Two b-jets events in 1.96 TeV $p\bar{p}$ collisions at CDF

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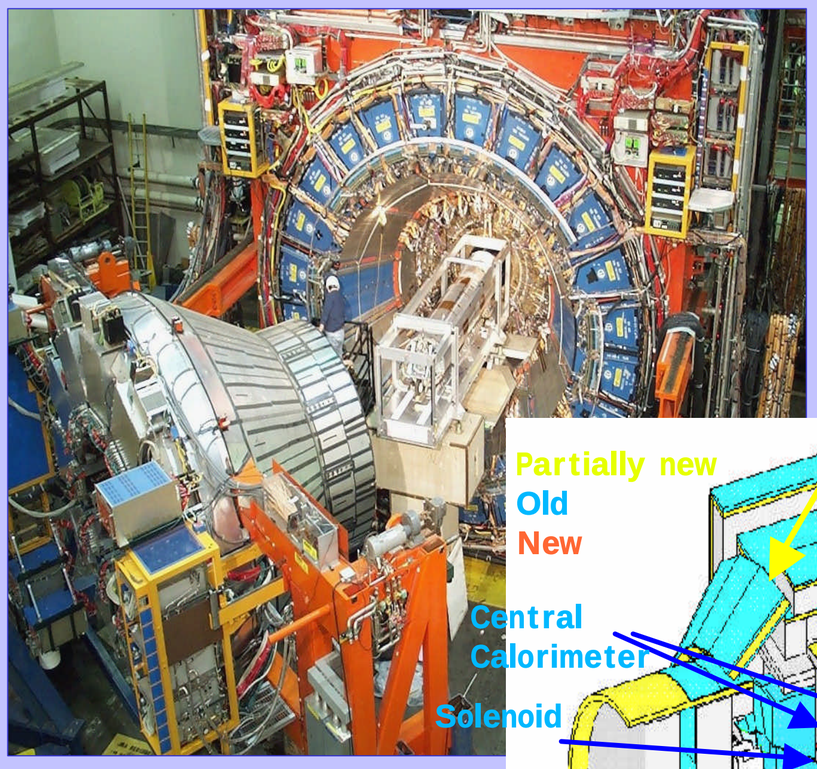
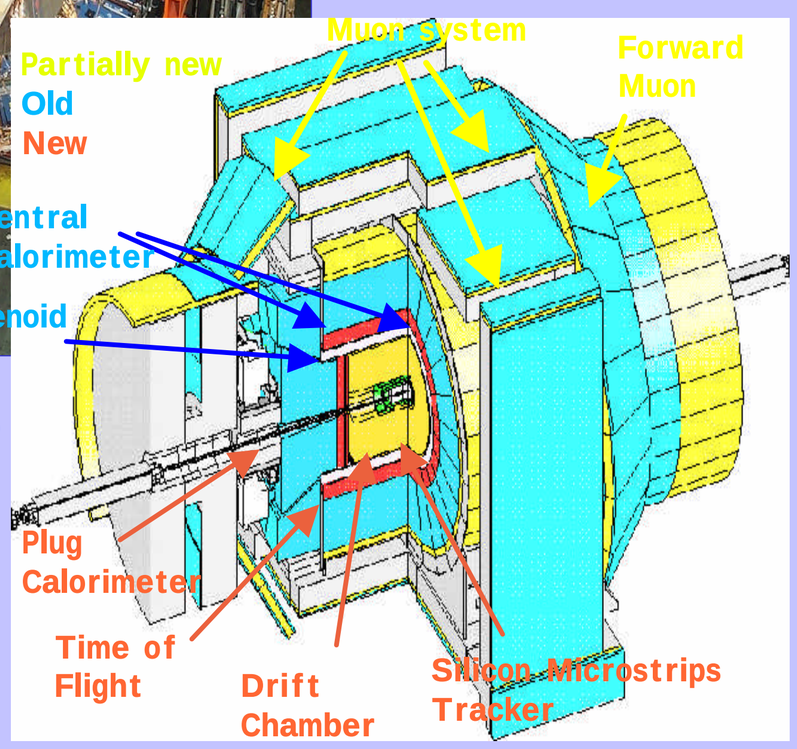
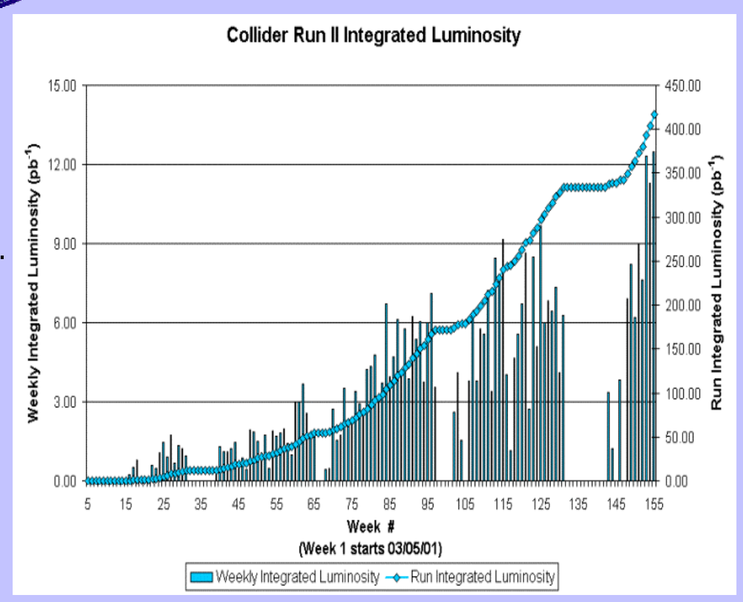




