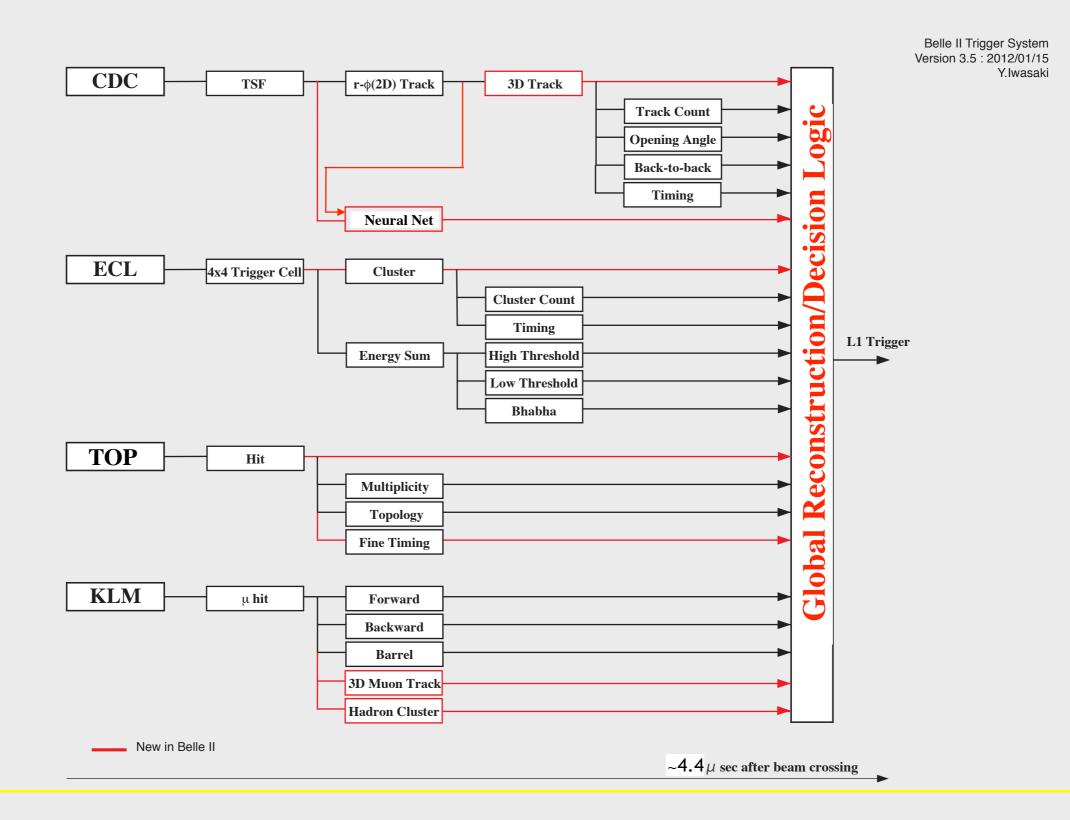
# GDL

TRG/DAQ workshop Yonsei University 20190828 H. Nakazawa (NTU)

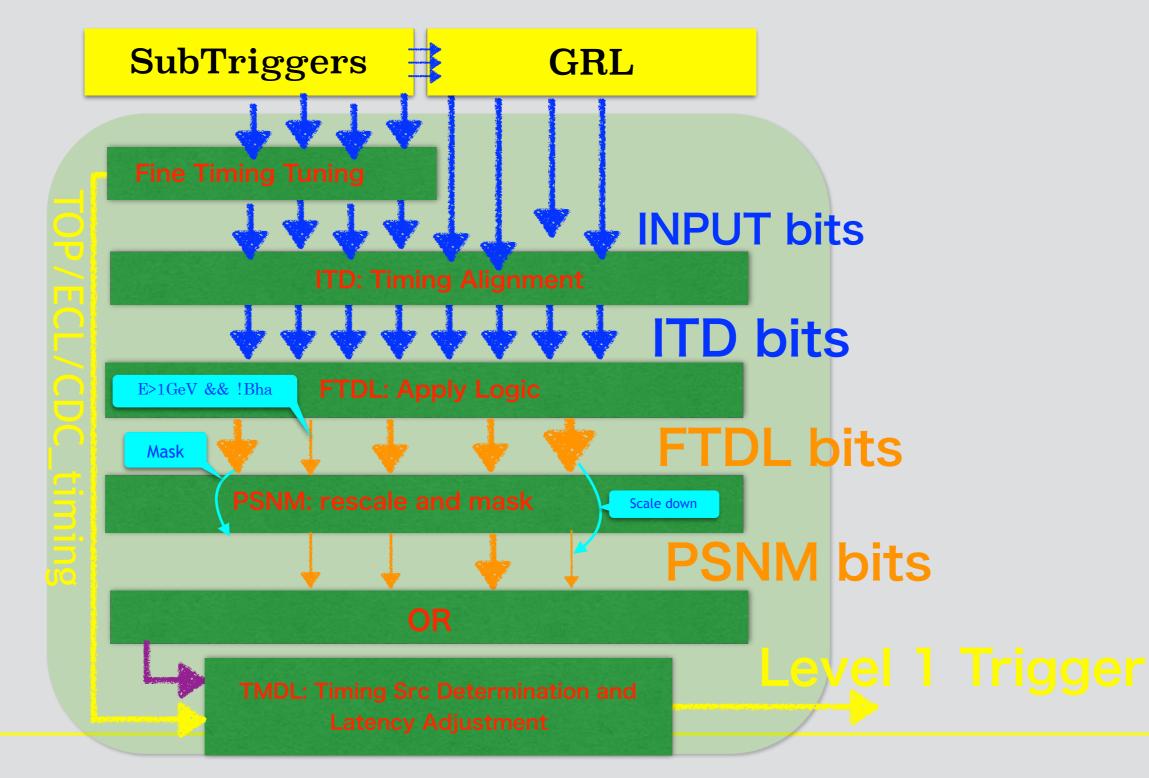
### L1 trigger Overview



H. Nakazawa

### **GDL (Global Decision Logic)**

#### Implemented on UT3 in Ehut, accessible with vmetrg18



## **GDL development schedule**

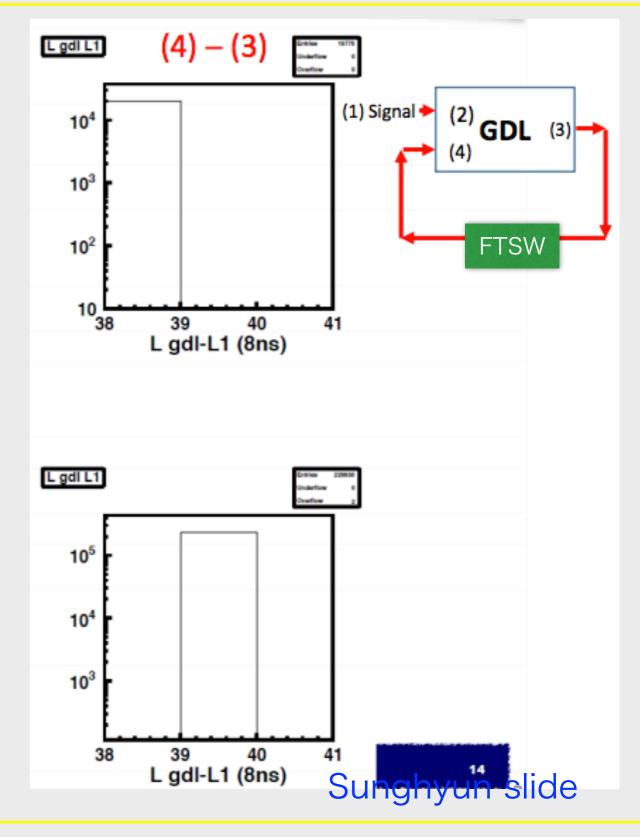
### • Short term (within Phase3)

- GDL-ETM link 🗸
- Rate check of ffy (three-track with at least one neuro-z)
- Middle term (during summer)
  - Common L1 timing shift (GDL->FTSW)
  - B2L data shift (not only GDL but all UT3 except for ETM)
  - Full readout of GDL data
  - VME I/F update
  - Scaler update
  - Edge sensitive ITD 🗸
  - Delayed Bhabha logic
  - Large deadtime with 10 kHz read-out
- Long term
  - UT3 -> UT4

### Iwasaki-san @ June TB

### Shift of gdlL1-comL1 latency

- Shift by 1 clock (8ns)
- GDL -> FTDW -> GDL takes 38 clocks or 39 clocks



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#### gdl trigger type is synchronized 110b0000 1f000000

#### Sync

- Latency = commonL1 gdlL1
- Sync: Timing adjustment

RUN	Sync	Latency								
378	0	38								
390	1	Nodata								
551	2	38	After break							
676	2	38								
770	0	39	After break							
849	0	39								
1001	1	38	After break							
1005	1	38								
1006	2	39	GDL no reboot							
1007	2	39								
1008	1	38	GDL no reboot							
1027	1	38								
1029	3	39	Not synchronized							
1030	2	39								
1036	1	38	GDL no reboot							
1037	2	39	GDL no reboot							
1038	1	38	Inj params DL							
1040	0	39	GDL rebooted							
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10000			
RUN	Sync	Latency	
1168	0	39	
1170	2	38	GDL rebooted
1175	2	38	
1200	0	39	After break
1207	0	39	
1208	2	38	GDL rebooted
1274	2	38	
1275	1	38	GDL rebooted
1278	1	38	
1279	0	38	GDL rebooted
1286	0	38	
1287	0	39	GDL rebooted
1336	0	39	
1413	1	38	After break
1433	1	38	
1506	0	38	After break
1519	0	38	
1520	1	Nodata	GDL rebooted
1524	]	38	
1525	2	38	GDL rebooted
1556	2	38	
1684	0	38	After break
1739	0	38	
1767		38	After break
1917	2	38	After break
1925	0	38	GDL rebooted
1961	0	38	GDL rebooted
1962	0	39	GDL not rebooted
2165	0	39	
2168	2	38	GDL rebooted

### Shift of gdlL1-comL1 latency

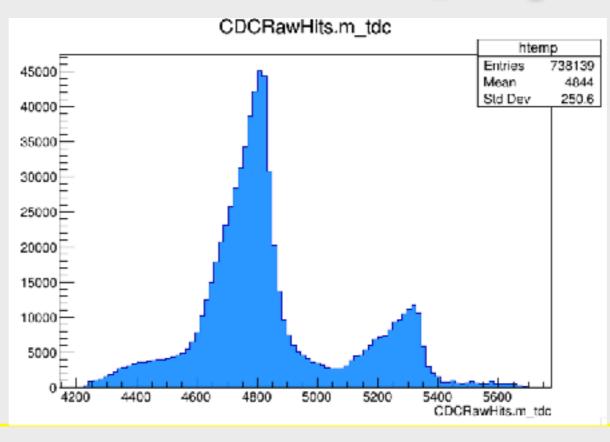
- Two possibilities
  - CDX on GDL, system clock vs b2tt clock
    - Clock unified to system clock but still the shift seen.
  - On FTSW side, timing phase is adjusted run by run in unit of 2 nsec
    - Nakao-san guesses this is due to scanning failure, but no idea how to solve it.
    - Can be corrected on GDL once the run starts.

