Data rate and event size update

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Event size

- Left: Barcelona version; Right: latest
- Vertex: Barcelona: average of first layer(hit rate much higher than other layers); latest: average of full 6 layers
- TPC and ECAL: Barcelona: gap was not added; latest: add the gap(Higgs 63%, Z 9%)
- HCAL: Barcelona: average of the fired hit; latest: average of all the hit(most of the hits are note fired)

Table 12.3: Time windows for each subdetector and the event size calculation for both Higgs and Z mode. The "Full Data" is from Figure 11.1. The data size per bunch is derived by dividing the "Full Data" by the collision frequency, with the Higgs mode collision frequency being 1.34 MHz and the Z mode 12 MHz. The data size per event is obtained after accounting for the impact of the time windows of each sub-detector on individual events.

	VTX	ITK	OTK	TPC	ECAL	HCAL	Muon	Total
Time windows (ns)	223	53	53	34023	323	1023	123	
Higgs mode Full Data(Gbps)	2220.0	16.4	79.0	52.7	1440.0	975.8	<1	4784.9
Data size / bunch (kB)	207.1	1.5	7.4	4.9	134.3	91.0	<0.1	446.4
Data size / event (kB)	207.1	1.5	7.4	604.7	268.7	364.1	<0.1	1453.5
12.1MW Z mode Full Data(Gbps)	8900.0	25.8	130.7	47.8	1111.0	808.0	<1	11024.3
Data size / bunch (kB)	92.7	0.3	1.4	0.5	11.6	8.4	<0.1	114.8
Data size / event (kB)	370.8	0.3	1.4	244.5	57.9	126.3	<0.1	801.1
50MW Z mode Full Data(Gbps)	25700.0	79.4	399.0	150.0	3450.0	2574.0	<1	32353.4
Data size / bunch (kB)	81.6	0.3	1.3	0.5	10.9	8.2	<0.1	102.6
Data size / event (kB)	815.4	0.8	3.8	701.0	153.2	367.5	<0.1	2041.6

Table 12.3: Time windows for each subdetector and the event size calculation for both Higgs and Z mode. The "Full Data" is calculated by multiplying the Ave. Hit Rate, from Table 3.6, 3.7 and 3.8, by the detector area, safety factor 1.5, and the bit width from Table 11.1. The data size per bunch is derived by dividing the "Full Data" by the collision frequency, with the Higgs mode collision frequency being 1.34 MHz and the Z mode 12 MHz. The data size per event is obtained after accounting for the impact of the time windows of each sub-detector on individual events.

	VTX	ITK	OTK	TPC	ECAL	HCAL	Muon	Total
Time windows (ns)	200	30	30	34000	300	1000	100	
Higgs mode Full Data(Gbps)	97.7	10.8	79.0	19.8	540.1	16.5	<1	764.7
Data size / bunch (kB)	9.1	1.0	7.4	1.8	50.4	1.5	<0.1	71.3
Data size / event (kB)	9.1	1.0	7.4	226.9	100.8	6.2	<0.1	351.4
12.1MW Z mode Full Data(Gbps)	275.9	18.9	130.7	42.8	892.2	17.0	<1	1378.6
Data size / bunch (kB)	2.9	0.2	1.4	0.5	9.3	0.2	<0.1	14.4
Data size / event (kB)	11.5	0.2	1.4	219.1	46.5	2.7	<0.1	281.3
50MW Z mode Full Data(Gbps)	1772.4	113.1	798.0	263.7	5635.0	106.9	<1	8690.2
Data size / bunch (kB)	5.6	0.4	2.5	0.8	10.0	0.3	<0.1	27.57
Data size / event (kB)	56.2	1.1	7.6	1232.5	139.4	15.3	<0.1	1562.97

DAQ

- Left: Barcelona; Right: latest

Table 12.12: Requirements for Detector Readout. L1 trigger rate is 50 kHz for Higgs mode and 120 kHz for low luminosity Z mode, while the proportions of the beam background passed L1 are 3.5% and 1%, respectively.