The Tevatron has started Run II pp collisions at $\sqrt{s}$ = **1.96 TeV** in Spring 2001; at the end of January it had delivered **370 pb^{-1}** (**290 pb^{-1}** on tape) but the base goal is to collect approximately **5 fb^{-1}** before 2009.
The CDF detector has a tracking sistem made up of central wire drift chamber (COT) and **SVX II**+ **L00**, a 7 layer silicon detector.

This system allows track reconstruction in 3 dimensions and has an i.p. resolution of **30 μm** and a $\sigma(p_t)$ of **$0.003p_t^2$**.
The calorimeters (EM + HAD) cover the full pseudorapidity range, (**80%/√E⊕50%** in $|\eta|$<1 for HAD).



Trigger: the **SVT** processor at L2 associates clusters formed from axial strips in the silicon with Pt>2 GeV/c tracks found in the COT providing a measurement of the i.p. of the track in the transverse (xy) plane in less than **10 μs**.
→ Possible to trigger at Level 2 on tracks coming from vertices displaced from the primary vertex.

Why $b\bar{b}$ events?

b production cross section is high!
σ ~ **56 μb** → CDF is a unique place to study b production and decay, to provide QCD measurement and search for new particles.
Events with two b-jets is especially important:

- Bumps in the invariant mass M($b\bar{b}$) can be signal of new physics (Higgs..) and benchmark QCD processes
- Measurement of b content in the di-jet spectrum is crucial input for LHC searches and 'exotics' at CDF
- Structure of events including a $b\bar{b}$ pair is important to measure CDF tagging efficiency itself!

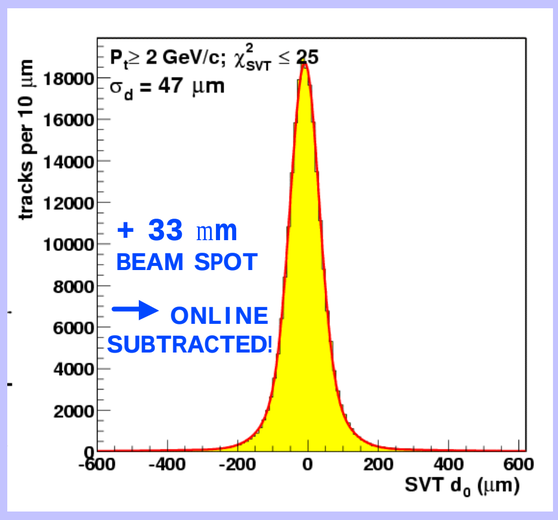
Studies on high-p_t b-jets

Sample: **HIGH_PT_BJET** sample designed to search for:
Higgs : **gg -> H -> bb**
HW, HZ -> bbjj
HZ -> bbνν
heavy objects decaying to bb.

