Summary of TDAQ session

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15:30 **Event sizes @ Zpole** 15m
Speaker: Francesco Grancagnolo (Universita & INFN Lecce (IT))
TDAQ at FCC-e... TDAQ at FCC-e...

15:45 **Triggerless design and tracking with ultra light TPC** 15m
Speaker: David Rohr (CERN)
2020-11-12 Tri...

16:00 **Readout of ultra light vertex detectors** 15m
Speaker: Gianluca Aglieri Rinella (CERN)
20201112-Agli...

16:15 **Long lived non-relativistic particles** 15m
Speaker: Sinead Farrington (University of Edinburgh)
sinead_LLPFC... sinead_LLPFC...

16:30 **LHCb TDAQ system** 15m
Speaker: Tommaso Colombo (CERN)
20201112.fcc_...

16:45 **Unsung heroes of an experiment** 15m
Speaker: Richard Jacobsson (CERN)
2020_11_12_F...

The big picture - Francesco Grancagnolo

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	CLD			IDEA		
		m^2	RO ch.		m^2	RO ch.
vertex detector		0.53	**0.84 G**		2.2 + 18	**1.17 + 0.36 G**
central tracker		200	**2.75 G**		175	**90 + 35 M**
calorimeter	ECAL	4000	**160 M**	PS	230	**1.5 M**
	HCAL	8000	**9.2 M**	DR		**130 M**
muon detector		3250	**3.6 M**		2800	**3.8 M**
TOTAL			**3.76 G**			**1.79 G**

+

Event rates at Z^0-pole

- 100 KHz Z decays
- 30 KHz $\gamma\gamma \rightarrow$ hadrons
- 50 KHz Bhabha
- 20 KHz beam backgrounds

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	Physics	Background/noise
CLD Vertex Detector	150 MB/s	6 GB/s
CLD Tracker	160 MB/s	10 GB/s
IDEA Drift Chamber	60 GB/s	2 GB/s
IDEA Si wrapper	32 MB/s	0.5 GB/s
CEPC ECAL	*21 GB/s*	/
CEPC HCAL	*1.8 GB/s*	/
IDEA DR Calorimeter	10 GB/s	(1.6 TB/s)
IDEA pre-shower	320 MB/s	820 MB/s
IDEA Muon Detector	4 MB/s	67 MB/s

The unknown - Sinead Farrington

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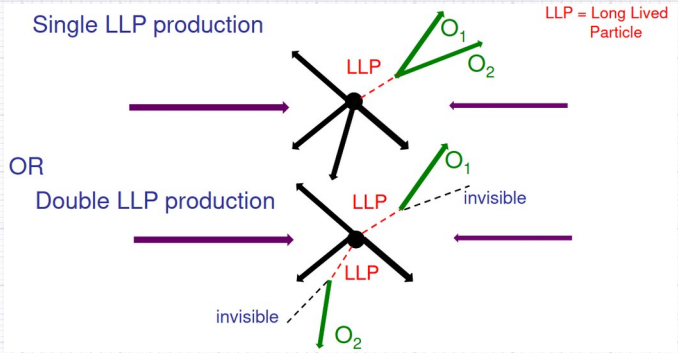

