$t\bar{t}$ Trigger Scheme

- **Optimize signal efficiency by combining various triggers**

	Bgd.(Hz)		$t\bar{t} \rightarrow \mu + jets$		$t\bar{t} \rightarrow all\ jets$	
Trigger	L1	L2	L1(%)	L2(%)	L1(%)	L2(%)
1–JMULT	49.7	2.1	88.9	27.4	98.6	69.8
2–MJTMET	55.2	3.3	93.4	68.5	82.0	48.7
3–JMAX	49.7	13.0	88.9	68.3	98.6	84.2
4–MUJET	64.1	41.6	75.4	74.3	53.2	53.6
5–JET2MED	186	85.2	96.5	88.3	99.3	98.3
$\Sigma\,(1 \rightarrow 3)$	82.5	17.2	96.0	86.0	99.6	96.2
$\Sigma\,(1 \rightarrow 5)$	239	113	98.4	96.1	99.9	99.8
$\Sigma\,(1 \rightarrow 3)+$ $\Sigma(4 \rightarrow 5) \times STT$	239	38.5	98.4	92.9	99.9	98.6

JMULT: ≥ 4 jets with $E_T \geq 15$ GeV
MJTMET: ≥ 3 $E_T^{jet} \geq 10$ GeV + missing $E_T \geq 20$ GeV
JMAX: ≥ 1 jet with $E_T \geq 45$ GeV
MUJET: ≥ 1 $p_T^{\mu} \geq 6$, $E_T^1 \geq 20$ GeV and $E_T^2 \geq 10$ GeV
JET2MED: ≥ 2 jets with $E_T \geq 20$ GeV
STT: at least 2 tracks with $\mid S \mid \geq 2.5$ ($\epsilon_{signal} = 80\%$)

$\Rightarrow$ **The STT would allow to optimize the trigger efficiency for $t\bar{t}$ events without leading to a large background rate increase.**

Higgs Search

- Signal Sample : $p\bar{p} \rightarrow W + H^0, Z + H^0$

with $H \rightarrow b\bar{b}$ and and $W \rightarrow q\bar{q}$ (67%); $Z \rightarrow q\bar{q}$ (70%)

- Background : "standard sample"
- Tev2000 study

$$p\bar{p} \rightarrow W(\rightarrow e\nu, \mu\nu) + H^0(\rightarrow b\bar{b})$$

M_{Higgs}	$\int \mathcal{L}$ fb^{-1}
80	5
100	10
120	25

- extend study beyond leptonic W decays, and include also $Z \rightarrow \nu\nu$ and $Z \rightarrow hadrons$
- Specific study :

$$p\bar{p} \rightarrow W + H^0 \rightarrow q\bar{q}b\bar{b}$$

- jet trigger rate and efficiencies :

Trigger	Cal. Thresh. n (L1,L2) GeV	L1 r (Hz)	L1 ϵ(%)	L2 r(Hz)	L2 ϵ(%)
JET_3_LOW	3 (3,5)	2000	100	140	78
JET_3_MED	3 (5,10)	200	91	63	74
JET_3_HIGH	3 (7,15)	52	71	15	52
JET_4_LOW	4 (3,5)	670	98	13	36
JET_5_LOW	5 (3,5)	250	93	2.0	8

- All studies relative to JET_3_MED trigger

Benefits of STT for Higgs triggers

Trigger	Background Rejection for $\epsilon =$ 90%	80%	50%	10%
N CFT tracks $w/p_T \geq 3$	2.5	4.7	10	35
N STT tracks $w/p_T \geq 3$	3.1	7.5	40	1000
$w/b \geq 30$	2	3.8	27	900
N STT tracks $\overline{b_{25}} \geq X$	2.2	3.8	21	300
$w/S_{25} \geq X$	2	5	27	200
N $w/p_T \geq 3$ and $\overline{S_{25}} \geq X$	2.8	7.1	33	650

- rejection(STT)/rejection(CFT)
  ≈ 1.2 for $\epsilon_{signal} = 90\%$
  ≈ 1.5 for $\epsilon_{signal} = 80\%$
  ≈ 4 for $\epsilon_{signal} = 50\%$
  ≈ 10 for $\epsilon_{signal} = 10\%$
- can maintain L2 trigger rate of
  20 Hz with efficiency = 68%

