

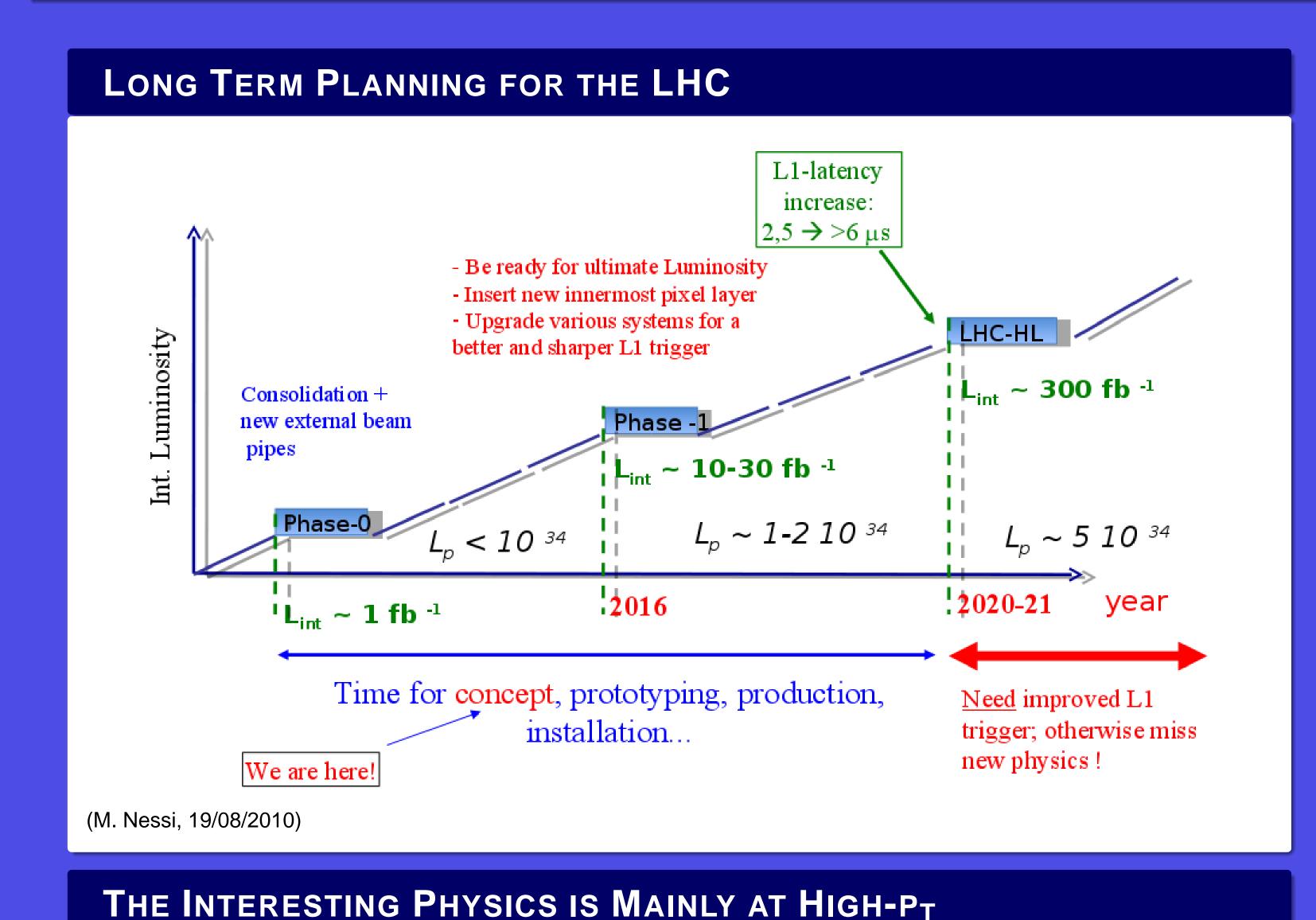
Upgrade of the ATLAS Muon Trigger for the SLHC

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ABSTRACT

The upgrade of the LHC towards luminosity beyond the design value requires improved level 1 (L1) trigger selectivity in order to keep the maximum total trigger rate at 100 kHz. In the ATLAS L1 muon trigger system this necessitates an increase of the p_T threshold for single muons. Due to the limited spatial resolution of the trigger chambers, however, the selectivity for tracks above $\sim 20 \, \text{GeV/c}$ is insufficient for an effective reduction of the L1 rate. We propose to used the precise track coordinates of the Monitored Drift Tube (MDT) chambers of the ATLAS muon spectrometer for a decisive improvement of the p_T determination and thus of the selectivity of the L1 muon trigger.



