

Efficiency

Table 12.11: Expected L1 trigger rate at the Higgs mode for 50 MW and at the Z mode. Samples are simulated with CEPCSW. Electronic noise is not added. Pile up event is not added.

Higgs mode	Efficiency(%)	Z mode	Efficiency(%)
Higgs production	>99	$q\bar{q}$	>99.9
$q\bar{q}$	99.8	$\mu^+\mu^-$	>99.9
$\mu^+\mu^-$	99.2	$\tau^+\tau^-$	99.7
$\tau^+\tau^-$	95.3	Bhabha	>99.9
Bhabha	99.7		
Di-photon processes		Di-photon processes	
Di-photon event rate	Efficiency(%)	Di-photon event rate	Efficiency(%)
5.6 kHz	24.9	17 kHz	39.6
Beam Background		Beam Background	
Background event rate	Veto efficiency(%)	Background event rate	Veto efficiency(%)
9.4 kHz	99.3	Low Lumi: 54 kHz	99.5
		High Lumi: 256 kHz	99.3
Total		Total	
15 kHz		Low Lumi: 81 kHz	
		High Lumi: 311 kHz	

Table 12.11: Expected L1 trigger rate at the Higgs mode for 50 MW and at the Z mode for 12.1 MW. Samples are simulated with CEPCSW. Electronic noise is not added. Pile up event is not added.

Higgs mode	Efficiency(%)	Z mode	Efficiency(%)
Higgs production	>99	$q\bar{q}$	>99.9
$q\bar{q}$	99.8	$\mu^+\mu^-$	>99.9
$\mu^+\mu^-$	99.4	$\tau^+\tau^-$	99.5
$\tau^+\tau^-$	96	Bhabha	>99.9
Bhabha	99.8		
Beam Background		Beam Background	
Background event rate	Veto efficiency(%)	Background event rate	Veto efficiency(%)
46.9 kHz	96.5	108 kHz	99.1

Table 11.1: Critical inputs from sub-detectors and Machine-Detector Interface (MDI) are used. Background rates are estimated by the MDI study, then the corresponding data rate for each module is calculated. Concerning the detector design and dimensions, the total data volume is calculated as the input for the trigger system. For each sub-detector, if applicable, "B" is the abbreviation of "Barrel", while "E" represents "Endcap". "GS" is the short form of "Glass Scintillator", and "Agg Brd" is the "Aggregation Board". During the calculation, a safety factor of 1.5 was considered for the background rate. The vertex detector has taken account of the synchrotron radiation effect, while for other sub-detectors, this effect was not considered.

	VTX	ITK	ITK	OTK	OTK	TPC	ECAL	ECAL	HCAL	HCAL	Muon
	B	E	B	E		B	E	B	E		
Chn/chip	512 × 1024	512 × 128		128	128	4-16 (common SiPM ASIC)					
Data Width	32 bit	42 bit / hit		40-48 bit / hit	48 bit / hit	48 bit / hit					
Module Size/Link	168 cm ² Half layer	56 cm ² 14 chip / module		128 cm ² 8×4 cm ² / module	461 cm ²	856 chn @ 1.5cm bar		600 GS / Agg Brd		Agg Brd	
Background rate (MHz/cm ²)											
@Higgs	3.75	9.45e-4	3.60e-3	5.55e-3	1.41e-3	4.80e-3	2.70e-3	0.12	3.00e-3	1.05e-3	5.25e-3
@LowZ	15.00	1.50e-3	6.00e-3	9.90e-3	2.25e-3	4.35e-3	1.95e-3	9.60e-3	9.00e-3	7.5e-3	1.8e-3
@HighZ	43.50	4.65e-3	0.018	3.00e-3	6.90e-3	1.37e-3	0.06	0.30	2.85e-3	2.4e-3	5.4e-3
Data rate per Link (Mbps)											
@Higgs	2.02e4	2.22	8.45	3.41	8.63	1.06e2	1.11e3	4.93e3	8.64	3.02e2	< 10
@LowZ	8.10e4	3.53	14.11	6.07	13.83	96.4	8.01e2	3.94e3	25.92	2.16e2	< 10
@HighZ	2.34e5	10.93	43.24	18.42	42.36	3.03e2	2.47e3	1.23e4	82.08	6.91e2	< 10
Detector Channel volume	1882 eqv chips	2376 mod-ules	1236 mod-ules	7040 mod-ules	6368 mod-ules	496 mod-ules	0.4M chn 480 mod-ules	0.16M chn 224 mod-ules	3.38M Agg Brds	2.24M Agg Brds	43.2k ch 72 Agg Brds
Full Data rate (Gbps)											
@Higgs	2.22e3	5.28	11.08	24.01	54.97	52.73	5.18e2	9.22e2	47.83	9.28e2	< 1
@LowZ	8.90e3	8.38	17.45	42.71	88.03	47.77	3.74e2	7.37e2	1.43e2	6.65e2	< 1
@HighZ	2.57e4	25.96	53.45	129	270	150	1.15e3	2.30e3	4.54e2	2.12e3	< 1