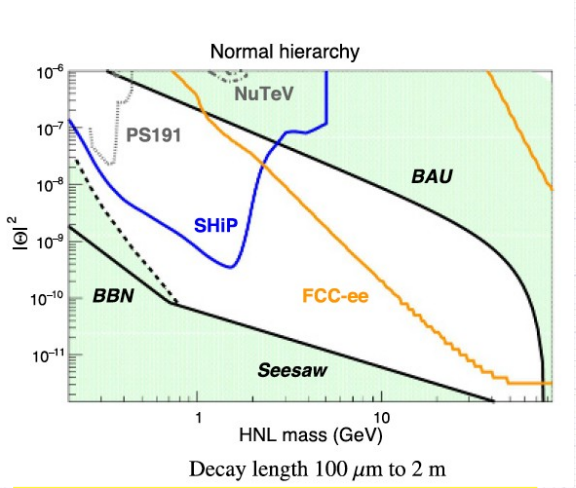

FCCee CDR: CERN-ACC-2019-0003

Summary

- What about the additional LLP detectors at the LHC
  - (FASER/Mathusla/CodexB) - design them in now, integral to the triggering of the main detectors
- If LLPs couple to H, FCCee will be complementary to the large Higgs samples of HL-LHC and FCChh through
  - Good vertex resolution
  - Clean environment in which to do LLP-friendly tracking and particle ID
- FCChh will give the reach to the broadest set of LLP masses, and through high statistics also to rare processes
- FCCee/hh has the opportunity to include LLP as a design requirement considering
  - Hardware that has the impact parameter resolution needed
  - Readout segmentation that lends itself to LLP triggering
  - Hardware track triggering for FCChh
- These trigger challenges suggest we need R&D now for FCChh to meet the ESU requirement to evaluate on the timescale of the next update
- As the CDR states, these issues may be crucial in determining the feasibility of constructing these detectors (in particular for FCChh)

Towards new technology- David Rohr , Gianluca Aglieri Rinella, Tommaso Colombo

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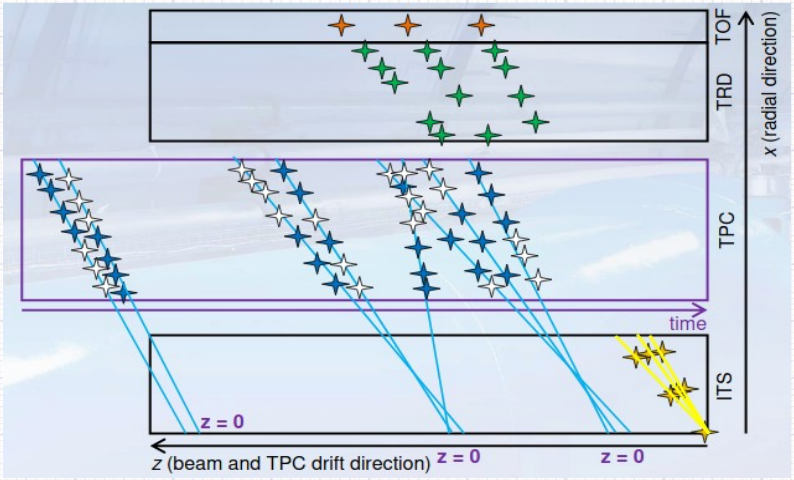
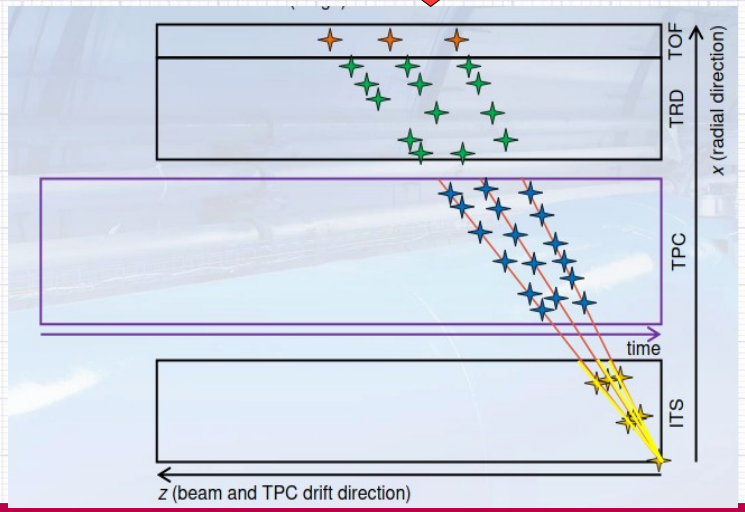
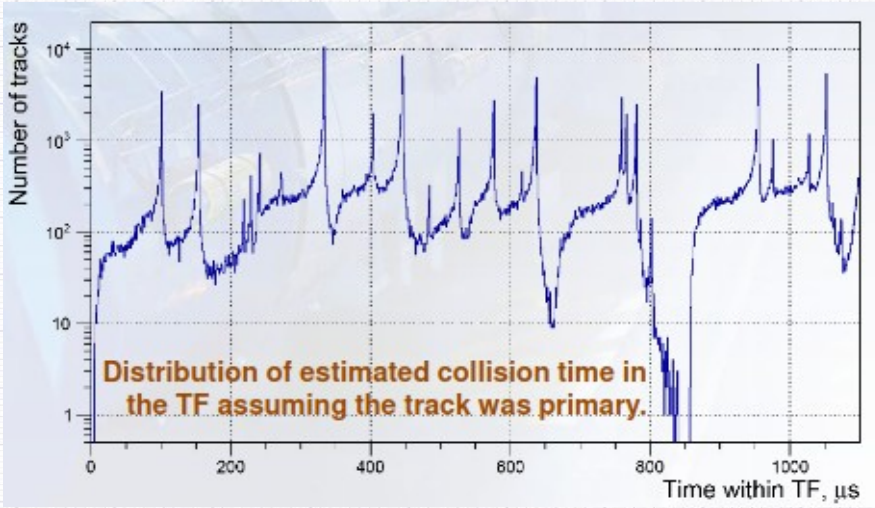
- Triggerless design (TPC tracking)