## **Delayed Bhabha logic**

- Data for background overlay to MC data to reproduce background situation.
- Bhabha, high purity, proportional rate to physics.
  - ~400Hz@8e35,PS=100
- To avoid abort gap, take data with same bunch crossing (same timestamp) with Bhabha after one (?) beam cycle.
- Design
  - If Bhabha bit (PSNM) is fired, timestamp and revolution counter for corresponding L1 signal is stored in FIFO
    - FIFO size is 5
  - Inject bha\_delay (=logic input) bit and timing source (=dph\_timing) before fixed (changeable) latency to L1
- Test OK. More realistic, high rate test will be done.

### **Timing tuning for cdc\_timing**

- In case of ECL signals
  - Data clock is 8 MHz, all signal delivered at the same clock
  - Timing is tuned to correct this effect using ecl\_timing value
- No correction for cdc\_timing.
  - Timing window of cdc\_timing was fluctuated.
  - Modified so that cdc\_timing signal is given to TMDL (timing decision logic) at fixed latency before L1 signal



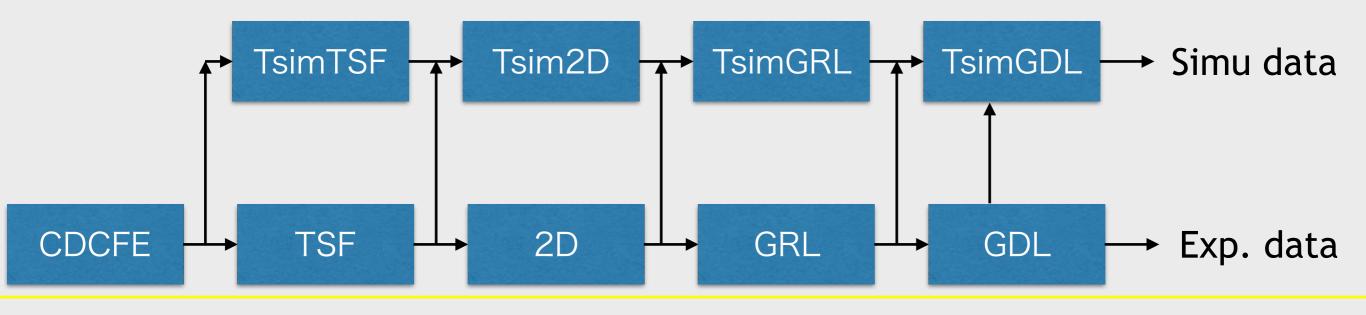
#### Cosmic data taken with cdc\_timing

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## Tsim GDL

#### • 3 types

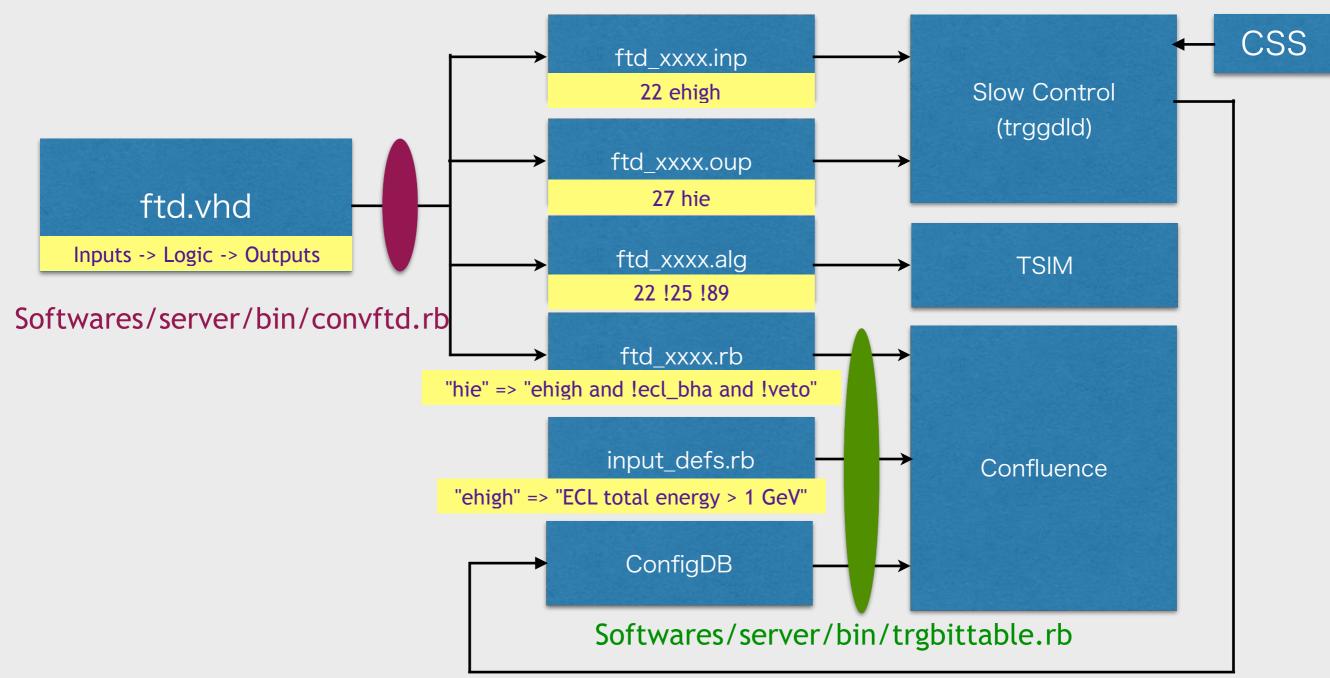
- Firmware simulation
  - Clock-by-clock. Converted from FW code. For detailed systematic study
  - Development not started
- Fast simulation
  - For Physics analysis
  - Ready. Considering how to test it.
- Data simulation
  - For algorithm validation. Main part is common with fast simulation.
  - Apply algorithm to exp. input data and compare the output with exp. output bits.
  - Ready and validation ongoing.
- Local DB is used for algorithm data. Need to embed it to global DB.
- Pull request made but not ready for release 4.



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### **Exporting Trigger Bit Map and PS values**



- ftd.vhd and input\_defs.rb are needed to be modified by hand.
- Bit map, PS value, Logics are recorded in DB run by run.

## **GDL full readout**

- For debugging
- At present, integrated (127MHz -> 32MHz) data.
   Logic consistency partially lost.
- Suppress mode?
- Readout through dedicated UT3 (GDL->one readout UT3-> 4\*B2L)
  - Koga-san started FW implementation
- Copper and hslb15003a,3b,4a,4b ready by Yamada-san
  - Can login from trg01
- trg03 is there. PS=4 if only trg03.
- Negotiation on FTSW, takes a few months to be delivered.
- SC

### **Data truncation**

- Data truncation
  - 1st several bytes (sometimes a few words) missing
  - Happend events < 0.3%
- Bug found and fixed.
- Dummy 30 kHz with 2 usec event separation
- GDL + skeleton 3Ds
- Will test with other modules when ready
  - Large dead time at 10 kHz solved?

-	hdrok	data ok	hdr bad	data bad	bad#wd	dd shift	ccdisodr	cc ok
2D0	0	0	0	0	0	0	0	0
2D1	0	0	0	0	0	0	0	0
2D2	0	0	0	0	0	0	0	0
2D3	0	0	0	0	0	0	0	0
3D0	221082	3505	0	0	0	0	0	3505
3D1	221082	3505	0	0	0	0	0	3505
3D2	221082	3505	0	Θ	0	0	0	3505
3D3	221082	3505	0	0	0	0	0	3505
NNO	0	0	0	Θ	0	0	0	0
NN1	0	0	0	0	0	0	0	0
NN2	0	0	0	0	0	0	0	0
NN3	0	Θ	0	0	0	0	0	0
SL0	0	Θ	0	Θ	0	0	0	0
SL1	0	Θ	0	Θ	0	0	0	0
SL2	0	Θ	0	Θ	Θ	0	0	0
SL3	0	Θ	0	Θ	0	0	0	0
SL4	0	Θ	0	Θ	0	0	0	0
SL5	0	Θ	0	Θ	0	0	0	0
SL6	0	0	0	0	Θ	0	0	0
GDL	0	224587	0	0	Θ	0	0	224587
ETF	0	0	Θ	0	0	Θ	0	0
							242,1	末尾

## Others

- GDL-ETM link
  - Optical Link: GTX->GTH on both side
  - Will test it at B2 testbench though not realistic.
- Veto signals, ecl\_bst, bha\_veto
  - bha\_veto via NIM to reduce latency.
  - ecl\_bst should be prepared anyway.
  - ecl\_bst should be through NIM.
    - Dedicated delay module to widen it to 2 usec
- Edge sensitive input signals, done.
- VME component update
  - To avoid access to VME parameter values in top.vhd.
  - CDX free.
  - Iwasaki-san has new VME component.
  - Need to develop scaler part?
- Compile with alive count scaler
  - Omitted at present for easy compiling. No plan.
- Logic and usage of TOP and KLM signals.

j: input average rates, J: input total counts f: ftd instant rates, F: ftd instant counts e: ftd average rates, E: ftd total counts p: psn instant rates, P: psn instant counts o: psn average rates, O: psn total counts g; general info interval 9.0 sec RUNNING