Detector	Readout Data Rate after L1-Trigger (Gbps) @Higgs	Readout Data Rate after L1-Trigger (Gbps) @Low Lumi Z	Back End Electronics Board Number	Data rate per BEE board (Gbps) @Low Lumi Z
VTX	82.84	356.00	6	59.33
TPC	52.70	47.80	32	1.49
ITK	0.61	0.26	227	0.001
OTK_B	0.90	0.43	34	0.013
OTK_E	2.05	0.88	45	0.020
ECAL_B	38.66	18.70	60	0.31
ECAL_E	68.81	36.85	28	1.32
HCAL_B	7.14	21.45	346	0.062
HCAL_E	138.50	99.75	192	0.52
Muon	0.04	0.02	24	$<1\times10^{-3}$
Trigger	-	-	150	-
Sum	392.24 (49.0 GB/s)	582.14 (72.8 GB/s)	1144	

Table 12.12: Requirements for Detector Readout after L1. L1 trigger rate is 50 kHz for Higgs mode and 120 kHz for low luminosity Z mode, while the proportions of the beam background passed L1 are 3.5% and 1%, respectively.

Detector	Readout Data Rate after L1-Trigger (Gbps) @Higgs	@Low Lumi Z	@High Lumi Z	Back End Electronics Board Number	Data rate per BEE board (Gbps) @Low Lumi Z
VTX	3.64	11.04	179.94	6	1.84
TPC	19.8	42.80	263.74	32	1.34
ITK	0.40	0.19	3.45	227	<0.01
OTK_B	0.90	0.43	7.86	34	0.01
OTK_E	2.05	0.88	16.45	45	0.02
ECAL_B	14.60	15.82	277.87	60	0.26
ECAL_E	25.70	28.79	523.05	28	1.03
HCAL_B	0.08	0.15	2.84	346	<0.01
HCAL_E	2.37	2.39	46.01	192	0.01
Muon	0.04	0.02	0.06	24	<0.01
Trigger	-	-	150	-	
Sum	69.56 (8.7 GB/s)	102.54 (12.8 GB/s)	1321.25 (165.2 GB/s)	1144	

Data rate

- Left: Barcelona; Right: latest
- High Z lumi: 95.2->192
- Now storage rate is smaller than before

Table 12.4: Trigger rate estimation table for different run conditions. The physical event rate is introduced in Section 12.1.1.1. The detailed readout rates of each sub-detector are shown in Table 12.12.

Operation phase		**I**		**II**	**III**
Condition	**Higgs**	***Z* (12.1 MW)**	**W**	***Z* (50 MW)**	***tt̄***
Non-empty bunch crossing rate(MHz)	1.34	12	6.5	39.4	0.17
Luminosity ($10^{34}/cm^2/s$)	8.3	26	26.7	95.2	0.8
Physical event rate (kHz)	0.5	10	1.1	40	5.7×10^{-2}
L1 triger rate (kHz)	50	120	65	400	2
DAQ readout rate (Gbyte/s)	49.0	72.8	-	555	-
HLT rate (kHz)	1	20	2	80	1
Raw event size (kbyte)	1453.5	801.1	1500	2042	1000
DAQ storage rate (Gbyte/s)	1.5	16	3	163	1

Table 12.4: Trigger rate estimation table for different run conditions. The physical event rate is introduced in Section 12.1.1.1. The detailed readout rates of each sub-detector are shown in Table 12.12.

Operation phase		**I**		**II**	**III**
Condition	**Higgs**	***Z* (12.1 MW)**	**W**	***Z* (50 MW)**	***tt̄***
Non-empty bunch crossing rate(MHz)	1.34	12	6.5	39.4	0.17
Luminosity ($10^{34}/cm^2/s$)	8.3	26	26.7	192	0.8
Physical event rate (kHz)	0.5	10	1.1	77	0.057
L1 triger rate (kHz)	50	120	65	400	2
DAQ readout rate (Gbyte/s)	8.7	12.8	-	165.2	-
HLT rate (kHz)	1	20	2	154	1
Raw event size (kbyte)	351.4	281.3	1000	1563.0	1000
DAQ storage rate (Gbyte/s)	0.4	5.6	2	83.9	1