THE PROBLEM OF RPC GRANULARITY AND SINGLE MUON L1 RATE ← RPC strip width ~30mm **₩₩₩ >** • Throshold 4 11 GeV ▲ Threshold 6 = 40 GeV High-p_T muons are a clear signature for not to scale interesting physics! $p_T = 40 \text{ GeV}$ $p_T = 20 \text{ GeV}$ $p_T = 10 \text{ GeV}$ 3 nb 47 nb However: the present L1-trigger system has insufficient spatial resolution to tag actual 11 kHz 24 kHz 110 kHz trig. rate muons above 10 GeV In the muon system trigger and precision chambers don't talk to each other at L1 → information only combined at higher trigger levels

ATLAS Muon TD \overline{v} $v \to \mu$ $v \to \mu$

The steep slope of the pT spectrum combined with the width of the p_T resol. curve leads to high fake trigger rates.

pt (GeV/c)

WHAT CAN THE MDT DO FOR THE L1 TRIGGER? Strip width of RPC (2,6−3,5 cm) leads to a resolution of about σ = 10 mm, insufficient for high high-p_T thresholds > 20 GeV MDT provides 100 x better resolution, but only factor ~ 10 needed! → can relax on drift time resolution (use only BX, ignore fine time)

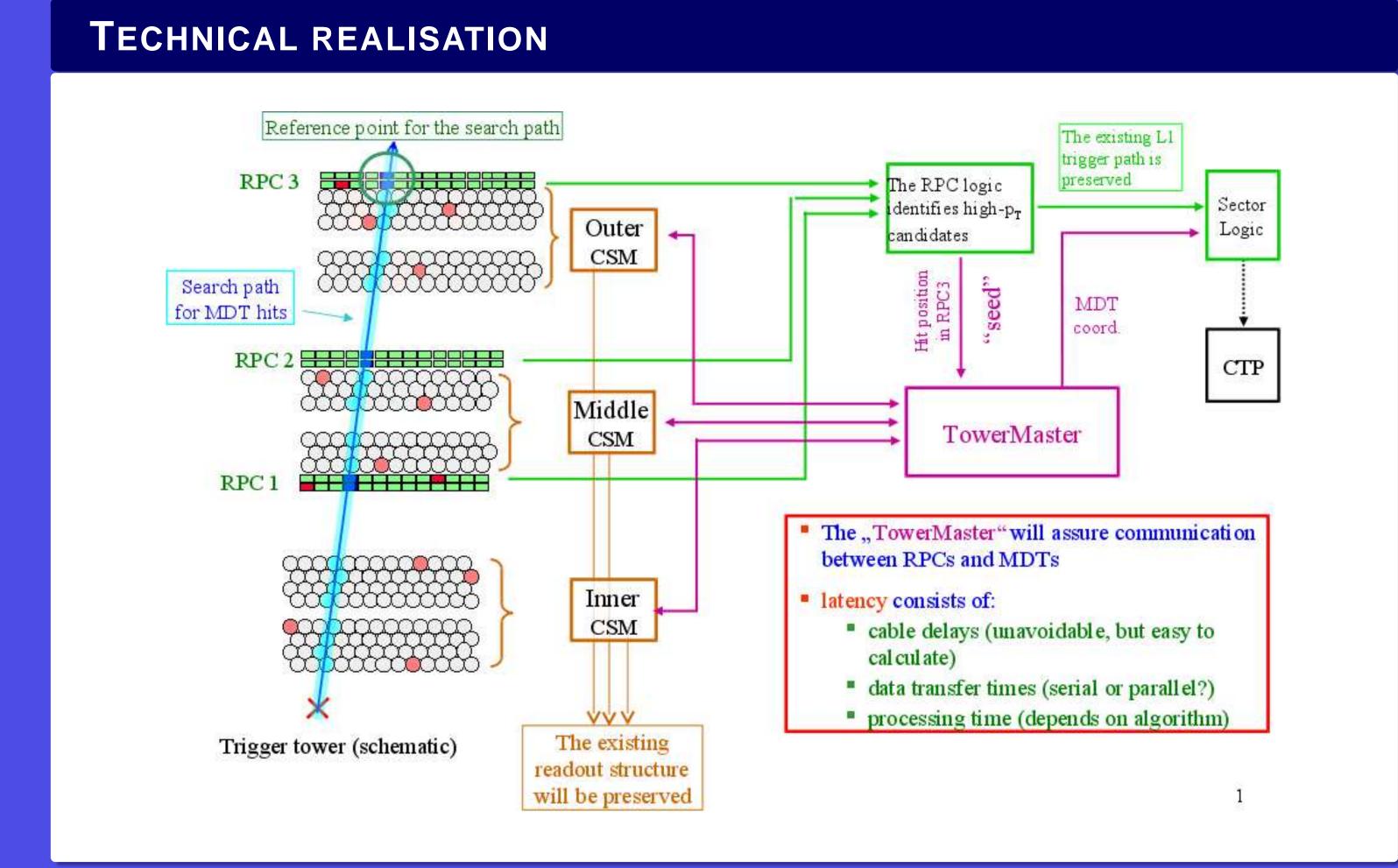
(use only BX, ignore fine time)