			4/00 /		1.00			•			1.00		~		
9	fff	1,	1608.4,	0.0	49	sp		θ,	0.0,	0.0		cdctop2	θ,	0.0,	0.0
1	ffs	Θ,	0.0,	0.0	50	zp		θ,	0.0,	0.0	99	odotop3	θ,	0.0,	0.0
2	fss	θ,	0.0,	0.0	51	ур		Θ,	0.0,	0.0		cdctop4	θ,	0.0,	0.0
3	\$\$\$	θ,	0.0,	0.0	52	d_5		Θ,	0.0,	0.0		olhie	1,	210.7,	0.0
-4	ffz	θ,	0.0,	0.0	53	shem		40,	26.8,	0.0		c1lume	1,	110.6,	0.0
5	fzz	θ,	0.0,	0.0	54	ohem		40,	32.5,	0.0	103	n1hie	1,	180.4,	0.0
6	ZZZ	θ,	0.0,	0.0	55	toptiming		Θ,	0.0,	0.0	104	n1lume	1,	100.6,	0.0
7	ffy	θ,	0.0,	0.0	56	ecltiming		θ,	0.0,	0.0	105	c3hie	1,	31.4,	0.0
8	fyý	θ,	0.0,	0.0	57	odotiming		θ,	0.0,	0.0		c3lume	1.	12.4,	0.0
9	ууу	θ,	0.0,	0.0	58	adabb		1,	502.3,	0.0		n3hie	1,	15.4,	0.0
10	ff	20,	270.0,	0.0	59	mu_pair		Θ,	0.0,	0.0		n3lume	1,	1.3,	0.0
11	fs	θ,	0.0,	0.0	60	mu_b2b		e,	0.0,	0.0		1m10	1,	316.8,	0.0
12	ss	θ,	0.0,	0.0	61	klmhit		θ,	0.0,	0.0		lml1	1,	72.9,	0.0
13	fz	θ,	0.0,	0.0	62	revolution	R	1,	0.9,	0.0		1m12	1,	46.1,	0.0
14	zz	θ,	0.0,	0.0	63	random	R	1,	0.7,	0.0		1m13	1,	96.6,	0.0
15			0.0,	0.0	64		R		0.0,	0.0		1m14	1,	150.4,	0.0
		θ,		0.0	65	bg pls		θ,		0.0		1m14 1m15			0.0
16		θ,	0.0,					θ,	0.0,			1m15 1m16	1,	83.3,	
17	ffo	1,	816.3,	0.0	66	poisson		θ,	0.0,	0.0			1,	63.4,	0.0
18	fso	θ,	0.0,	0.0	67	Ť		2000,	12.5,	0.0		1m17	1,	45.7,	0.0
19	\$\$0	θ,	0.0,	0.0	68	s		θ,	0.0,	0.0		1m18	1,	28.3,	0.0
20	fzo	θ,	0.0,	0.0	69	z		θ,	0.0,	0.0		1m19	1,	112.7,	0.0
21	fyo	θ,	0.0,	0.0	70	У		θ,	0.0,	0.0		1m110	1,	139.4,	0.0
22	ffb	1,	377.7,	0.0	71	nim0		θ,	0.0,	0.0		lm111	θ,	0.0,	0.0
23	fsb	θ,	0.0,	0.0	72	nima03		Θ,	0.0,	0.0		ZZZV	θ,	0.0,	0.0
24	ssb	Θ,	0.0,	0.0	73	nimo03		Θ,	0.0,	0.0	122	уууч	θ,	0.0,	0.0
25	fzb	θ,	0.0,	0.0	74	eclnima03		Θ,	0.0,	0.0	123	fffv	θ,	0.0,	0.0
26	fyb	θ,	0.0,	0.0	75	eclnimo03		Θ,	0.0,	0.0	124	ZZV	θ,	0.0,	0.0
27	hie	1,	230.7,	0.0	76	n1gev0		θ,	0.0,	0.0	125	ууч	θ,	0.0,	0.0
28	lowe	θ,	0.0,	0.0	77	n1gev1		θ,	0.0,	0.0		ffov	θ,	0.0,	0.0
29	lume	θ,	0.0,	0.0	78	n1gev2		θ,	0.0,	0.0	127	hiev	θ,	0.0,	0.0
30	02	150,	17.1,	0.0	79	n1gev3		θ,	0.0,	0.0		lumev	θ,	0.0,	0.0
31	63	50,	5.7,	0.0	80	n1gev4		θ,	0.0,	0.0		o4v	θ,	0.0,	0.0
32	c4	1,	63.0,	0.0	81	n2gev1		θ,	0.0,	0.0		bhabhav	θ,	0.0,	0.0
33	a5	θ,	0.0,	0.0	82	n2gev2		θ,	0.0,	0.0		bhapurv	θ,	0.0,	0.0
34	bha3d	1,	158.8,	0.0	83	n2gev3		θ,	0.0,	0.0		mu_pairv	θ,	0.0,	0.0
35		1.	174.5,	0.0	84	n2gev4		θ.	0.0,	0.0		bha3dv	ė.	0.0,	0.0
36		1,	35.7,	0.0	85	c2gev1		1,	13.0,	0.0		s10b2b	e,	0.0,	0.0
37	bhabha_brl	1,	42.2,	0.0	86	c2gev2		1,	4.7,	0.0		mu_epair	e,	0.0,	0.0
20	bhabha_ecp	1,	132.3,	0.0	87	c2gev3		ē,	0.0,	0.0		mu_eb2b	e,	0.0,	0.0
39	bhapur	1,	187.1,	0.0	88	c2gev4		θ,	0.0,	0.0		eklmhit	e,	0.0,	0.0
40	eclmumu	1,	109.1,	0.0	89	cdcecl1		3000,	1.9,	0.0		fffo	e,	0.0,	0.0
40	bhauni	1,	187.1,	0.0	90	cdcecl2		150,	2.0,	0.0		fffc2	θ,	0.0,	0.0
42			16.8,	0.0		cdcec13			16.8,	0.0		ffoo	e,	0.0,	0.0
		1,				cdcecl4		1,				ffoc2			
43	g_high	20,	12.5,	0.0				1,	4.8,	0.0			θ,	0.0,	0.0
44		1500,	21.7,	0.0	93			θ,	0.0,	0.0		fffo	1,	399.8,	0.0
45		150,	10.5,	0.0	94	cdcklm2		θ,	0.0,	0.0		fffov +14b0b	θ,	0.0,	0.0
46		1,	30.8,	0.0	95	cdcklm3		θ,	0.0,	0.0		s11b2b	θ,	0.0,	0.0
47	fed	1,	64.8,	0.0	96	odoklm4		θ,	0.0,	0.0		\$12b2b	θ,	0.0,	0.0
48	fp	1,	176.6,	0.0	97	cdctop1		θ,	0.0,	0.0	146	s112b2b	θ,	0.0,	0.0

```
j: input average rates, J: input total counts
f: ftd instant rates, F: ftd instant counts
e: ftd average rates, E: ftd total counts
p: psn instant rates, P: psn instant counts
o: psn average rates, O: psn total counts
g; general info
interval 9.0 sec
RUNNING
```

46 eed

47 fed

48 fp

0	fff	1,	1369.3,	0.0	49	<b>6</b> 70	е,	88.4,	0.0	98 cdctop2	θ,	14.9,	0.0
1	ffs	ē,	850.5,	0.0	50	sp zp	ě,		0.0	99 cdctop3	e,	7.4,	0.0
2	fss	e,	432.8,	0.0	51	yp	ě,		0.0	100 cdctop4	ě,	15.1,	0.0
3	555	e,	114.1,	0.0	52	d_5	ě,	364.6,	0.0	101 c1hie	1,	228.5,	0.0
4	ffz	e,	2165.0,	0.0	53	shem	40,	1056.8,	0.0	102 c1lume	1,	123.5,	0.0
5	fzz		1596.0,	0.0	54	ohem	40,	1282.1,	0.0	103 n1hie		197.1,	0.0
6		e,	8939.5,	0.0	55	toptiming		204272.1,	0.0	103 n11ume	1,	111.8,	0.0
7	zzz ffy	e,	1368.9,	0.0	56	eoltiming	e,	58652.2,	0.0	105 c3hie	1,	29.5,	0.0
		e,	1360.2,	0.0	57	odotiming	e,	56334.6,	0.0	106 c3lume	1,	12.9,	0.0
8	fyy	e,			58	cdcbb	θ,	341.2,		105 c310me	1,		0.0
9	ууу ff	e,	1164.3,	0.0			1,		0.0	107 hanie 108 h3lume	1,	12.9,	
10		20,	5131.2,	0.0	59	mu_pair	e,		0.0		1,	0.9,	0.0
11	fs	e,	3856.2,	0.0	60	mu_b2b	θ,		0.0	109 lm10	1,	325.7,	0.0
12	55	Θ,	1283.3,	0.0	61	klmhit	θ,	0.0,	0.0	110 lml1	1,	78.3,	0.0
13	fz	θ,	5745.1,	0.0	62	revolution	1,		0.0	111 lm12	1,	48.5,	0.0
14	zz	θ,	17939.1,	0.0	63	random	1,		0.0	112 lm13	1,	107.8,	0.0
15	fy	θ,	5130.4,	0.0	64	bg	θ,		0.0	113 lm14	1,	153.1,	0.0
16	уу	θ,	4622.3,	0.0	65	pls	θ,		0.0	114 lm15	1,	89.5,	0.0
17	ffo	1,	689.6,	0.0	66	poisson	θ,	0.4,	0.0	115 lm16	1,	68.2,	0.0
18	fso	θ,	269.7,	0.0	67	f	2000,	24525.3,	0.0	116 lm17	1,	46.6,	0.0
19	\$\$0	θ,	64.0,	0.0	68		θ,	12649.1,	0.0	117 lm18	1,	30.8,	0.0
20	fzo	θ,	692.7,	0.0	69	z	θ,	33135.1,	0.0	118 lm19	1,	104.9,	0.0
21	fyo	θ,	689.3,	0.0	70	У	θ,	24566.0,	0.0	119 lml10	1,	135.8,	0.0
22	ffb	1,	264.0,	0.0	71	nim0	θ,	3218208.8,	0.0	120 lml11	Θ,		0.0
23	fsb	θ,	98.8,	0.0	72	nima03	θ,	0.0,	0.0	121 zzzv	θ,	9211.0,	0.0
24	ssb	θ,	27.4,	0.0	73	nimo03	θ,	6074096.5,	0.0	122 yyyv	Θ,		0.0
25	fzb	θ,	253.2,	0.0	74	eclnima03	θ,	0.0,	0.0	123 fffv	θ,	1495.7,	0.0
26	fyb	θ,	263.8,	0.0	75	eclnimo03	θ,	47726.0,	0.0	124 zzv	Θ,	18313.7,	0.0
27	hie	1,	239.2,	0.0	76	n1gev0	θ,	1079.0,	0.0	125 yyv	θ,	4777.8,	0.0
28	lowe	θ,	1260.4,	0.0	77	n1gev1	θ,	72.0,	0.0	126 ffov	Θ,	773.8,	0.0
29	lume	θ,	57.0,	0.0	78	n1gev2	θ,	8.5,	0.0	127 hiev	Θ,	289.4,	0.0
30	¢2	150,	2628.8,	0.0	79	n1gev3	θ,	0.3,	0.0	128 lumev	Θ,	94.6,	0.0
31	o3	50,	295.1,	0.0	89	n1gev4	θ,		0.0	129 c4v	Θ,	126.0,	0.0
32	¢4	1,	67.3,	0.0	81	n2gev1	θ,	23.1,	0.0	130 bhabhav	Θ,	201.4,	0.0
33	o5	Θ,	28.3,	0.0	82	n2gev2	θ,	5.9,	0.0	131 bhapurv	Θ,	200.6,	0.0
34	bha3d	1,	172.2,	0.0	83	n2gev3	θ,	0.1,	0.0	132 mu_pairv	Θ,	0.0,	0.0
35	bhabha	1,	189.3,	0.0	84	n2gev4	θ,	0.0,	0.0	133 bha3dv	Θ,	172.9,	0.0
36	bhabha_trk	1,	39.3,	0.0	85	c2gev1	1,	12.8,	0.0	134 s10b2b	Θ,	182420.8,	0.0
37	bhabha_brl	1,	45.2,	0.0	86	c2gev2	1,	4.1,	0.0	135 mu_epair	θ,	998.0,	0.0
38	bhabha_ecp	1,	144.0,	0.0	87	c2gev3	θ,	0.2,	0.0	136 mu_eb2b	Θ,	184.3,	0.0
39	bhapur	1,	199.7,	0.0	88	c2gev4	θ,	0.0,	0.0	137 eklmhit	θ,	7228.9	0.0
40	eclmumu	1,	108.0,	0.0	89	cdcecl1	3000,	5863.2,	0.0	138 fffo	θ,	334.8,	0.0
41	bhauni	1,	199.7	0.0	90	cdcec12	150,	310.5,	0.0	139 fffo2	θ,	106.2,	0.0
42	ecloflo	1,	17.3,	0.0	91	cdcec13	1,	17.7,	0.0	140 ffoc	θ,	351.7,	0.0
43	g_high	20,	266.7	0.0	92	cdcecl4	1,		0.0	141 ffoc2	θ,	160.5,	0.0
44	g_c1	1500,	32960.6	0.0	93	odok1m1	θ,		0.0	142 fffo	1,	279.9	0.0
45	99	150,	1620.3,	0.0	94	odok1m2	θ,		0.0	143 fffov	Θ,	357.6,	0.0

