Observations on the Trigger Performance

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- Performance of L0
- Status of (mini-) L1
- Conclusions

Performance of L0

- Comparative studies with samples of minimum bias and $B_d \to \pi\pi$ events
  $\surd$ for Brunel v13r1
  $\surd$ SICBMC v245 (Dec. 2001)

- Re-tuning of the L0 E_T thresholds
  $\surd$ to a L0 output rate of 900 kHz (allowing a margin of 10%)
  $\surd$ to a L0 output rate of 1 MHz

- NOTE: re-tuning based on minimum bias events **keeping the bandwidth division fixed**
  (BW division study to be done ...)

General observations:

▷ Current L0 E_T thresholds in Brunel v13r1 seem slightly too high $\to$ the L0 "under-performs", since only about 4.5$\%$ of minimum bias events are accepted at L0, which corresponds to an output rate of 670 kHz (design at 1 MHz)

▷ The re-tuning of the thresholds allows to recover most of the rate

Comparison of L0 Rates

Rates for Minimum Bias Events

	SICBMC v245 (12/2001)	Brunel v13r1	retuning 900 kHz	retuning 1 MHz
$\sum E_T$ veto[(1)]	45.8	47.4	47.4	47.4
Pile-up veto[(1)]	10.7	15.9	16.2	16.2
L0-accept for Pile-up vetoed events[(2)]	25.8	17.7	27.6	30.1
% events accepted by pile-up veto and $\sum E_T$ cut	43.5	36.7	36.4	36.4
L0 total accept rate	6.07	4.5	5.9	6.5
L0 "single" accept rate[(3)]	14	12.3	16.2	17.7

- The pile-up veto seems to be to a large extent responsible for a reduction of the output rate: it now rejects 16% of minimum bias events compared to 11% as of Dec. 2001.
  BUT it still performs well in rejecting multiple-interaction events: the ratio
  (L0-accept for Pile-up vetoed events)/(L0 "single" accept rate) is rather constant and ≈ 2

(1) $\sum E_T$ / Pile-up veto : % events rejected by $\sum E_T$ cut / Pile-up veto

(2) % of the events "pile-up vetoed" that otherwise would pass L0

(3) % events classified as single interaction by pile-up veto, that pass L0

Comparison of L0 Rates (II)

NOTE: no offline selection applied !

Rates for $B_d \to \pi\pi$ Events				
	SICBMC v245 (12/2001)	Brunel v13r1	retuning 900 kHz	retuning 1 MHz
$\sum E_T$ veto	1.0	1.1	1.1	1.1
L0-accept for $\sum E_T$ vetoed events	4.9	5.0	5.5	5.5
Pile-up veto	29.2	39.1	40.7	40.7
L0-accept for Pile-up vetoed events	57.5	47.9	61.9	64.8
% events accepted by pile-up veto and $\sum E_T$ cut	69.7 (76.2[*])	59.8	58.2	58.3
L0 total accept rate	33.5 (58.0[*])	27.0	31.3	33.0
L0 "single" accept rate	48.1 (76.1[*])	45.2	53.8	56.6

[*] same numbers for offline-selected events

Comparison of L0 E_T Thresholds

L0 E_T Thresholds				
	SICBMC v245 (12/2001)	Brunel v13r1	retuning 900 kHz	retuning 1 MHz
μ P_T cut	0.795	0.61	0.529	0.462
electron E_T cut	2.712	2.65	2.486	2.403
γ E_T cut	5.006	3.82	5.045	4.991
hadron E_T cut	4.469	3.95	3.313	3.182
$\sum P_T(\mu\mu)$ cut	5.024	1.83	4.126	4.013

TO BE USED in next Brunel version ...

