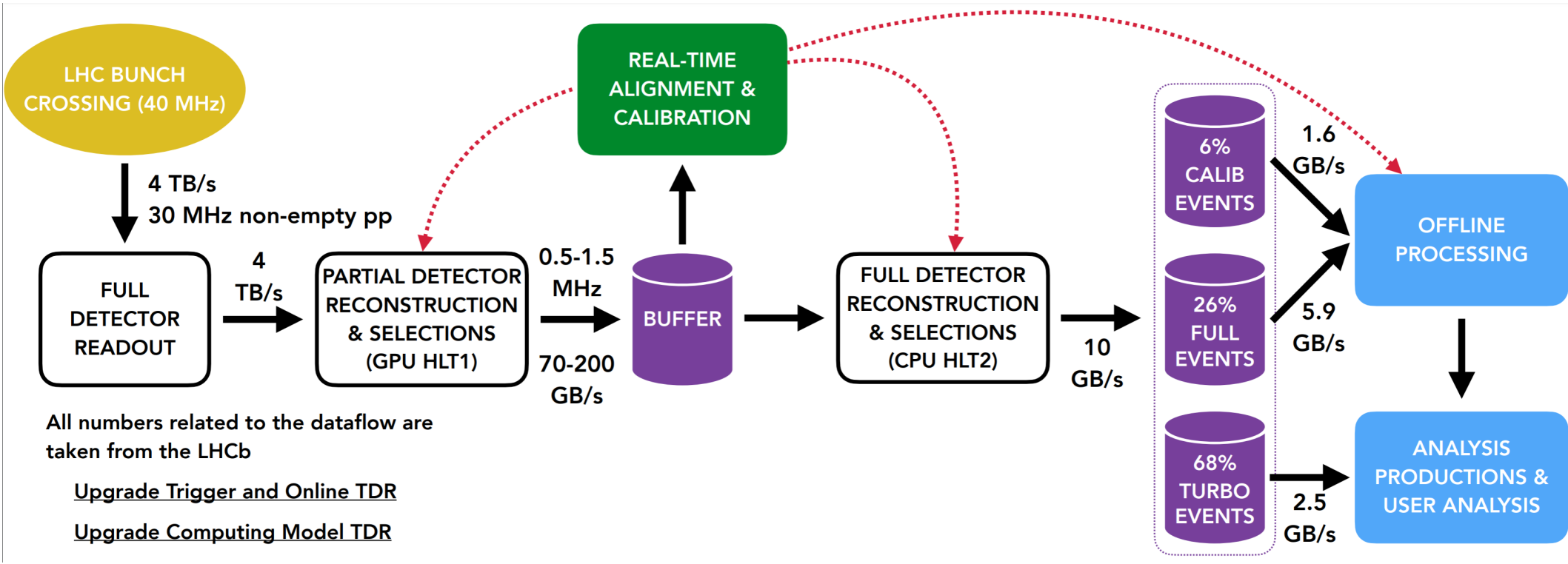
Personal introduction

Saur Miroslav
(Lanzhou university)

2025/03/20

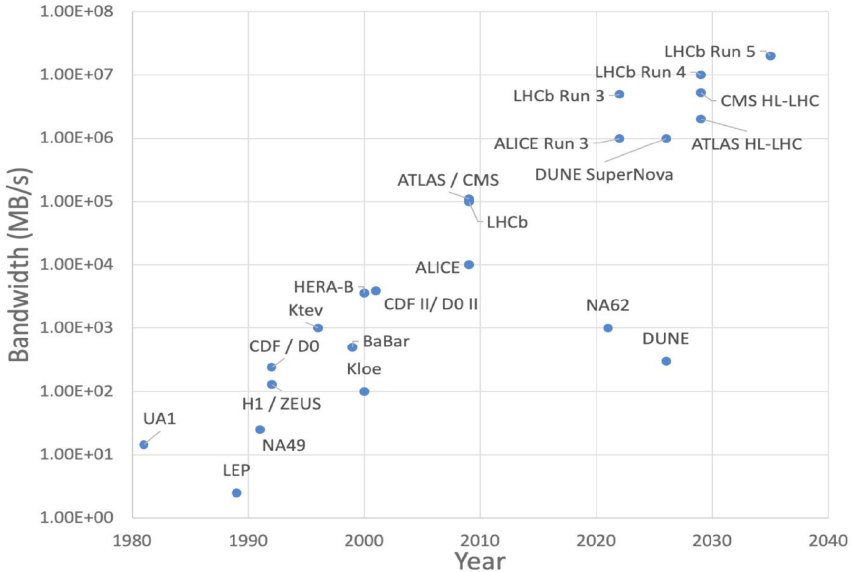
LHCb trigger design (Run3)

- LHCb is using a software-only trigger for Run 3
- Full offline-quality reconstruction in real time at the trigger level