θ,

θ,

θ,

0.0,

0.0,

1045.1,

0.0

0.0

0.0

144 sl1b2b

145 s12b2b

146 sl12b2b

0, 328470.2,

0, 452253.6,

0, 24247.6,

0.0

0.0

0.0

95 odoklm3 96 odoklm4

0.0 97 cdctop1

30.3,

64.9,

176.6,

0.0

0.0

1,

1,

1,

i: input instant rates, I: input instant counts
j: input average rates, J: input total counts
f: ftd instant rates, F: ftd instant counts
e: ftd average rates, E: ftd total counts
p: psn instant rates, P: psn instant counts
o: psn average rates, O: psn total counts
g: general info

#### RUNNING

interval 5.1 se

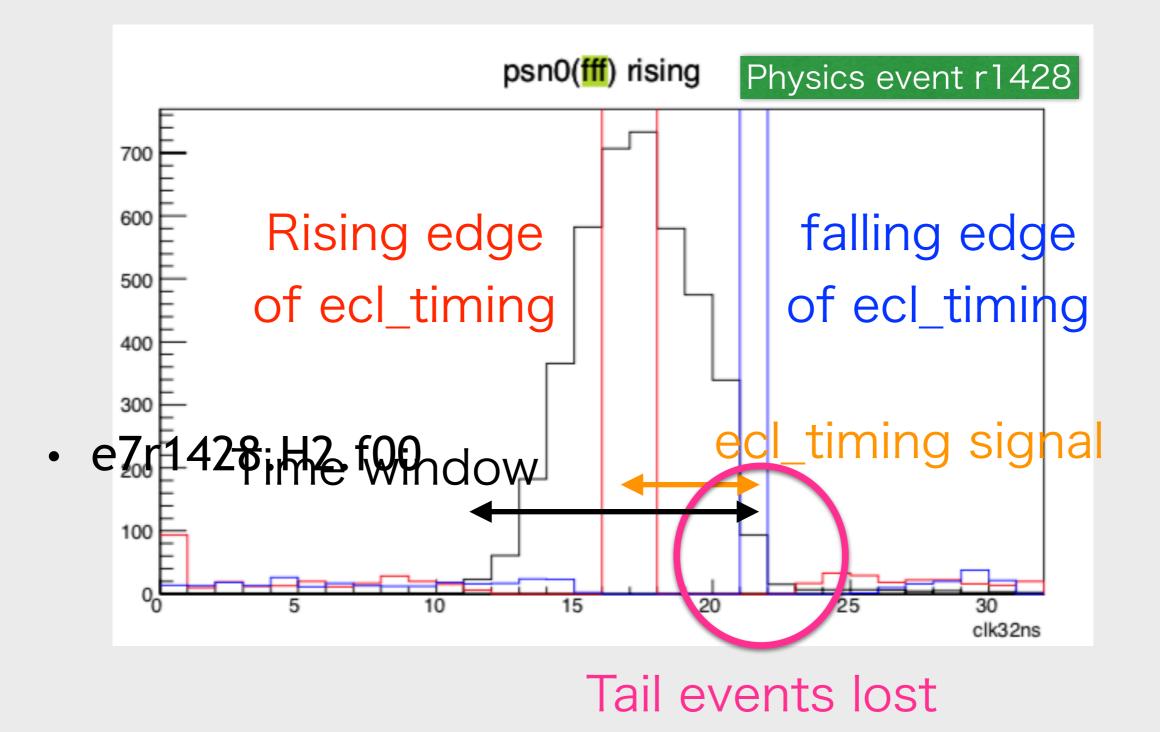
<pre>6 t1.0 0 0, 12088.5, 0.0 146 ecl_min_t 10 14, 64232.1, 0.0 16 0 for ndger_0 21 22, 4, 0.6, 0.0 14, 0.1, 0.0 14, 0.1, 0.0 14, 0.0</pre>																	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	9	t3_0	9	θ,				ecl_active			60320.1,	0.0				0.0,	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	1		9	θ,						16,			97 n2gev_0			21.4,	
$ \begin{array}{c} c \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$	2	t3_2	e	Θ,		0.0	50			16,		0.0	98 n2gev_1			4.6,	0.0
$ \begin{bmatrix} 6 & ty_{-1}^{-1} & 47 & 31, 3765.9, 0.0 \\ 6 & ty_{-2}^{-1} & 47 & 31, 3765.9, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 3273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 47 & 31, 1273.7, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 995.5, 0.0 \\ 1 & ty_{-3}^{-1} & 43 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1442.0, 0.0 \\ 1 & ty_{-3}^{-1} & 19 & 31, 1207.7, 0.0 \\ 1 & ty_{-3}^{-1} & 10 & 16, 120.4, 0.0 \\ 1 & ty_{-3}^{-1} & 10 & 31, 1207.7, 0.0 \\ 1 & ty_{-3}^{-1} & 10 & 16, 120.4, 0.0 \\ 1 & ty_{-3}^{-1} & 10 & 16, 120.4, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 16, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0.0 \\ 1 & ty_{-4}^{-1} & 10 & 10, 0$	3	t3_3	0	θ,	5105.7,	0.0	51	ecl_timing_bwd	19	16,		0.0	99 n2gev_2	23	16,	0.0,	0.0
	4	ty_0	47	31,	20377.4,	0.0	52	ecl_phys	19	16,		0.0	100 n2gev_3	23	16,	0.0,	0.0
7 $t_{1}^{-2}$ 47 31, 1273.7, 0.0 16 56 ecl_ml_1 19 16, 905.2, 0.0 140 $c_{1}^{2}e_{2}^{-2}$ 23 16, 2.4, 0.0 0 t2.1 47 31, 1988.6, 0.0 156 ecl_ml_1 19 16, 110.0, 0.0 146 $c_{1}^{2}e_{2}^{-2}$ 23 16, 2.4, 0.0 0 t2.1 47 31, 1980.6, 0.0 156 ecl_ml_1 19 16, 190.0, 0.0 146 $c_{1}^{2}e_{2}^{-2}$ 23 16, 2.4, 0.0 0 15 t2.1 47 31, 1990.6, 0.0 158 ecl_ml_1 3 9 16, 07.7, 0.0 148 $c_{1}^{2}e_{2}^{-2}$ 23 16, 2.4, 0.0 0 15 t12.3 43 31, 1127.7, 0.0 158 ecl_ml_1 3 9 16, 07.7, 0.0 148 $c_{1}^{2}e_{2}^{-2}$ 23 16, 4.1.0, 0.0 15 t12.3 43 31, 1127.0, 0.0 16 46 ecl_ml_1 4 9 154, 190.0, 0.0 1190 ccccl_l 2 23 16, 4.1.0, 0.0 15 t12.3 43 11, 1127.7, 0.0 16 46 ecl_ml_2 5 164, 2.4.6, 0.0 1190 ccccl_l 2 0 23 16, 2.4.7, 0.0 15 t12.5, 0.0 15 t12.5, 0.0 155 t2.5, 0.0 164 ecl_ml_2 5 164, 124.4, 0.0 1190 ccccl_l 2 0 164, 0.6, 0.0 156 ccc_l 0.0 0 156 ccc_l 0.0 0 164 ecl_ml_2 10 154, 124.6, 0.0 1111 ccccl_ml_2 0 16, 0.6, 0.0 0 156 ccc_l 0.0 0 156 cccc_l 0.0 0 156 ccc_l	5	ty_1	47	31,	3705.9,	0.0	53	ecl_oflo	19	16,	523.2,	0.0	101 c2gev_0	23	16,	29.3,	0.0
6       t2_0       47       31, 19830.6,       0.0       15       ec.]ml_1       19       19.6,       0.0       144.c2ges/3       23       14, 120.6,       0.0         10       t2_1       47       31, 3903.6,       0.0       15       ec.]ml_3       19       14, 0.0,       0.0       146.c2ges/3       23       14, 642.0,       0.0         11       t2_3       43       31, 1362.2,       0.0       156       ec.]ml_4       19       14, 140.0,       0.0       146.c2ges/3       23       14, 642.0,       0.0         13       t1_1       10       31, 11272.4,       0.0       154.c1ml_4       10       16, 72.2,       0.0       110       164.c1ml_0       144.c2ges/3       23       14, 72.4,       0.0         14       t1_3       10       154.c1ml_4       154.c       154.c1ml_0       0.1       110       154.c1ml_0       0.1       111       154.c1ml_0       0.0       154.c1ml_0       0.0       154.c1ml_0       <	6	ty_2	47	31,		0.0	54	ecl_3dbha	19	16,	161.8,	0.0	102 c2gev_1	23	16,	44.5,	0.0
9 t t_1 + 7 31, 3996.5, 0.0 6 7 ecl_lal_2 19 16, 61.4, 0.0 106 cocel_0 22 16, 6439.3, 0.0 11 t t_2.3 4.4 31, 996.6, 0.0 58 ecl_lal_3 19 15 16, 97.7, 0.0 106 cocel_1 2 23 16, 641.0, 0.0 11 t t_2.3 4.4 31, 1366.2, 0.0 59 ecl_lal_4 19 16, 49.0, 0.0 100 cocel_2 23 16, 641.0, 0.0 11 t t_2.3 4.4 31, 1366.2, 0.0 14 t t_2.1 19 31, 1442.0, 0.0 14 ecl_lal_5 19 16, 84.0, 0.0 110 cocel_2 23 16, 641.0, 0.0 13 t t_1 1 19 31, 1442.0, 0.0 14 ecl_lal_5 19 16, 42.4, 0.0 110 cocel_3 23 16, 64.0, 0.0 15 t t_3 19 31, 127.4, 0.0 14 ecl_lal_5 19 16, 42.4, 0.0 110 cocklm_1 0 16, 64.2, 0.0 15 t t_3 19 31, 127.7, 0.0 149 ecl_lal_8 19 16, 141.0, 0.0 111 cocklm_2 0 16, 0.0, 0.0 15 t t_3 1, 157.7, 0.0 149 ecl_lal_1 19 16, 144.5, 0.0 111 cocklm_2 0 16, 0.0, 0.0 17 coce_setive 183 31, 50438.5, 0.0 16 t ecl_lal_1 19 19 16, 140.5, 0.0 111 cocklm_2 0 16, 0.0, 0.0 17 coce_setive 183 31, 50438.5, 0.0 16 t ecl_lal_1 19 19 16, 140.5, 0.0 111 cocklm_2 0 16, 0.0, 0.0 17 coce_setive 183 31, 50438.5, 0.0 16 t ecl_lal_1 11 19 15, 1506.5, 0.0 111 cockup_0 0 15, 156.5, 0.0 110 cockup_0 0 156, 0.0 120 cokupb0 0 17 11 1100.4, 0.0 0 170 100.0 0.0 110 t 0.0 110 cockup_0 0 156.5, 0.0 171 t 0.0 0.0 0.0 0.0 0.0 110 t 0.0 0.0 110 t 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	7	ty_3	47	31,		0.0	55	ecl_lml_0	19	16,	905.2,	0.0	103 c2gev_2	23	16,	5.4,	0.0
19       t <sup>2</sup> / <sub>2</sub> 43       31, 1964.2, 0.0       68       ecl_lal_3       19       16, 197.7, 0.0       0.0       100       cdccel_1       23       15, 461.0, 0.0         11       t2_3       43       11       10       31, 11672.4, 0.0       0.0       60       ecl_lal_5       19       16, 100       0.0       100       eccel_2       23       15, 41.0, 0.0       0.0         14       t1_2       10       31, 11672.4, 0.0       0.0       64       ecl_lal_7       19       16, 42.4, 0.0       100       ecckim_0       15, 40.0, 0.0       0.0         15       t1_3       10       31, 1077, 0.0       0.4       ecl_lal_10       19       16, 100       111       0.0       111       eckim_2       15, 0.0, 0.0       0.0       0.0       0.0       112       eckim_3       156, 0.0, 0.0       0.0	8	t2_0	47	31,		0.0	56	ecl_lml_1	19	16,	119.0,	0.0	104 c2gev_3	23	16,	23.6,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	9	t2_1	47	31,	3995.5,	0.0	57	ecl_lml_2	19	16,	61.4,	0.0	105 cdcecl_0	23	16,	6139.3,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	10	t2_2	43	31,	993.0,	0.0	58	ecl_lml_3	19	16,	97.7,	0.0	106 cdcecl_1	23	16,	401.0,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	11	t2_3	43	31,	1366.2,	0.0	59	ecl_lml_4	19	16,	180.0,	0.0	107 cdcecl_2	23	16,	61.9,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	12	ts_0	19	31,	11872.4,	0.0	60	ecl_lml_5	19	16,	84.9,	0.0	108 cdcecl_3	23	16,	221.2,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	13	ts_1	19	31,	1442.0,	0.0	61	ecl_lml_6	19	16,	72.2,	0.0	109 odoklm_0	Θ	16,	94.2,	0.0
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	14		19			0.0	62	ecl_lml_7	19	16,	42.4,	0.0	110 odoklm_1				0.0
16       6dc_open70       47       31       1678.7       0.0       164       ecl_lnl_3       0       16       0.0       0.0         17       cdc_p254       47       31       604.4       0.0       166       607.40       0.0       113       6dctop_0       0       16.       122.2       0.0         18       cdc_p254       47       31.       604.4       0.0       166       ecl_p1.1       114       cdctop_0       0       16.       322.2       0.0         19       cdc_p254       47       31.       1080.9       0.0       164       126.5       0.0       115       cdctop_2       0       16.       422.2       0.0       0       114       cdctop_3       0       16.       407.1       0.0       0       126.5       0.0       1114       cdctop_3       0       16.       407.1       0.0       0       117.0       0       0.0       0.0       0.0       1117       16.       407.1       0.0       0       0.0       1100       0.0       1100       0.0       0.0       1100       0.0       0.0       1100       0.0       0.0       0.0       0.0       0.0       0.0       0.0	15		19			0.0	63	ecl_lml_8	19	16,	101.8,	0.0	111 cdcklm_2				0.0
17       cdactive       183       31,       6401.5,       0.0       166       ecl_lnl_10       10       16,       146.8,       0.0       111       cdctop_0       0       16,       132,       0.0         19       cdc_b2b5       47       31,       867.3,       0.0       16       ecl_bhauni       19       16,       191.6,       0.0       115       cdctop_2       0       16,       422,       0.0         10       cdc_b2b7       47       31,       1900.0,       0.0       0.6       0.6       0.0       111       0.0       111       0.0       111       0.0<	16	cdc_open90	47			0.0	64	ecl_lml_9	19	16,	244.5,	0.0	112 odoklm_3				0.0
<pre>18 cd_b2b3 47 31, 604.4, 0.0   66 cd_lnl_t1 10 16, 5074.0, 0.0   114 cdctop_1 0 16, 321.2, 0.0 10 cd_b2b5 47 31, 1000.9, 0.0   66 cd_lnnun 19 16, 191.5, 0.0   115 cdctop_3 0 16, 427.1, 0.0 21 cd_b2b9 47 31, 1130.4, 0.0   60 cd_lnnun 19 16, 191.5, 0.0   115 cdctop_3 0 16, 477.1, 0.0 22 chigh 19 16, 744.3, 0.0   70 top_0 0 0, 0.0   10 top_1 0 0, 0.0   114 cdctop_3 0 16, 477.1, 0.0 23 clow 19 16, 1824.4, 0.0   71 top_1 0 0, 0.0   0.0   110 d3 23 16, 375.7, 0.0 24 clum 19 16, 485.2, 0.0   72 top_2 0 0, 0.0, 0.0   110 d3 23 16, 545.3, 0.0 25 ccl_bhs 19 16, 251.9, 0.0   73 top_b0 0 0, 0.0, 0.0   120 d9 23 16, 945.8, 0.0 27 bhs_type_1 19 16, 153.0, 0.0   75 kim_hit 42 31, 0.0, 0.0   122 p5 23 16, 1144.1, 0.0 28 bhs_type_1 19 16, 153.0, 0.0   76 kim_0 42 0, 0.0, 0.0   122 p5 23 16, 1144.1, 0.0 29 bhs_type_3 19 16, 24.9, 0.0   77 kim_1 42 0, 0.0, 0.0   124 p0 23 16, 35152.1, 0.0 30 bhs_type_2 19 16, 42.4, 0.0   77 kim_1 42 0, 0.0, 0.0   124 p0 23 16, 1424.1, 0.0 29 bhs_type_3 19 16, 25.5, 0.0   77 kim_1 42 0, 0.0   0.0   124 p0 23 16, 1424.1, 0.0 30 bhs_type_2 19 16, 42.4, 0.0   77 kim_1 42 0, 0.0   0.0   125 track 36 63, 35152.1, 0.0 31 bhs_type_5 19 16, 44.4, 0.0   79 kim_3 42 0, 0.0, 0.0   125 track 36 63, 35152.1, 0.0 31 bhs_type_5 19 16, 43.0, 0.0   80 kim2b_0 42 0, 0.0, 0.0   127 nimin0 0 0, 3254872.0, 0.0 31 bhs_type_5 19 16, 43.0, 0.0   80 kim2b_0 42 0, 0.0, 0.0   120 minin1 0 0, 3254872.0, 0.0 32 bhs_type_5 19 16, 43.0, 0.0   80 kim2b_0 42 0, 0.0, 0.0   120 minin1 0 0, 3254872.0, 0.0 34 bhs_type_1 19 16, 44.4, 0.0   79 kim_3 42 0, 0.0, 0.0   120 minin1 0 0, 3254872.0, 0.0 34 bhs_type_1 19 16, 44.4, 0.0   80 kim2b_0 42 0, 0.0, 0.0   120 minin1 0 0, 3254872.0, 0.0 35 bhs_type_1 19 16, 43.0, 0.0   80 kim2b_0 42 0, 0.0, 0.0   120 minin1 0 0, 3254872.0, 0.0 34 bhs_type_1 19 16, 43.0, 0.0   80 kim2b_0 42 0, 0.0, 0.0   130 minin3 0 0, 0.200, 0.0, 0.0, 0.0, 0.0, 0.0, 0.</pre>	17	cdc_active	183			0.0	65	ecl_lml_10	19	16,	166.8,	0.0	113 cdctop_0				0.0
19       cd_b2b5       47       31,       667.3,       0.0       67       ccl_bhauni       19       16,       191.6,       0.0       115       cdtcp2_2       0       16,       427.4,       0.0         21       cdc_b2b7       47       31,       11300.4,       0.0       16       ccl_bhapur       19       16,       117.63       0.0       117       cds_c2b_3       0       16,       375.7,       0.0         22       chiph       19       16,       746.3,       0.0       174       top_1       0.0       0.0       0.0       0.0       1118       d5       23       16,       375.7,       0.0         23       clow       19       16,       745.3,       0.0       174       top_2       0       0.0       0.0       119       d7       23       16,       375.7,       0.0         24       clow       19       16,       185.0,       0.0       174       top_2       0       0.0       0.0       0.0       0       0.0       0       0.0       0       0.0       0       0.0       0       0       0       0       0.0       0       0       0.0       0       0.0 <td>18</td> <td></td> <td>47</td> <td></td> <td></td> <td>0.0</td> <td>66</td> <td>ecl_lml_11</td> <td>19</td> <td></td> <td></td> <td>0.0</td> <td></td> <td></td> <td></td> <td></td> <td>0.0</td>	18		47			0.0	66	ecl_lml_11	19			0.0					0.0
19       cd_b2b7       47       11,       1900.0,       0.0       68       ec_bapur       19       16,       124.5,       0.0       117       d3       23       16,       497.1,       0.0         21       cdc_b2b9       47       31,       1130.4,       0.0       17       01.0       0.0       117       d3       23       16,       497.1,       0.0         23       elow       19       16,       191.5,       0.0       117       d3       23       16,       556.3,       0.0         23       elow       19       16,       192.7,       0.0       0.0       0.0       119       d7       23       16,       556.3,       0.0         24       elum       19       16,       120.40       0.0       119       d7       23       16,       170.7,       0.0         25       ecl_bha       19       16,       120.40       0.0       0.0       121.93       23       16,       140.1,       0.0         26       bha_type_1       19       16,       122.97       23       16,       1420.1,       0.0         27       bha_type_1       19       16,       14	19	cdc_b2b5	47			0.0	67	ecl_bhauni	19			0.0					0.0