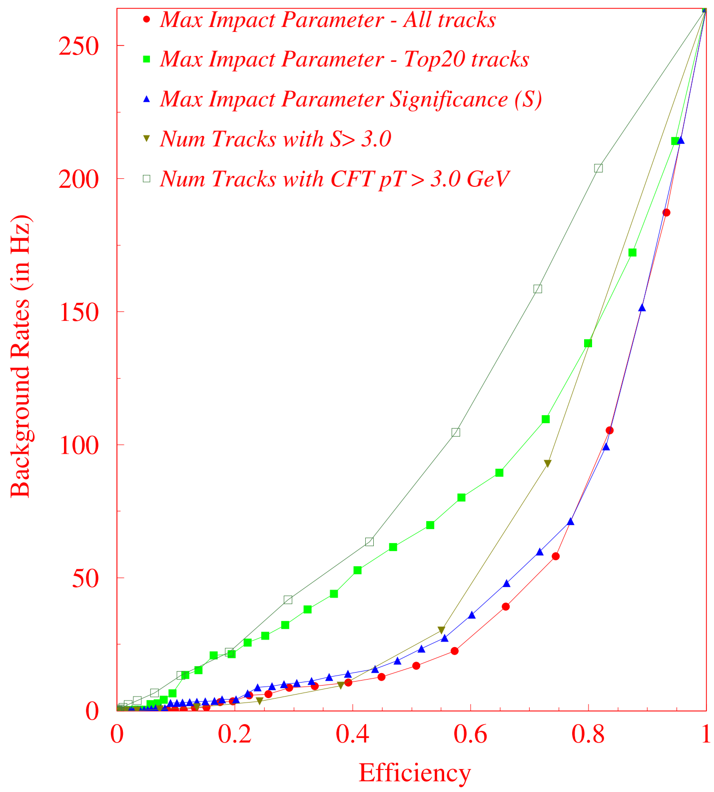
Triggering on $Z \to b\bar{b}$

- Control sample for
  - top mass measurement
  - Higgs$\to b\bar{b}$
- Check b-jet energy scale
- Optimize/check $b\bar{b}$ mass resolution
- Signal Sample : $Z \to b\bar{b}$ – 10k events
- Background : “standard sample”
- Trigger rates and efficiencies using Cal and CFT objects

Trigger	Cal n(L1,L2)	L1 r (Hz)	L1 ϵ(%)	L2 r(Hz)	L2 ϵ(%)
JET_2_MIN	2(3,10)	8028	82	1390	67
JET_2_MED	2(5,15)	621	56	264	41
JET_2_MAX	2(7,20)	186	32	85	20
JET_3_MIN	3(3,10)	1502	68	132	9
JET_3_MED	3(5,15)	167	31	25	4
	Cal/CFT n(L1,L2)+(n,p_T)				
JET_2_MIN_T1	2(3,10)+(2,3)	2389	67	866	57
JET_2_MIN_T2	2(3,10)+(3,3)	1319	57	541	50
JET_2_MED_T1	2(5,15)+(2,3)	450	48	201	35

- cannot trigger with Cal/CFT only

$Z \to b\bar{b}$: Improvement with STT



Trigger	Cal/CFT r (Hz)	Cal/CFT ϵ(%)	Silicon Trigger r(Hz)	Silicon Trigger ϵ(%)	Silicon Trigger r(Hz)	Silicon Trigger ϵ(%)
JET_2_MIN	1390	67	60	35	20	19
JET_2_MED	264	41	110	35	20	23
JET_2_MIN_T1	866	57	62	35	20	20
JET_2_MIN_T2	541	50	77	35	20	19
JET_2_MED_T1	201	35				
JET_3_MED	25	4				

- $\Rightarrow$Signal efficiency of 20% with a background rate of 20Hz is achievable

- $Z \to b\bar{b}$: expected signal

$$\begin{aligned} \sigma(p\bar{p} \to Z \to b\bar{b}) &\sim 1 \text{ nb} \\ \epsilon(trigger) &= 20\% \\ \epsilon(offline) &= 25\% \quad \text{(double b-tag)} \\ \Rightarrow \sigma(vis) &= 5 \times 10^4 \text{ fb} \end{aligned}$$

- ... over background

$$\begin{aligned} \sigma = 20\text{Hz}/2 \times 10^{32}/\text{cm}^2/\text{s} &= 100 \text{ nb} \\ \epsilon(offline) &= 10\% \quad \text{(double b-tag)} \\ \Rightarrow \sigma(vis) &= 10^7 \text{ fb} \end{aligned}$$

- for 1 fb^{-1} : $\text{S/B} = 5 \times 10^4/10^7$
  $\text{S}/\sqrt{\text{B}} = 17$