Overall L0 optimization without M1

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In short …

Goal:

- assess the impact of dropping M1 on the overall L0 performance

Background:

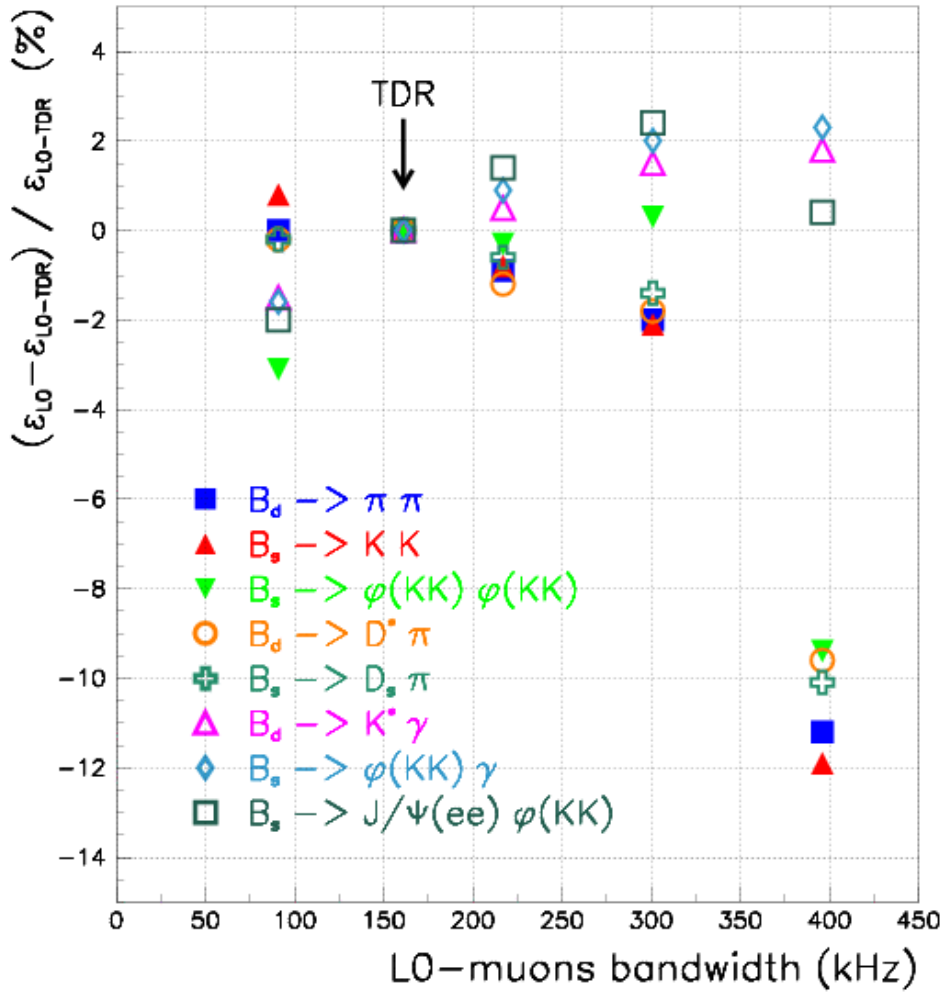
- L0-muon studies proved that efficiency for muon channels can be maintained when dropping M1 provided the muon bandwidth is increased by ~ 60%
  (Olivier Leroy, 24th Jan. 2004)

"Global" investigations in 2 perspectives:

- channel efficiencies as a function of muon bandwidth (standard trigger = with M1)
  - ➥ at the moment: muon bandwidth ~ 160 kHZ
  - ➥ how the L0-efficiencies for hadronic/electromagnetic channels suffer from increasing the muon bandwidth up to say ~ 300 kHz?
- overall L0 optimization without the M1 station

Dependence of the L0 performance on the muon bandwidth

Losses in efficiency wrt TDR values:



* losses less than 4% up to 300 kHz

* losses only become significant if muons given a very large share of the total BW

  * Electromagnetic channels less affected by the h/μ bandwidth division

Note:

- no optimizations done
- each setting is a change in the h/μ BW
- total HCAL+ECAL+MUONS BW = 1 MHz
- at each BW the settings are the same for all channels

Single-channel optimization without M1

Samples

- set of (LHCb) benchmark channels
  - "representatives" of hadronic / electromagnetic / muon channels

Outcome

- single-channel optimizations with or without M1 give roughly the same L0-max efficiencies
  - this means are roughly as at the time of the TDR
  - slightly worse for muon channels

(DC'04 data)

Ex.:

Channels	L0 eff. Max. (%) With M1	L0 eff. Max. (%) without M1
$B_d \to \pi\pi$	55.0 ± 0.9	54.1 ± 0.9
$B_d \to J/\Psi(\mu\mu)\ K_s$	95.4 ± 0.4	94.5 ± 0.4
$B_s \to \phi\gamma$	76.0 ± 1.6	76.2 ± 1.3

L0 bandwidth division without M1

Optimized cuts:

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Optimized L0 cuts (GeV)
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Hadron          =   3.60
Electron        =   2.60
Photon          =   2.70
Pi0 Local       =   4.50
Pi0 Global      =   3.70
Muon            =   1.30
Di-muon         =   1.40
Sum Et          =   5.00
VetoSumPeak2    =   3.00
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Channels	L0 eff. (%) With M1	L0 eff. (%) without M1
B_d -> $\pi\pi$	51.5 ± 0.9	52.5 ± 0.9
B_d -> $K\pi$	52.4 ± 0.8	53.8 ± 0.8
B_s -> KK	51.6 ± 0.8	52.9 ± 0.8
B_d -> $D^*\pi$	49.2 ± 1.0	50.5 ± 1.2
B_d -> $J/\Psi(\mu\mu)$ K_s	93.5 ± 0.5	93.2 ± 0.5
B_d -> $K^*\mu\mu$	95.4 ± 0.6	95.2 ± 0.6
B_s -> $\mu\mu$	98.1 ± 0.3	98.3 ± 0.3
B_s -> $\phi\gamma$	69.6 ± 1.7	72.1 ± 1.4

(DC'04 data)

! The "with M1" eff. should be scaled up slightly as the M. B. retention in DC'04 is at present ~ 900 kHz

L0 bandwidth division without M1

Inclusive efficiencies for "no M1" L0 trigger and bandwidth optimization

Channels	HCAL	ECAL	Muons
B_d -> $\pi\pi$	44.4 ± 0.9	12.0 ± 0.6	9.3 ± 0.5
B_s -> K K	44.5 ± 0.8	11.5 ± 0.5	10.6 ± 0.5
B_d -> $J/\Psi(\mu\mu)$ K_s	17.6 ± 0.7	6.5 ± 0.5	92.1 ± 0.5
B_d -> $K^*\mu\mu$	19.0 ± 1.1	7.6 ± 0.8	94.5 ± 0.6
B_s -> $\phi\gamma$	30.7 ± 1.5	66.3 ± 1.5	11.7 ± 1.0

(DC'04 data)

Bandwidth on minimum bias events (kHz)	608	231	312

was ~ 700 kHz in TDR

Almost doubles compared to TDR

Conclusions

For Level-0

- staging of the M1 station is not critical !
  - losses in efficiency for muon channels can be recovered with a larger share of the L0 bandwidth being taken by the muon triggers
  - optimization of L0 bandwdith division also prevents the hadronic and electromagnetic channels from losses in efficiency

but

  - note that these conclusions are for the nominal luminosity …
    - ➥ … how critical and fast the situation becomes with increasing luminosity needs to be assessed …