11       cdc_b2b9       47       31,       1130.4,       0.0       60       ecl_phapur       19       16,       111.5,       0.0       1117       d3       22       16,       575.7,       0.0         22       chigh       19       16,       746.3,       0.0       71       top_1       0       0,       0.0       1118       d5       23       16,       575.7,       0.0         24       clum       19       16,       1824.4,       0.0       71       top_1       0       0,       0.0       1118       d5       23       16,       575.7,       0.0       0.0         25       ccl_bha       19       16,       1824.4,       0.0       72       top_2       0       0,       0.0       121       07       23       16,       143.4       0.0       0.0       122       p5       23       16,       1434.1,       0.0       0.0       122       p5       23       16,       1434.1,       0.0       0.0       124       p0       23       16,       1434.1,       0.0       0.0       125       trainin       0.3       35152.1,       0.0       0.0       125       trainin       0.0	20		47				68										
12       ehigh       19       16,       746.3,       0.0       170       top_0       0.0       0.0       118       d5       23       16,       564.5,       0.0         23       elow       19       16,       1824.4,       0.0       171       top_1       0       0.0	21		47				69										
22       elor       19       16,       1824.4,       0.0       71       top_1       0       0,0       0.0       110       d7       23       16,       700.7,       0.0         24       elum       19       16,       485.2,       0.0       72       top_2       0       0,0       0.0       121       03       23       16,       863.8,       0.0         25       col_bha       19       16,       251.9,       0.0       73       top_abb       0       0,0       122       p5       23       16,       1124.1,       0.0         26       bha_type_0       19       16,       153.0,       0.0       76       klm,hit       42       0,0       0.0       122       p7       23       16,       1420.1,       0.0         29       bha_type_1       19       16,       24.0       0.0       0.0       124       p7       23       16,       163.1,       0.0         29       bha_type_2       19       16,       25.5,       0.0       77       klm,1       42       0,       0.0       125       track       35       35       35       16,       163.15       164, <t< td=""><td>22</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	22																
24       elum       19       16,       485.2,       0.0       72       top_22       0       0,       0.0       120       09       23       16,       983.0,       0.0         25       ecl_bhs       19       16,       251.9,       0.0       73       top_potb       0       0,0       0.0       121       p3       23       16,       917.9,       0.0         27       bha_type_1       19       16,       153.0,       0.0       75       klm,hit       42       31,       0.0       0.0       124       p7       23       16,       1420.1,       0.0         28       bha_type_1       19       16,       124.9,       0.0       76       klm_1       42       0,       0.0       124       p7       23       16,       1420.1,       0.0         29       bha_type_1       19       16,       124.9,       0.0       124       p7       23       16,       1420.1,       0.0         20       bha_type_2       19       16,       35.5,       0.0       78       klm_2       42       0,       0.0       125       trafine       0.3       35152.1,       0.0         31	23								Θ								
25       ccl_bha       19       16,       251.9,       0.0       73       top_bb       0       0,       0.0       121 p3       22       16,       917.9,       0.0         26       bha_veto       0       63,       251.9,       0.0       74       top_active       26       0,       208891.2,       0.0       122 p5       23       16,       1120.1,       0.0         27       bha_type_0       19       16,       153.0,       0.0       75       klm_0       42       0,       0.0,       0.0       125       track       36       63,       35152.1,       0.0         29       bha_type_1       19       16,       24.9,       0.0       0.0       0.0       125       track       36       63,       35152.1,       0.0         20       bha_type_1       19       16,       24.9,       120       0.0       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_5       19       16,       43.0,       0.0       120       nimin1       0,       3254972.0,       0.0         32       bha_type_5       19       16,       38.0,       0.0	24								0								
22       bha_veto       0       63,       251.0,       0.0       74       top_active       26       0,       208891.2,       0.0       122 p5       23       16,       1184.1,       0.0         27       bha_type_1       19       16,       153.0,       0.0       75       klm_hit       42       31,       0.0,       0.0       123 p7       23       16,       1420.1,       0.0         28       bha_type_1       19       16,       122.4,       0.0       0.0       124 p9       23       16,       1434.1,       0.0         29       bha_type_2       19       16,       124.9,       0.0       0.0       125       track       36       63,       35152.1,       0.0         30       bha_type_4       19       16,       44.4,       0.0       124       0.0       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_6       19       16,       38.3,       0.0       18       klm2b2       42       0,       0.0       125       rainin       0       0,       254972.0,       0.0         32       bha_type_6       19       16, <td< td=""><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	25																
27       bha_type_0       19       16,       153.0,       0.0       75       klm_hit       42       31,       0.0,       0.0       123 p7       23       16,       1420.1,       0.0         28       bha_type_1       19       16,       12.4,       0.0       76       klm_0       42       0,       0.0,       0.0       124 p9       23       16,       1424.1,       0.0         29       bha_type_2       19       16,       24.0,       0.0       0.0,       0.0       125 track       36       63,       35152.1,       0.0         30       bha_type_3       19       16,       34.4,       0.0       79       klm_3       42       0,       0.0,       0.0       125 track       36       35152.1,       0.0         31       bha_type_3       19       16,       44.4,       0.0       79       klm_3       42       0,       0.0,       0.0       122 track       36,       35152.1,       0.0         32       bha_type_5       19       16,       38.0       0.0       131       120 minin1       0       0,       3254972.0,       0.0         32       bha_type_5       19       16,	26																
28       bha_type_1       19       16,       12.4,       0.0       76       klm_0       42       0,       0.0,       0.0       124       p9       23       16,       1634.1,       0.0         29       bha_type_2       19       16,       24.9,       0.0       77       klm_1       42       0,       0.0       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_4       19       16,       44.4,       0.0       78       klm_2       42       0,       0.0       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_4       19       16,       44.4,       0.0       79       klm_2       42       0,       0.0       127       nimin0       0,       3254872.0,       0.0         32       bha_type_7       19       16,       43.0,       0.0       82       klm2b_2       42       0,       0.0,       0.0       129       nimin1       0,       3254872.0,       0.0       0.0       0.0       129       nimin1       0,       3254872.0,       0.0       0.0       0.0       120       nimin1 <td< td=""><td>27</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>	27																
29       bha_type_2       19       16,       24.9,       0.0       77       klm_1       42       0,       0.0,       0.0       125       track       36       63,       35152.1,       0.0         30       bha_type_3       19       16,       35.5,       0.0       78       klm_2       42       0,       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_4       19       16,       44.4,       0.0       78       klm_2       42       0,       0.0       125       track       36       63,       35152.1,       0.0         31       bha_type_5       19       16,       44.4,       0.0       78       klm21       42       0,       0.0       125       trainin       0       0,       3254872.0,       0.0         32       bha_type_6       19       16,       42.0,       0.0       0.0       129       nimin1       0       0,       3254872.0,       0.0         34       bha_type_7       19       16,       62.6,       0.0       83       klm2b_2       42       0,       0.0       130       nimin3       0       0,       5167	28																
39       bha_type_3       19       16,       35.5,       0.0       78       klm_2       42       0,       0.0,       0.0       126       trkflt       0       63,       35152.1,       0.0         31       bha_type_4       19       16,       44.4,       0.0       78       klm_3       42       0,       0.0       127       nimind       0       0,       3254872.0,       0.0         32       bha_type_5       19       16,       43.0,       0.0       88       klm2b_0       42       0,       0.0,       0.0       122       nimin1       0       0,       3254872.0,       0.0         34       bha_type_7       19       16,       62.6,       0.0       82       klm2b_1       42       0,       0.0,       0.0       129       nimin1       0       0,       3254872.0,       0.0         34       bha_type_7       19       16,       62.6,       0.0       82       klm2b_2       42       0,       0.0,       120       nimin2       0,       51670.3,       0.0       0.0         35       bha_type_10       19       16,       79.1,       0.0       85       ler_kick       0,	29																
31       bha_type_4       19       16,       44.4,       0.0       79       klm_3       42       0,       0.0,       0.0       127       nimin0       0       0,       3254972.0,       0.0         32       bha_type_5       19       16,       43.0,       0.0       90       klmb2b_0       42       0,       0.0,       0.0       129       nimin1       0       0,       3254972.0,       0.0         33       bha_type_5       19       16,       38.0,       0.0       91       klmb2b_1       42       0,       0.0,       0.0       129       nimin1       0       0,       3254972.0,       0.0         34       bha_type_6       19       16,       38.0,       0.0       92       klmb2b_2       42       0,       0.0,       0.0       119       nimin3       0       0,       516703,       0.0         35       bha_type_8       19       16,       58.0,       0.0       93       revo       0       0,       0.0       131       tsf0b2b       0,       190266.7,       0.0         36       bha_type_10       19       16,       79.1,       0.0       95       1er_kick       0	30																
32       bha_type_5       19       16,       43.0,       0.0       90       klmb2b_0       42       0,       0.0,       0.0       128       nimin1       0       0,       3254872.0,       0.0         33       bha_type_6       19       16,       38.3,       0.0       81       klmb2b_1       42       0,       0.0,       0.0       129       nimin1       0       0,       3254872.0,       0.0         34       bha_type_6       19       16,       38.3,       0.0       81       klmb2b_1       42       0,       0.0,       0.0       130       nimin1       0       0,       0.0,       0.0         34       bha_type_7       19       16,       58.6,       0.0       82       klmb2b_2       42       0,       0.0,       0.0       130       nimin1       0       0,       5670.3,       0.0         36       bha_type_9       19       16,       81.1,       0.0       84       her_kick       0       0,       0.0,       0.0       132       eklmb1it       0       0,       531.6,       0.0         38       bha_type_11       19       16,       102.6,       0.0       88	31																