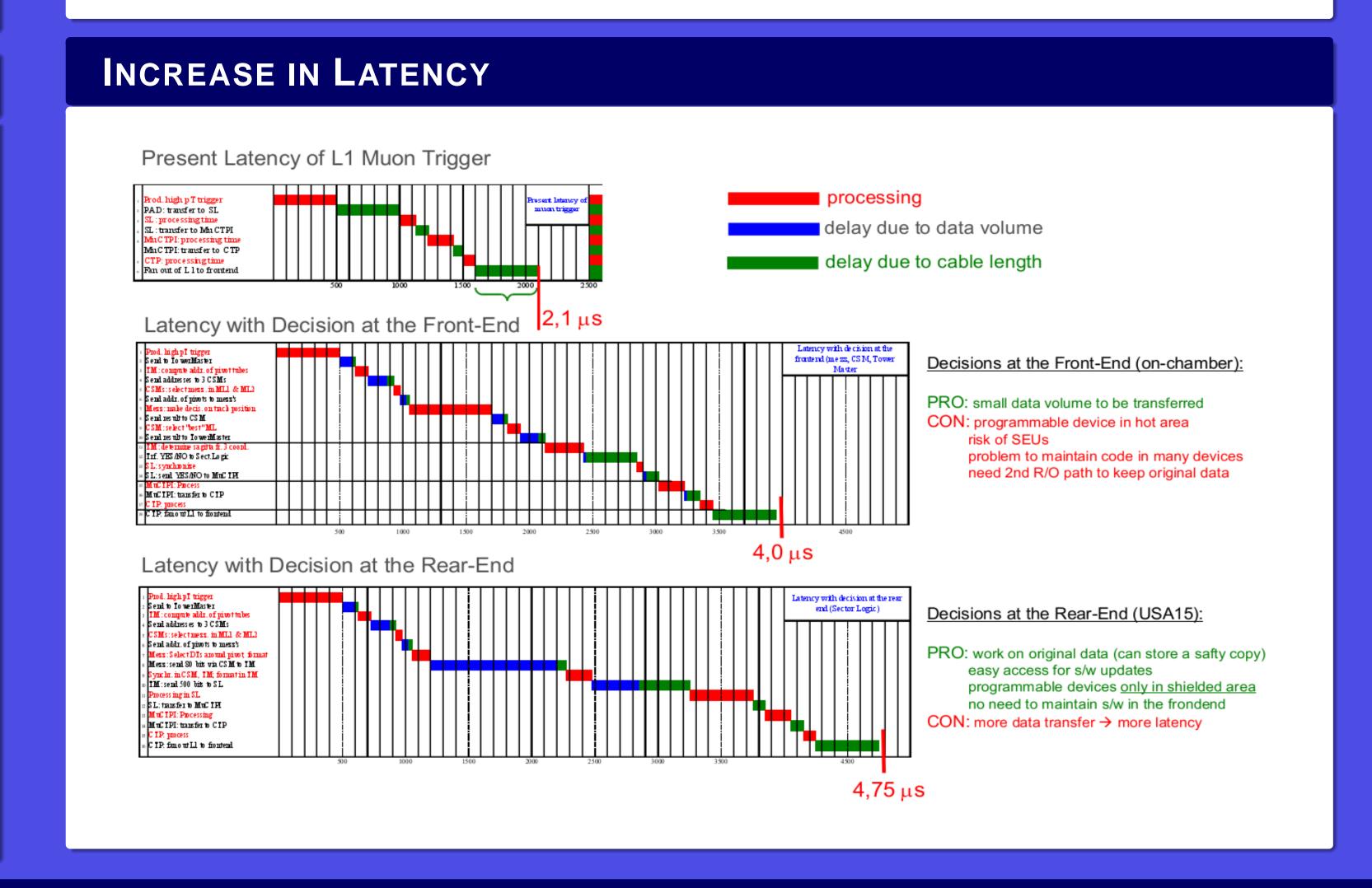
In the present system the BI layer is not used for the L1 → 50% of the bending

power dismissed for the trigger!

In the present system the high spatial resolution of the MDT is only used at Level 2 → reduces rate by 2 orders of magnitude.

Could we have part of this reduction already at Level 1?





BI

schematic, not to scale

Conclusions

- ▶ MDT precision can be used for L1 sharpening.
- ▶ Need only extra latency of $\sim 2 \mu s$.
- \Rightarrow Wait for 2020.

Benefits:

- ▶ No additional trigger chambers required.
- No interference with "normal" readout.

Required Hardware Developments:

- New front-end boards (mezzanine and CSM).
- Architecture of "TowerMaster"
- ▶ Interface to RPC readout