	Vertex	ITKB	ITKE	OTKB	OTKE	TPC	ECAL-B	ECAL-E	HCAL-B	HCAL-E	Muon
Chn/chip	512*1024/Stch	512*128		128		128	4-16 @common SiPM ASIC				
Data Width	32bit/hit	42bit/hit		40-48bit/hit		48bit/hit	48bit/hit				
Module Size/Link	168.15cm2 Half Inner layer	56.00cm2 14 chip/module		128.00cm2 8*4cmSensor/module		461.44cm2 Module size	2000 chn 1000 dual bar @ 1cm with 0.1MIP th		600 GS 120 cell*5 PCB/Aggr Brd		Aggr Brd
Higgs Bkg (MHz/cm ²)	3.351	9.45e-4	4.16e-3	1.02e-3	1.40e-3	5.1e-3	0.0165	0.0675	3.0e-4	7.95e-3	2.1e-6
Higgs Data rate/Link(Mbps)	18,031.59	2.22	9.77	6.27	8.57	112.96	1,584	6,480	8.64	228.96	<10
LowZ Bkg (MHz/cm ²)	13.22	1.53e-3	5.97e-3	1.82e-3	2.34e-3	5.55e-3	0.0225	0.0975	1.05e-3	1.23e-02	2.67e-6
LowZ Data rate/Link(Mbps)	71,157.78	3.60	14.04	11.15	14.38	122.93	2,160	9,360	30.24	354.24	<10
HighZ Bkg (MHz/cm ²)	40.79	5.69e-3	0.021	5.63e-3	7.31e-3	-	0.116	0.501	3.3e-3	7.95e-02	8.87e-6
HighZ Data rate/Link(Mbps)	219,494.63	13.37	50.45	34.56	44.88	-	11,088.00	48,096.00	95.04	2,289.60	<10
Detector Channel/module	1882 equiv chips @Stch & Ladder	2376 modules	1236 modules	7040 modules	6368 modules	496 modules	0.96M chn 480 modules	0.52M chn 260 modules	3.38M chn 5536 Aggr Brds	2.24M chn 3072 Aggr Brds	43.2k ch 72 Aggr Brds
Full Data rate @Higgs (Gbps)	1,983.879	5.281	12.079	44.119	54.579	56.028	760.320	1,684.80	47.831	703.365	<0.72
Full Data rate @LowZ (Gbps)	7,828.952	8.550	17.355	78.506	91.552	60.972	1,036.800	2,433.60	167.409	1,088.225	<0.72
Full Data rate @HighZ (Gbps)	24,149.333	31.770	62.357	243.302	285.808	-	5,322.240	12,504.960	526.141	7,033.651	<0.72

Figure 11.1: Critical inputs from sub-detectors & MDI. Background rates are estimated by the MDI study, then the corresponding data rate for each module are calculated. Concerning the detector design and dimension, the total data volume are calculated as the input for the trigger system.