33       bha_type_6       19       16,       38.3,       0.0       81       klmb2b_1       42       0,       0.0,       129       nimin2       0       0,       0.0,       0.0,         34       bha_type_7       19       16,       62.6,       0.0       82       klmb2b_2       42       0,       0.0,       0.0       130       nimin3       0       0,       51670.3,       0.0         35       bha_type_8       19       16,       58.6,       0.0       83       revo       0       0,       1.10,       0.0       131       tsf0b2b       0       0,       7531.1,       0.0         36       bha_type_9       19       16,       81.1,       0.0       84       her_kick       0,       0.0,       0.0       133       eklm_hit       0,       7531.1,       0.0         37       bha_type_10       19       16,       102.0,       0.0       85       ler_kick       0,       0.232.3,       0.0       133       eklm_11       0,       520.2,       0.0         38       bha_type_11       19       16,       102.6,       0.0       85       pseud_rand       0,       0.4,       0.0       1	32													à			
34       bha_type_7       19       16,       62.6,       0.0       82       klmb2b_2       42       0,       0.0,       130       nimin3       0       0,       51670.3,       0.0         35       bha_type_8       19       16,       58.6,       0.0       83       revo       0       0,       1.0,       0.0       131       tsf0b2b       0       0,       190266.7,       0.0         36       bha_type_9       19       16,       81.1,       0.0       84       her_kick       0       0.0,       0.0       132       eklm_hit       0       0,       7531.1,       0.0         37       bha_type_10       19       16,       79.1,       0.0       85       ler_kick       0       0,       6.3,       0.0       133       eklm_11       0       0,       531.6,       0.0         38       bha_type_11       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.6,       0.0       135       eklm_11       0       0,       520.2,       0.0         39       bha_type_13       19       16,       132.6,       0.0       135       eklm23       0,	33													à			
35       bha_type_8       19       16,       58.6,       0.0       83       revo       0       0,       1.0,       0.0       131       tsf0b2b       0       0,       190266.7,       0.0         36       bha_type_9       19       16,       81.1,       0.0       84       her_kick       0       0,       0.0       132       eklm_hit       0       0,       7531.1,       0.0         37       bha_type_10       19       16,       79.1,       0.0       85       ler_kick       0       0,       6.3,       0.0       133       eklm_bit       0       0,       531.6,       0.0         38       bha_type_11       19       16,       102.0,       0.0       86       bha_delay       0       0,       232.3,       0.0       134       eklm_11       0       0,       520.2,       0.0         39       bha_type_12       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.6,       0.0       134       eklm_21       0       0,       202.2,       0.0         40       bha_type_13       19       16,       134.6,       0.0       88       plsin	34																
36       bha_type_9       19       16,       81.1,       0.0       84       her_kick       0       0,       0.0,       132       eklm_hit       0       0,       7531.1,       0.0         37       bha_type_10       19       16,       79.1,       0.0       85       ler_kick       0       0,       6.3,       0.0       133       eklm_hit       0       0,       531.6,       0.0         38       bha_type_11       19       16,       102.0,       0.0       86       bha_delay       0       0,       232.3,       0.0       133       eklm_11       0       0,       520.2,       0.0         39       bha_type_12       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.6,       0.0       135       eklm_21       0       0,       30.7,       0.0         40       bha_type_13       19       16,       134.6,       0.0       88       plsin       0       0,       0.2,       0.0       135       eklm_20       0       0,       172.3,       0.0         41       clst_0       19       16,       39161.5,       0.0       90       veto	35																
37       bha_type_10       19       16,       79.1,       0.0       95       ler_kick       0       0,       6.3,       0.0       133       eklm_00       0       0,       531.6,       0.0         38       bha_type_11       19       16,       102.0,       0.0       86       bha_delay       0       0,       232.3,       0.0       134       eklm_11       0       0,       520.2,       0.0         39       bha_type_12       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.6,       0.0       135       eklm_22       0       0,       30.7,       0.0         40       bha_type_13       19       16,       134.6,       0.0       88       plsin       0       0,       1.0,       0.0       135       eklm_3       0       0,       2.8,       0.0         41       clst_0       19       16,       39161.5,       0.0       89       poissonin       0       0,       6.316.1,       0.0       138       eklmb2b_0       0       0,       172.3,       0.0         42       clst_1       19       16,       2943.9,       0.0       90       <	36																
38       bha_type_11       19       16,       102.0,       0.0       86       bha_delay       0       0,       232.3,       0.0       134       eklm_1       0       0,       520.2,       0.0         39       bha_type_12       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.0       135       eklm_2       0       0,       30.7,       0.0         40       bha_type_13       19       16,       134.6,       0.0       88       plsin       0       0,       1.0,       0.0       135       eklm_3       0       0,       2.8,       0.0         41       clst_0       19       16,       39161.5,       0.0       89       poissonin       0       0,       0.2,       0.0       137       eklmb2b_0       0       0,       172.3,       0.0         42       clst_1       19       16,       2943.9,       0.0       90       veto       0       0,       6316.1,       0.0       138       eklmb2b_11       0       0,       29.5,       0.0         43       clst_2       19       16,       328.2,       0.0       91       samhem       31 </td <td></td> <td>_</td> <td></td> <td></td>															_		
39       bha_type_12       19       16,       102.6,       0.0       87       pseud_rand       0       0,       0.6,       0.0       135       eklm_22       0       0,       30.7,       0.0         40       bha_type_13       19       16,       134.6,       0.0       88       plsin       0       0,       1.0,       0.0       136       eklm_3       0       0,       2.8,       0.0         41       clst_0       19       16,       39161.5,       0.0       89       poissonin       0       0,       0.2,       0.0       137       eklmb2b_0       0       0,       172.3,       0.0         42       clst_1       19       16,       2943.9,       0.0       90       veto       0       0,       6316.1,       0.0       138       eklmb2b_1       0       0,       29.5,       0.0         43       clst_2       19       16,       328.2,       0.0       91       samhem       31       16,       1335.1,       0.0       139       eklmb2b_2       0       0,       11.4,       0.0         44       clst_3       19       16,       239.0,       0.0       92       opohem <td></td>																	
40       bha_type_13       19       16,       134.6,       0.0       88       plsin       0       0,       1.0,       0.0       136       eklm_3       0       0,       2.8,       0.0         41       clst_0       19       16,       39161.5,       0.0       89       poissonin       0       0,       0.2,       0.0       137       eklmb2b_0       0       0,       172.3,       0.0         42       clst_1       19       16,       2943.9,       0.0       90       veto       0       0,       6316.1,       0.0       138       eklmb2b_1       0       0,       29.5,       0.0         43       clst_2       19       16,       328.2,       0.0       91       samhem       31       16,       1335.1,       0.0       139       eklmb2b_2       0       0,       11.4,       0.0         44       clst_3       19       16,       239.0,       0.0       92       opohem       31       16,       1507.8,       0.0       140       tsf1b2b       0       0,       341322.2,       0.0         45       ecl_bg_0       19       16,       5.3,       0.0       93       n1gev_0 </td <td></td>																	
41 clst_0       19 16, 39161.5,       0.0       89 poissonin       0       0, 0.2,       0.0       137 eklmb2b_0       0       0, 172.3,       0.0         42 clst_1       19 16, 2943.9,       0.0       90 veto       0       0, 6316.1,       0.0       138 eklmb2b_1       0       0, 29.5,       0.0         43 clst_2       19 16, 328.2,       0.0       91 samhem       31 16, 1335.1,       0.0       139 eklmb2b_2       0       0, 11.4,       0.0         44 clst_3       19 16, 239.0,       0.0       92 opohem       31 16, 1507.8,       0.0       140 tsf1b2b       0       0, 341322.2,       0.0         45 ecl_bg_0       19 16, 5.3,       0.0       93 nlgev_0       23 24, 64.7,       0.0       141 tsf2b2b       0       0, 469221.9,       0.0         46 ecl_bg_1       19 16, 3635.7,       0.0       94 nlgev_1       23 24, 7.7,       0.0       141 tsf2b2b       0       0, 469221.9,       0.0																	
42       clst_1       19       16,       2943.9,       0.0       90       veto       0       0,       6316.1,       0.0       138       eklmb2b_1       0       0,       29.5,       0.0         43       clst_2       19       16,       328.2,       0.0       91       samhem       31       16,       1335.1,       0.0       139       eklmb2b_2       0       0,       11.4,       0.0         44       clst_3       19       16,       239.0,       0.0       92       opohem       31       16,       1507.8,       0.0       140       tsf1b2b       0       0,       341322.2,       0.0         45       ecl_bg_0       19       16,       5.3,       0.0       93       n1gev_0       23       24,       64.7,       0.0       141       tsf2b2b       0       0,       469221.9,       0.0         46       ecl_bg_1       19       16,       3635.7,       0.0       94       n1gev_1       23       24,       7.7,       0.0       0       0.0       0.0       0.0       0.0       0.0																	
43 clst_2       19 16,       328.2,       0.0       91 samhem       31 16,       1335.1,       0.0       139 eklmb2b_2       0 0,       11.4,       0.0         44 clst_3       19 16,       239.0,       0.0       92 opohem       31 16,       1507.8,       0.0       140 tsf1b2b       0 0,       341322.2,       0.0         45 ecl_bg_0       19 16,       5.3,       0.0       93 nlgev_0       23 24,       64.7,       0.0       141 tsf2b2b       0 0,       469221.9,       0.0         46 ecl_bg_1       19 16,       3635.7,       0.0       94 nlgev_1       23 24,       7.7,       0.0       0.0																	
44 clst_3       19 16,       239.0,       0.0       92 opohem       31 16,       1507.8,       0.0       140 tsf1b2b       0 0,       341322.2,       0.0         45 ecl_bg_0       19 16,       5.3,       0.0       93 n1gev_0       23 24,       64.7,       0.0       141 tsf2b2b       0 0,       469221.9,       0.0         46 ecl_bg_1       19 16,       3635.7,       0.0       94 n1gev_1       23 24,       7.7,       0.0       0.0																	
45       ecl_bg_0       19       16,       5.3,       0.0       93       n1gev_0       23       24,       64.7,       0.0       141       tsf2b2b       0       0,       469221.9,       0.0         46       ecl_bg_1       19       16,       3635.7,       0.0       94       n1gev_1       23       24,       7.7,       0.0       0.0																	
46 ecl_bg_1 19 16, 3635.7, 0.0 94 n1gev_1 23 24, 7.7, 0.0																	
														Ŷ	41		
		***=*8=*		241	4.4.4.4.41	919	1 14				0.41	414					

```
i: input instant rates, I: input instant counts
j: input average rates, J: input total counts
  ftd
        instant rates, P: psn
                                 instant counts
        average rates, O: psn
                                 total counts
g; general info
RUNNING
exp(8),run(2630),subrun(0)
gd10070t.mcs
GDL0072i_non fmt=(2,31,21),(2,20,16),(3,31,28).(non,col,cos,std)
timsrc(6,14,10):random(on),psn(off),top(off),ecl(on),cdc(off)
required(1,30,24):grl(on),top(off),ecl(on),etf(off),klm(on),kle(off),t3d(off)
sublinkstat(rdy):GRL_ECL_KLM
delayed_bha cycle=0
top_inp_dly(16,26,18)=160
ecl_inp_dly(16,17,9)=19
cdc_inp_dly(16, 8, 0)=160
top_rvc_offset(8,29,20)=569
ecl_rvc_offset(8,19,10)=350
cdc_rvc_offset(8, 9, 0)=560
top_rvc_diff=0
eol_rvo_diff=5
                   <- should be 4 to 6
odo_rvo_diff=0
```

