

OEC status

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OEC SW

Goal: Compress raw data (~ 40GB/s) from front electronics to 60 MB/s and be implemented in DAQ

✓ 7 updated versions have been tested in DAQ, since the last CM, currently 0.2.19 can run stably.

See details of update in later Yu Peng and Xing Wen's talk

OEC can support:

- 1) Reuse offline reconstruction/classification algorithms
- 2) Store waveform for certain event type which need save waveform
- 3) Store 100 ns rise edge of waveform for muon
- 4) Store waveform randomly (pre-scale) based on event type and energy / vertex
- 5) Monitoring plots (muon events rate, energy spectrum, vertex distribution ...)
- 6) Multi-threading (inter-event, intra-event, and inside-algorithm levels of concurrency)

Need more development and study

Version 0.2.13 (junosw add firedPMTs info)
Version 0.2.14 (change shared library path)
Version 0.2.15 (add Global scale function)
Version 0.2.16 (Add save mode configuration)
Version 0.2.17 (Fix the multi-threading bug)
Version 0.2.18 (Resolve memory leak issue)
Version 0.2.19 (Change log level)

Updated criteria / waveform menu for CD

Singles @LOEC: run on parallel nodes	
Type/Energy range	Waveform of fired
< 0.8 MeV	no
(0.8, 2) MeV	R<15 m
(2, 5) MeV	R<16.5 m
(5, 20) MeV	always
(20, 100) MeV	no
SN	As much as possible
Calibration	Non-moving source
Unable to decide	Save all WF
Option	Save WF randomly

Pairs @HOEC: operate based on LOEC inputs							
Type	Ep, MeV	Ed, MeV	ΔR , m	Δt	WF prompt	WF delayed	
IBD	0.5–100	1–12	<3.5	<2 ms	All PMTs	All PMTs	
Michel e	>100	12–60	<2 (track)	<20 μ s	Risied edge (fired)	Fired PMTs ($\Delta t > 7 \mu$ s)	
Spallation n	>100	1–12	–	<2 ms		Fired PMTs ($\Delta t > 8 \mu$ s)	
^{12}B	>100	1–20	–	2ms~1s	Risied edge (fired)	Fired PMTs ($\Delta t > 8 \mu$ s)	

Tracks	Energy	Waveform of fired
Non-shower muon	(100 MeV, 10 GeV)	Rising edge
Shower muon	>10 GeV	Yes
Afterpulses		No
Atmospheric ν	>100 MeV	Yes

- Updated criteria based on comments from discussion meeting with solar/reactor/atmospheric
- The events that do not save waveforms can randomly save waveforms based on event type and energy/vertex
 - ✓ Studying external background or detector response.
 - ✓ Tuning algorithms

Current OEC performance

➤ Data sample:

Mixed data with muon, radio and IBD (realistic event rates)