L1: 2 CAL towers and 2 XFT tracks
L2: 2 CAL clusters and
> 1 SVT tracks with **$|d_0|$ >100 μm**
L3: 2 central jets and 2 **SecVtx TAGS**

CDF II expects to see the Z-> $b\bar{b}$ (σ **~15 GeV**) → looking for such a channel is an interesting starting point to test b-tagging capability and trigger efficiency on b-jet. Therefore first step is comparing this sample to a dedicated **Z_BB** trigger path developed to calibrate with high accuracy calorimeter response to b-jet using the SVT.

Secondary Vertex Tagging

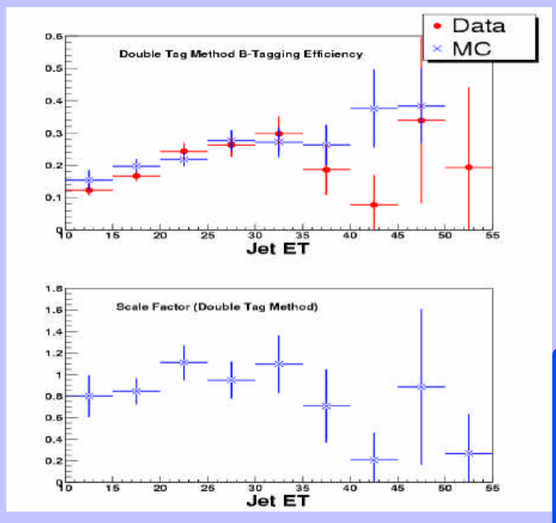


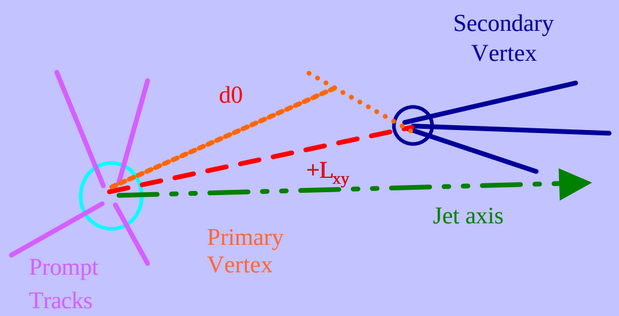
Flavour tagging a jet is one of the toughest experimental challenges in high energy physics, particularly at a hadronic collider.

Signature of **b decay** is a displaced vertex because of long lifetime of b/c hadrons (**cτ ~ 450 μm**).
Algorithm: SecVtx algorithm uses displaced tracks associated with jets to tag them.

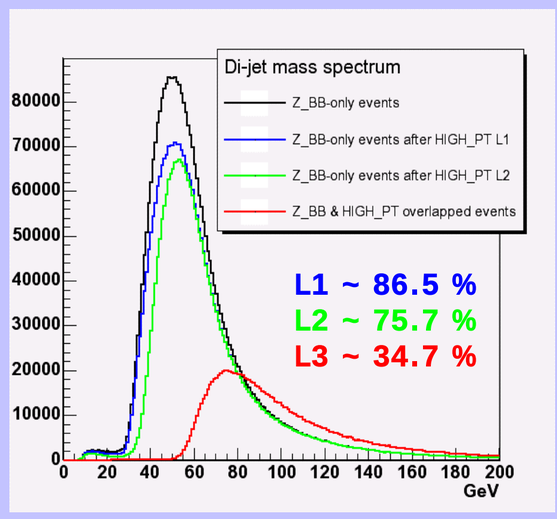
- Tracks are associated with a jet if inside a fixed cone around the jet axis;
- Jets are selected according to quality requirements (e.g. **E_T**, η)
- Secondary Vertices displaced from Primary Vertex are searched
- Jet is tagged as b-jet if **L_{xy}/s_{xy} >3** (typical **s_{xy}~150μm**)

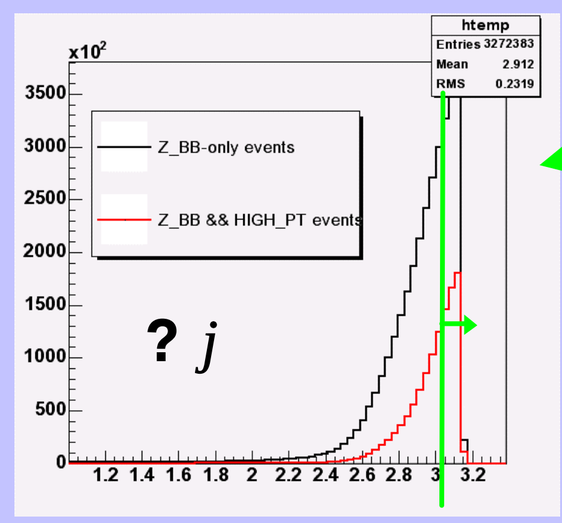
b-tag efficiency and ratio data/MC as a function of jet E_t, i.e. "scale factor"