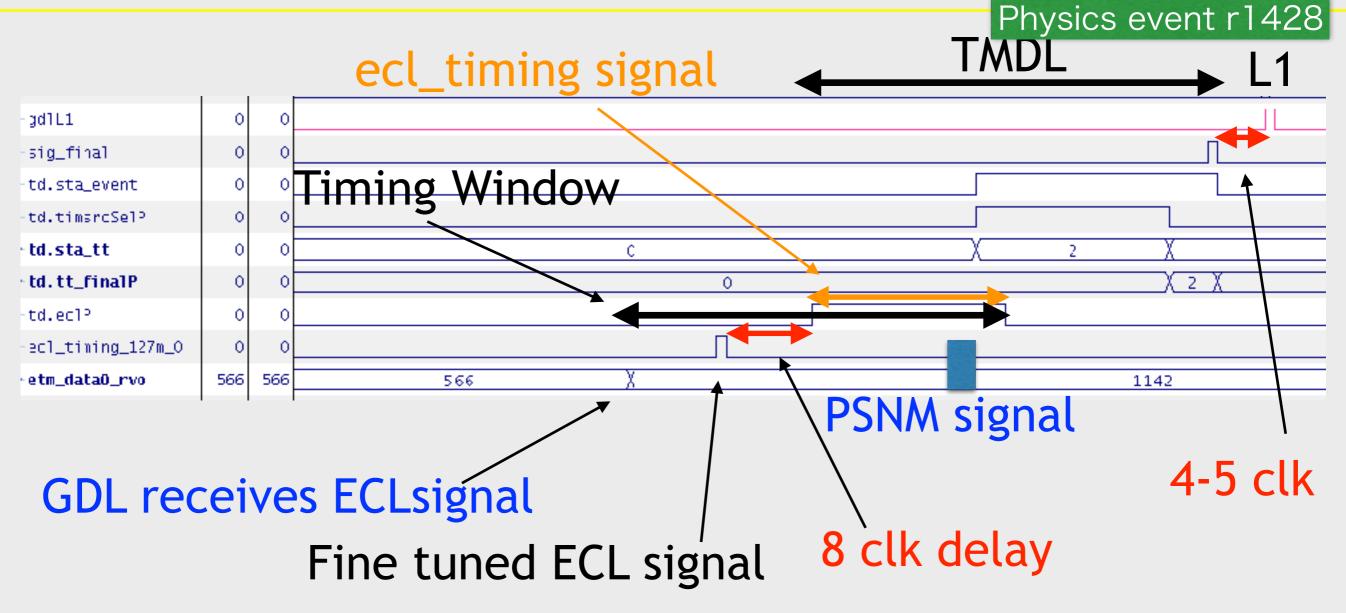
```
TOP:lane(up), txdst(up), txsrc(up), rxsrc(up), rdreq(up), fifoemp(down)
ETM:link(up), txdst(up), txsrc(up), rxsrc(up), rdreq(up), fifoemp(down)
tmdl_busy_length(12,23,0)=0,b21_buffer_delay(6,9,1)=5
```