LHCb Upgrade 2 Trigger challenges

- LHCb is planning the Upgrade 2 for Run 5 and 6
  - TDR approved last March: LHCb-TDR-023
  - Updated in Scoping document (2025)
- Luminosity: 1.5x1034 cm-2s-1; pileup: 40
- Significant challenge for DAQ and trigger
  - Currently estimated bandwidth around 25 TB/s
  - The highest expected value at HEP
  - Direct impact on physics reach
  - Non-negligible cost
- Needs to rethink whole system again
  - No similar experiment at all
- Only possible overlap with CepC/FCC-ee running high-intensity Z-pole and tt-bar threshold with flavour physics program
  - Limited community worldwide and we should cooperate

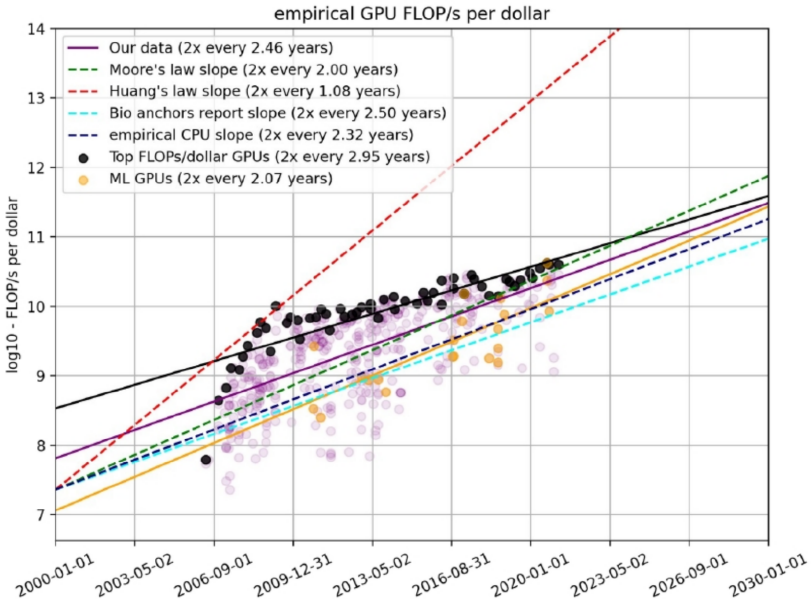


	Baseline	Middle	Low
$\mathcal{L}_{\text{peak}}$ ($10^{34}\,\text{cm}^{-2}\,\text{s}^{-1}$)	1.5	1.0	1.0
$\mathcal{L}_{\text{int}}$/year [fb^{-1}]	55.7	43.0	43.0
	(kCHF)	(kCHF)	(kCHF)
HLT1	736	491	491
HLT2	15200	9070	7280
Disk buffer	2800	2160	1760
Total RTA	18800	11700	9500

Detector	Baseline (kCHF)	/FTDR
VELO	16672	1.13
UP	8077	0.91
Magnet Stations	2592	1.13
Mighty-SciFi	21767	0.97
Mighty-Pixel	15994	0.82
RICH	21450	1.38
TORCH	12508	1.26
PicoCal	27607	0.79
Muon	9785	1.38
RTA	18800	1.08
Online	11800	1.33
Infrastructure	14463	1.07
Total	181515	1.04

Basic assumptions for LHCb Upgrade 2 trigger

- Investigating even a broader interplay between various architectures
  - RETINA project: Ongoing study to use FPGAs for downstream tracking [JINST 17 C04011]
  - Investigate new architectures as TPUs, IPUs, ... ?
- Offline constrains: available CPU power and disk space (becoming limitation for LHC experiments)
- Different designs
  - HLT1 reconstruction and HLT2 selection, both on GPUs for higher performance and single code base



Personal interest

- Interested in idea of having full HLT2 on GPUs (or similar massive-parallel architecture)
  - Implementing HLT2 using GPUs or any massive-parallel architecture is necessary to keep up with the ever rising input rate and broad physics goals
  - Mostly interested in event model, selection and persistency framework
  - Data structures and event model have significant impact of the total performance
- Additional related topics:
  - Scalability of selection algorithms on GPUs (LHCb has around 3000 dedicated selection lines)
  - Large scale deployment of ML models (possibly dedicated MVA model for each selection line)
- LHCb aims to have Upgrade 2 Trigger TDR in 2030

- For physics, I am interested in heavy baryons, CPV and BSM searches via rare decays
  - Various explanation of baryogenesis are requiring search for various invisible decays – CepC would be ideal laboratory
  - Would like to start contributing by benchmarking of various specific decays studying feasibility of such an analyses at CepC
  - I see large possible synergies in development of HLT code on massive parallel architectures between experiments and strengthening local trigger community

Thank you for inviting me
Looking towards working together