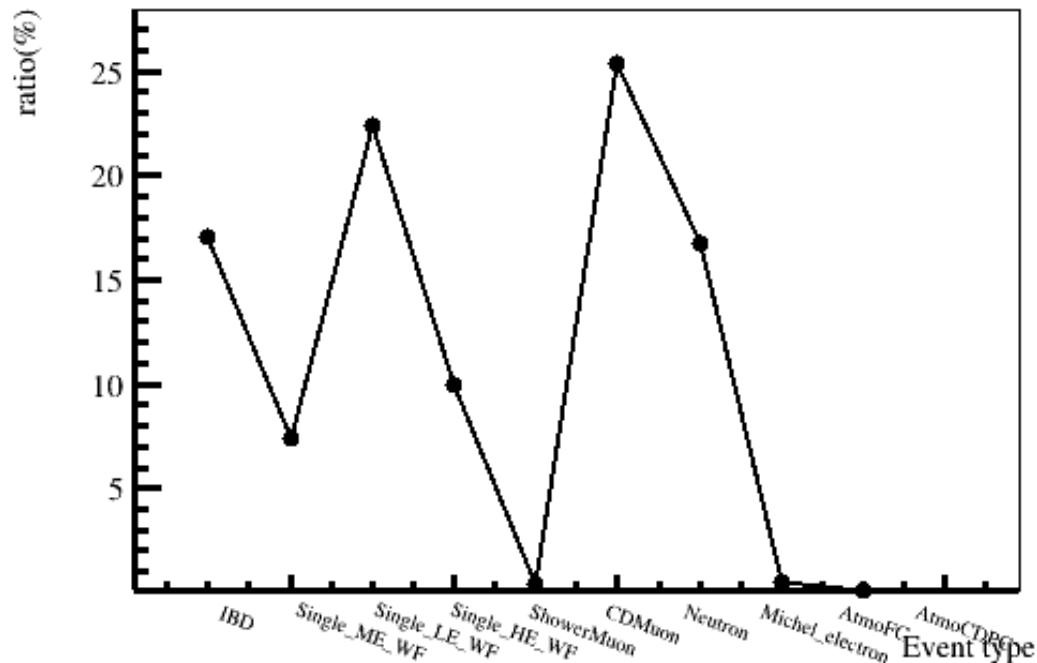
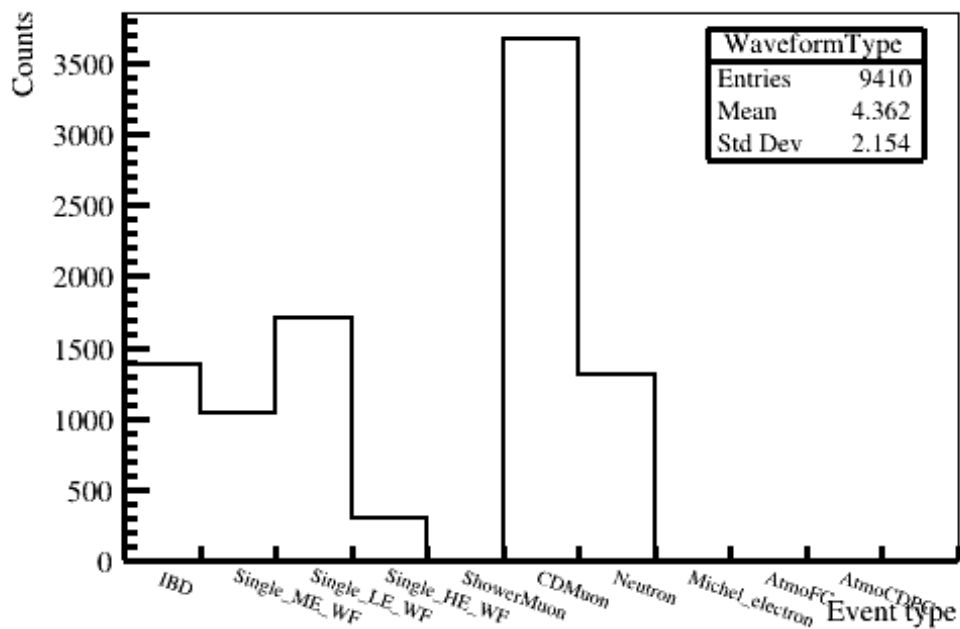
➤ JUNOSW version `--Trigger_FiredPmtNum 160 --nHitsThreshold 155`

J23.1.0.rc8 Elecsim (1kHz with low trigger threshold) + J24.1.1

OEC (Next plan, use J24 detsim data sample)

➤ Data size results (with zero compression)

Stream	Mean (MB/s)	Event rates (Hz)
CD LPMT Waveform	~ 102.5 (53.1%)	11.6
CD LPMT TQ	~ 79.4 (41.1%)	994.8
SPMT TQ	~ 10.9 (6%)	
WPLPMTTQ	~ 0.1 (0.3%)	58.8
OEC	~ 0.1 (0.3%)	1057
Total	~ 193	1057
After lossless compression (~2.5)	~ 77.2	-