		raw count,	raw rate ali	ve count,	alive rate to	ot raw ont,	ave raw rate tot	alv ont,	ave alv rate
0	commonL1	12180,	1819.7	Θ,	0.0	22320303,	1833.2	Θ,	0.0
1	gdlL1	12299,	1837.5	Θ,	0.0	22604005,	1856.5	Θ,	0.0
2	top_timing	Θ,	0.0	Θ,	0.0	Θ,	0.0	Θ,	0.0
3	eol_timing	12282,	1834.9	Θ,	0.0	22580181,	1854.6	Θ,	0.0
4	odo_timing	Θ,	0.0	Θ,	0.0	Θ,	0.0	Θ,	0.0
5	psn_timing	Θ,	0.0	θ,	0.0	Θ,	0.0	Θ,	0.0
6	rnd_timing	17,	2.5	Θ,	0.0	23824,	2.0	Θ,	0.0
7	dph_timing	Θ,	0.0	Θ,	0.0	Θ,	0.0	Θ,	0.0
8	ika	Θ,	0.0	Θ,	0.0	Θ,	0.0	Θ,	0.0
9	tako	θ,	0.0	Θ,	0.0	Θ,	0.0	Θ,	0.0
10	interval	6.7							
11	duration	12175.5							

### **PSNM vs Timing signal**

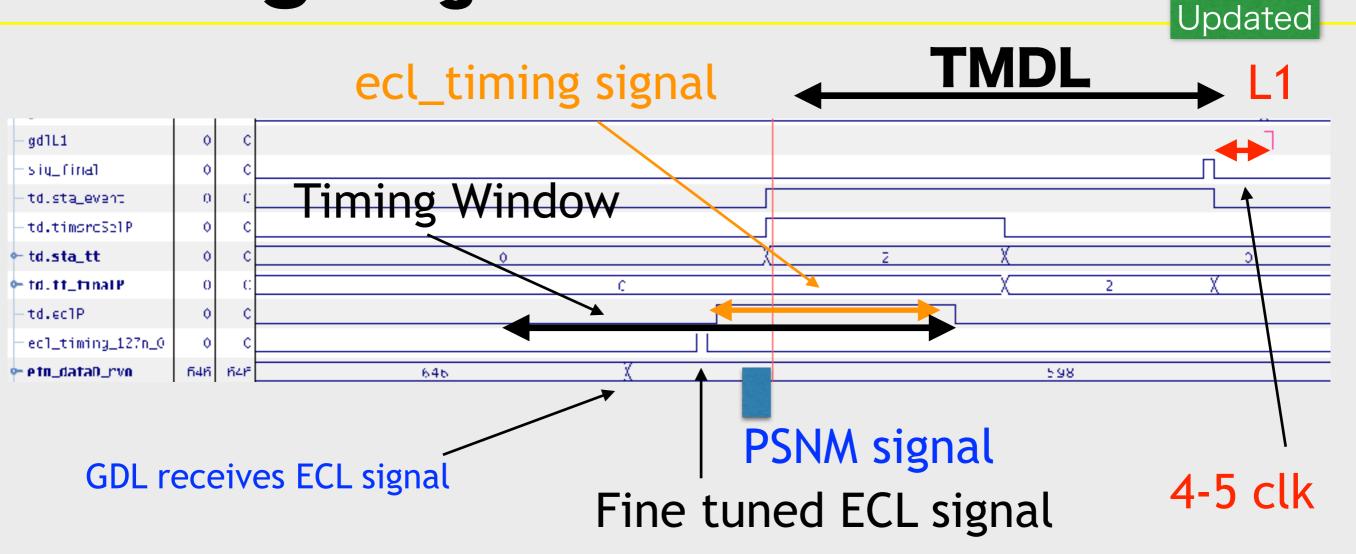


### **Timing Adjustment in TMDL**



- No room to extend timing window to future direction
- No room to shift PSNM(fff) signal to past direction because delay of corresponding input bits t2(n) were 0.
- t2(n): GRL->GDL via GTH. Use LVDS instead of GTH.

### **Timing Adjustment in TMDL**



- Using LVDS, latency reduced by 61 clocks.
  - fff distribution will be check when physics.
- Timing window is extended to past direction.
- Sunghyun can reduce ecl\_timing latency by ~10 clocks.

## **Trigger Bits**

- Input 141 bits, output 146 bits
- Exp 7 <u>https://confluence.desy.de/display/BI/Trigger+Bit+Table+for+Exp+7</u>
- Exp 8 <u>https://confluence.desy.de/display/BI/TriggerBitTable</u>