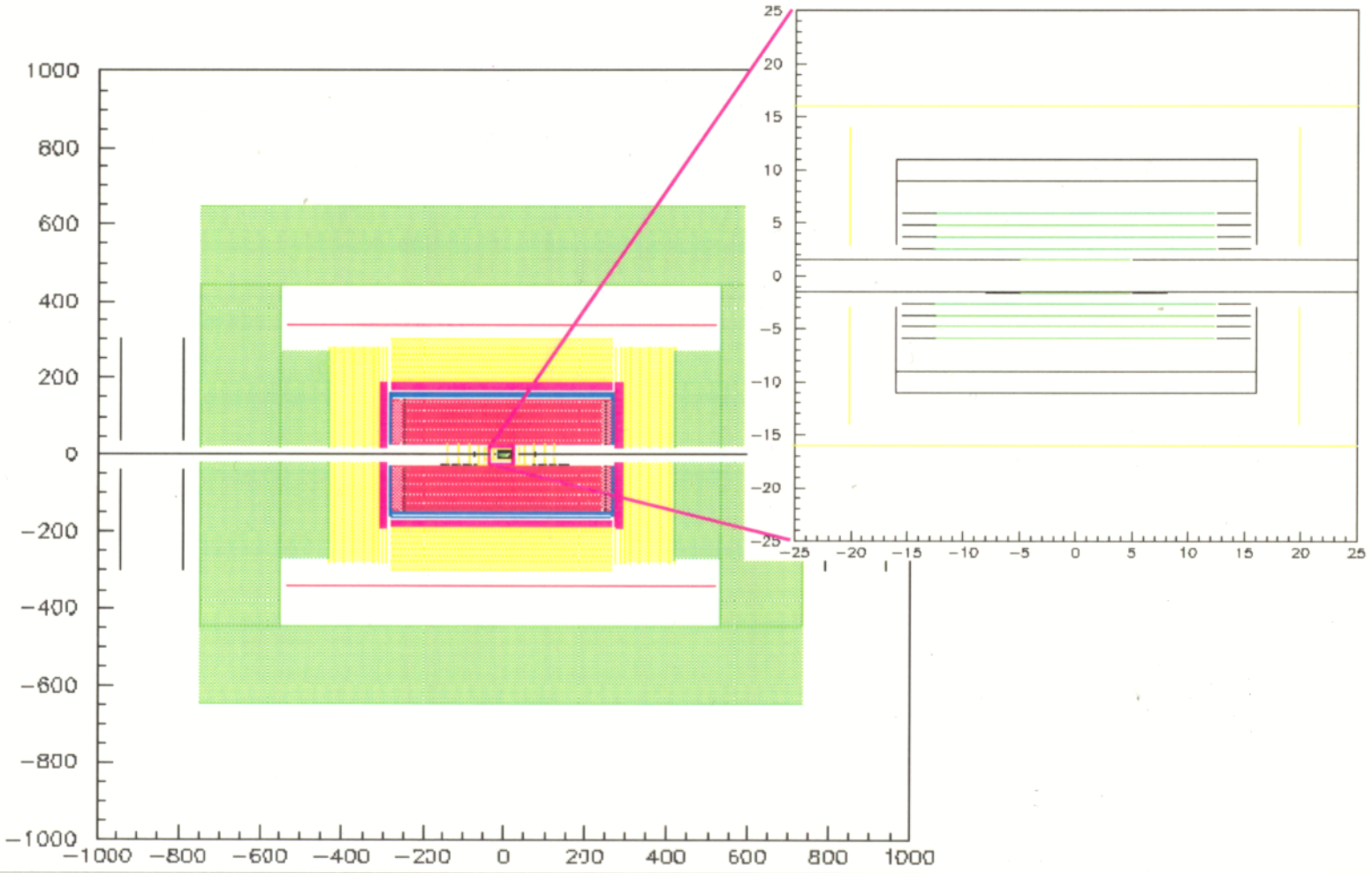
c) easy to handle

functionality:

a) Smears track parameters
b) simulates calorimeter response from given parameters
c) EM-interactions in detector material
d) scintilators, taggers