Conclusions:

- ▷ Some thresholds changed significantly (e.g. μ cuts), but:
  - the origins are understood
  - changes will occur with the new BW division (under way ...)
- ▷ A best and efficiency-aimed re-tuning of the L0 trigger should be made in conjunction with the re-tuning of the E_T thresholds and the pile-up veto
- ▷ **We propose, for production for TDR studies, to change in the next Brunel release to the new L0 E_T thresholds so as to obtain a L0 output rate of about 1 MHz**

Status of (Mini-) L1

Observations:

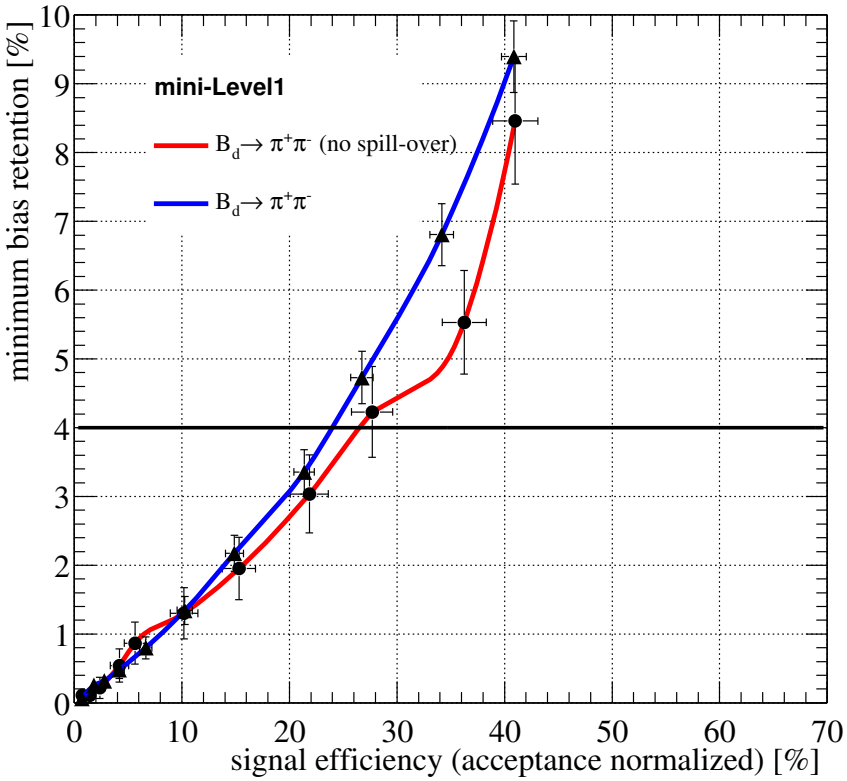
- Performance is rather low: we see efficiencies of only $\approx 25\%$ whereas we should get $50-60\%$ according to the previous software release

Possible explanations:

- ▷ Quality of the L1 tracks?
  The algorithm was run switching from the VELO tracks to L1 tracks with this production. However, using the offline VELO tracks, very similar results are obtained; so it must be something else.
- ▷ Could it be a more general problem in the tracking stations?
  Similar problems should then be (probably) seen elsewhere ...
- ▷ Could it be due to the spill-over?
  Small difference seen which cannot account for the loss in performance (see next page)

Status of (Mini-) L1 (II)

Effect of Spill-over is small !



Further investigations:

- ▷ look at primary vertex used in L1
- ▷ look at differences in geometry
- ▷ look at clusters in TT1

(Mini-) L1 in DaVinci

Prospects for a future release on the Mini-L1 algorithm in DaVinci:

- ▷ No code will be released before the reason(s) for the loss in performance is(are) understood;
- ▷ However, a DaVinci-compliant version will still be built to make sure there are no technical issues (not a public release)

Conclusions

- A change in the behaviour of the pipe-up veto has been observed, which result in a lower efficiency; BUT the re-tuning of the L0 thresholds allows to recover the bandwidth

  $\Rightarrow$ a tuning of the pile-up veto and of the L0 thresholds will be made in conjunction

- loss in performance observed in the Mini-L1 algorithm

  $\Rightarrow$ possible sources under investigation

- New L0 E_T thresholds proposed for further production