- Ions move very slowly => 10-20 ms of continuous data instead of events
- Space charge distortions a big challenge
- GEM readout scales linearly with a interaction rate up to 50 kHz → not compatible with rates at z-pole

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Readout of ultra light vertex detectors

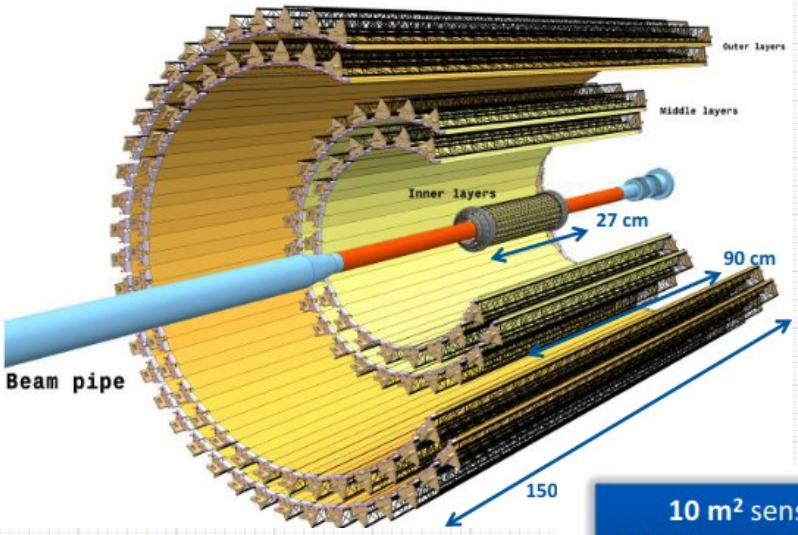
ALPIDE *particle rate* max. capabilities

Assuming 2.5 average cluster size

Matrix to Periphery hit data transfer: ~ 50 MHz/cm^2

At slow frame rates. Reduces with faster frame rate

Chip output link max capacity: ~ 6 MHz/cm^2 (with on-chip data reduction), ~ 4 MHz/cm^2 (raw)



10 m^2 sensitive area
24120 CMOS Pixel Sensors
~12.5 Gpixels

- 6 us time-stamping/event → in continuous mode hits can span across events
- The effect on readout rates when switching to air-cooling ?