SGV – A Fast Simulation Tool

Detector Description



b–Tagging

Principle

The b–tagging package has been adopted from BRAHMS:

4 algorithms give jet properties describing probabilities for secondary vertices:

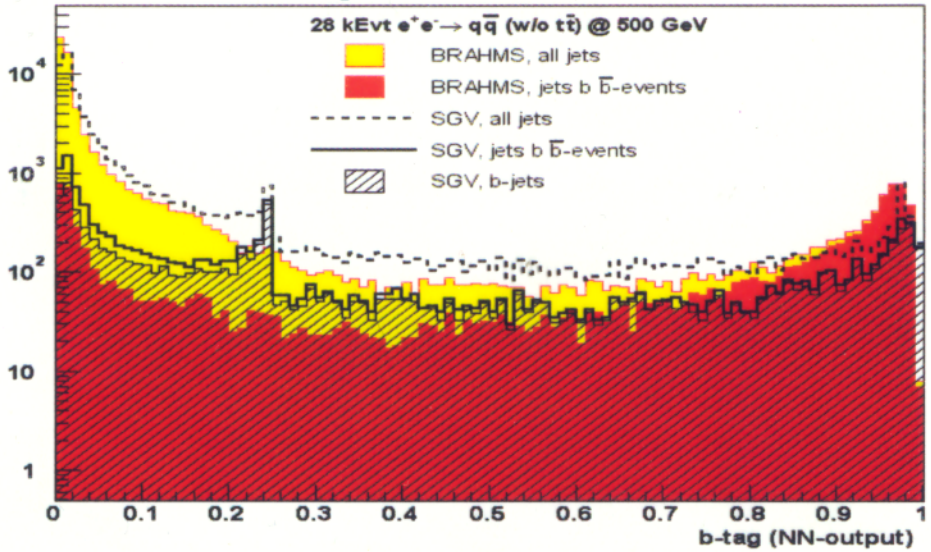
a) impact parameter joint probability tag
b) tear down vertex finder
c) Most significant tracks in jet
d) ZVTOP

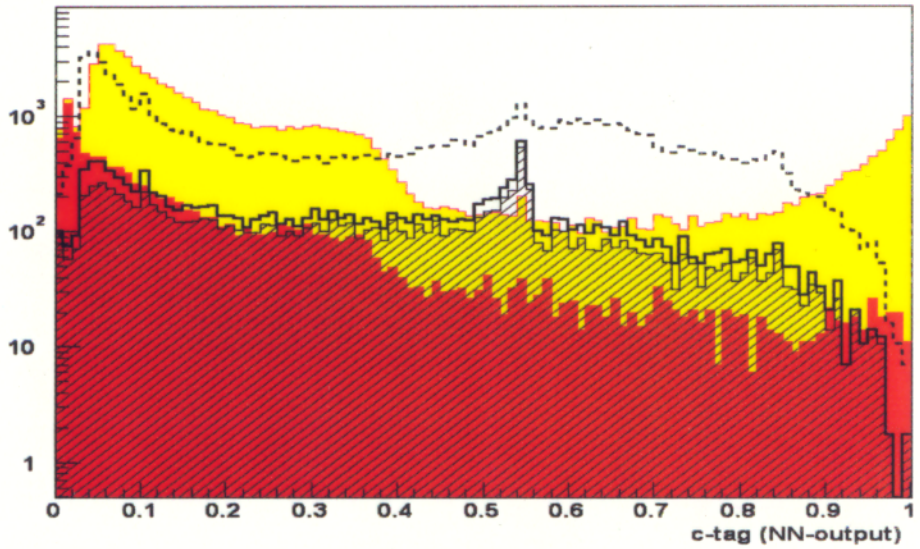
NN gives 3 tagging values:

b–tag, c–tag, b/c–distinction–tag

B-Tagging

Comparison with Full Simulation (LCFI)*





pre-selection:

a) $p_t \geq 5$ GeV

b) #tracks ≥ 6

actual problem:

NN-output does not describe jet flavours well

$\Rightarrow$ check SGV-input w.r.t. BRAHMS

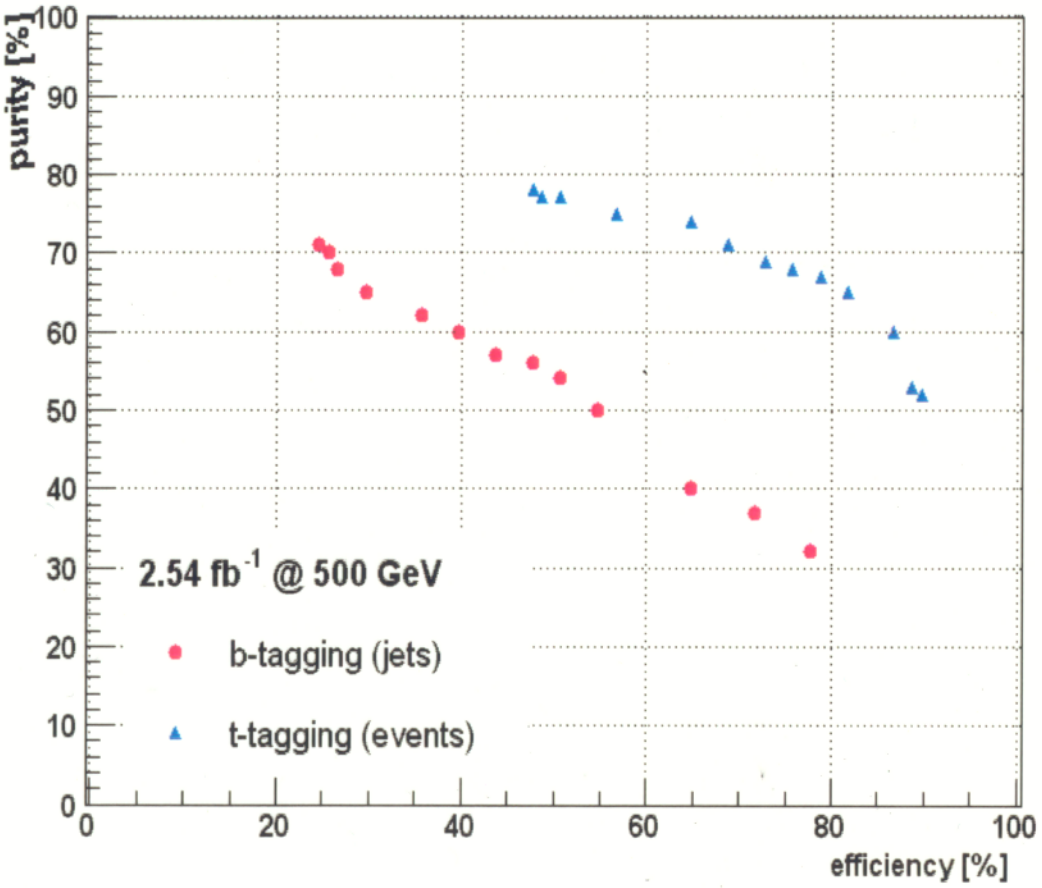
**) Thanks to S.M. Xella Hansen for providing the ntuples.*

t–Reconstruction

a) pre–selection
b) # of jets with (#tracks > 1)
> x
c) # of tagged b–jets > y
⇒very simple

but...

This is just the starting point.



Summary

a) BRAHMS b-tagging has been adapted to SGV.

⇒ running, but still problems

b) starting point of top-reconstruction has been found and shows (very) first results

⇒ effective pre-selection

⇒ first top-finding

Work has just begun...

Outlook

Next steps:

a) investigation of SGV-related problems within TESLA environment to improve b-tagging

b) top-reconstruction
(S.V. Chekanov, V.L. Morgunov: *LC-PHSM-2003-001*)

c) using varying detector parameters

Future plans:

a) switching to full simulation and reconstruction (GEANT4,BRAHMS)

b) finding optimised design parameters for LC-VXD (MAPS)

b–Tagging

Comparison with Full Simulation (LCFI)