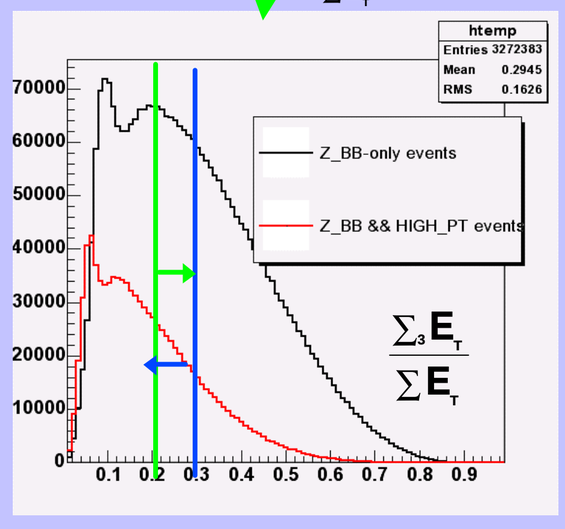
Selection: Expected **S/B** is 8-13% after first selection.. Thus signal is extracted as an excess on the double SecVtx tags i.e. difference between 'observed' and 'predicted' background spectrum.
Background spectrum is estimated on NO tagged + TAGGABLE events
Data is split into 2 tagging samples: 2-TAGGED (++) and NO + TAGGABLE (+0). And then into a **SIGNAL ZONE (SZ)** and a **NORMALIZATION ZONE (NZ)**.

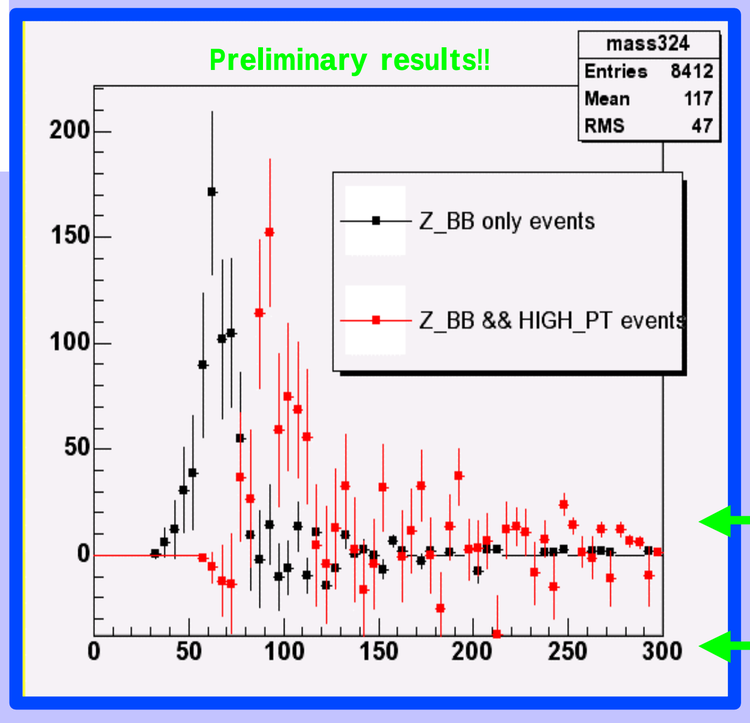




SZ: ? $j > 3$ $\quad \frac{\sum_3 E_T}{\sum E_T} < 0.2$

NZ: out of SZ
? $j > 0$ $\quad \frac{\sum_3 E_T}{\sum E_T} < 0.3$





Tag probability is computed and extrapolated to SZ to get the absolut background prediction:

ε = **N(NZ,++) / N(NZ,+0)**

N_{exp} (SZ,++) = N(SZ,+0) ·ε

What is in progress !!

An excess at low mass is observed.. work is being done to understand this.. Z selection relies on an algorithm first developed in Run I.. It seems the method applied doesn't fit completely the new Run II environment.

Although designed for higher spectrum HIGH_PT_BJET doesn't throw away all the events in this region!