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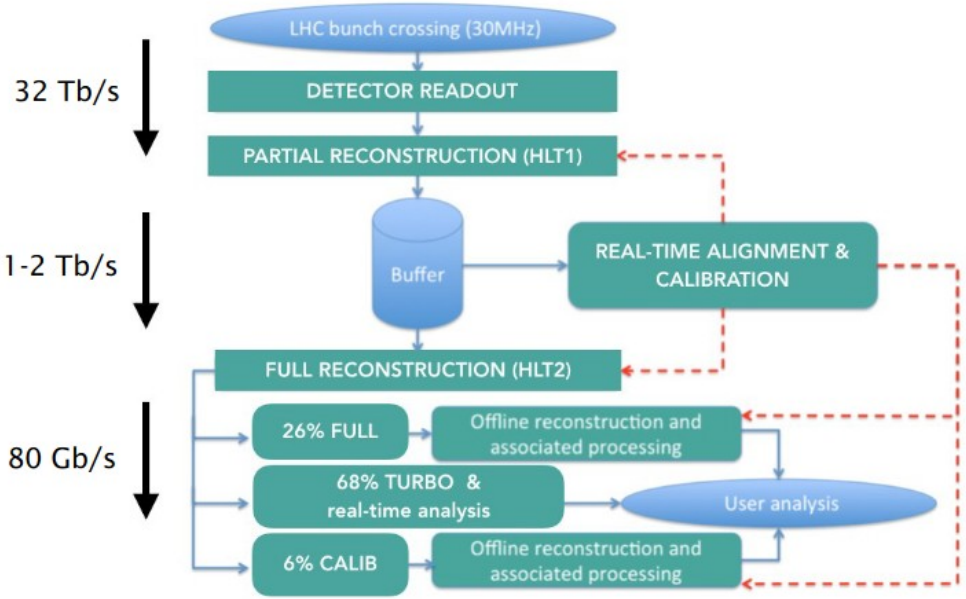
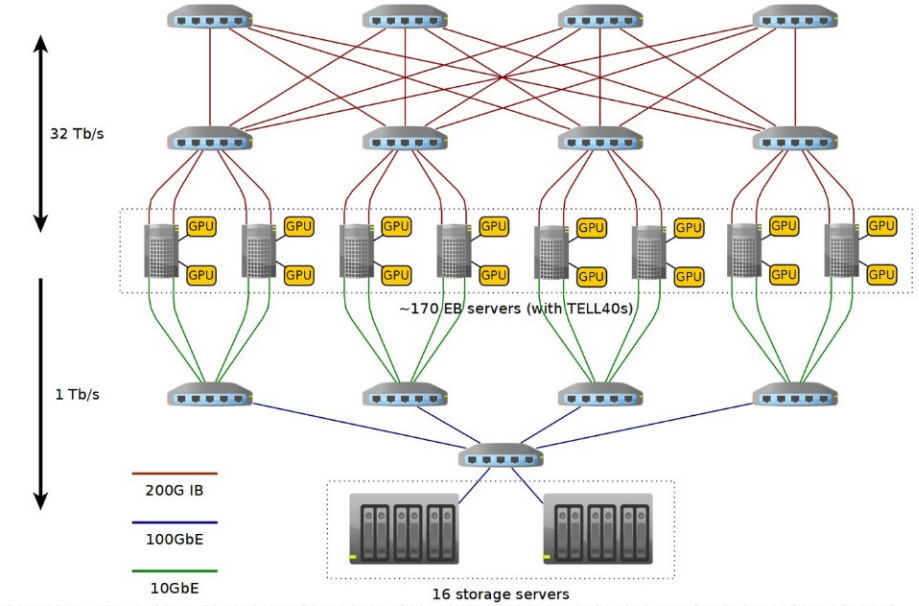
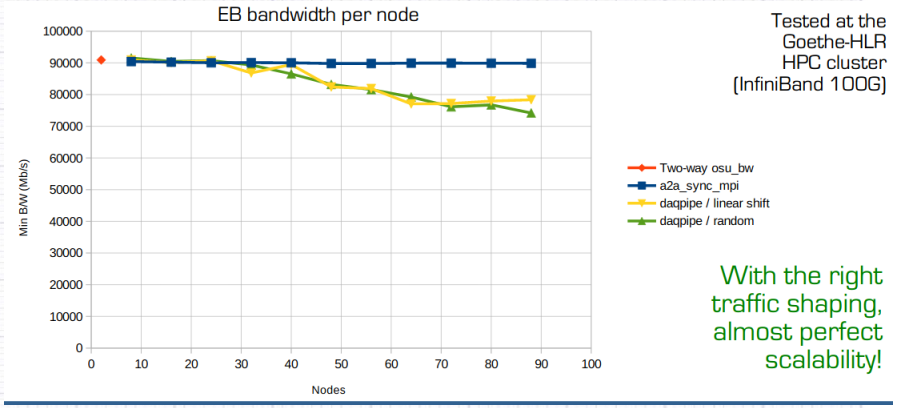
Triggerless DAQ system (LHCb)





- 2 levels of s/w filtering: from 32 Tbs to 1-2 Tbs to 80 Gbs
- Biggest worry: scalability and reliability of network
- Event-selection is entirely in software to maximize physics yield, increase the amount of data collected, flexibility and minimize cost
- The system is very well scalable, by up to 3 a factor without any substantial changes



Have we learned anything? - Richard Jacobsson

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