Current OEC performance

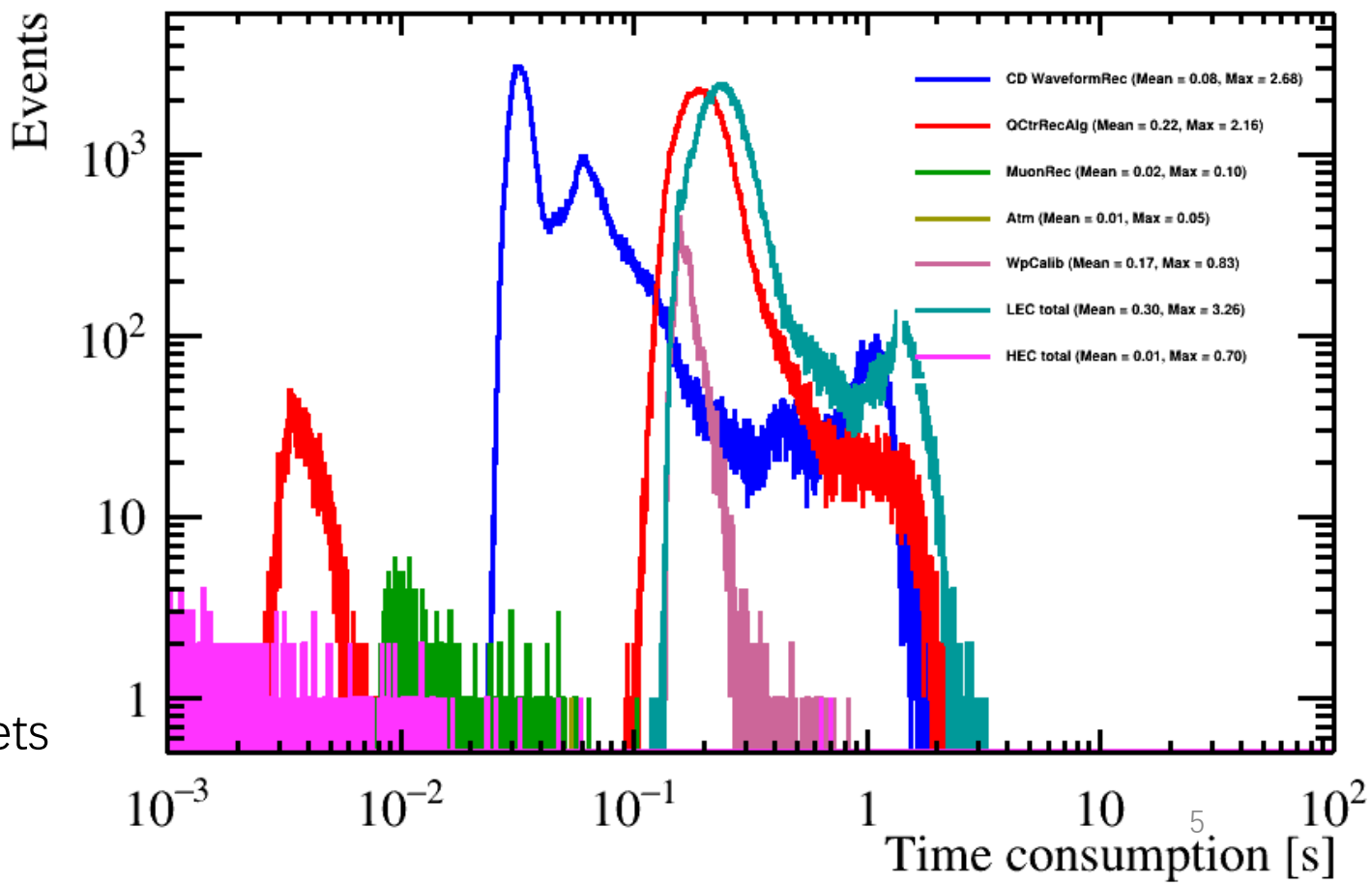
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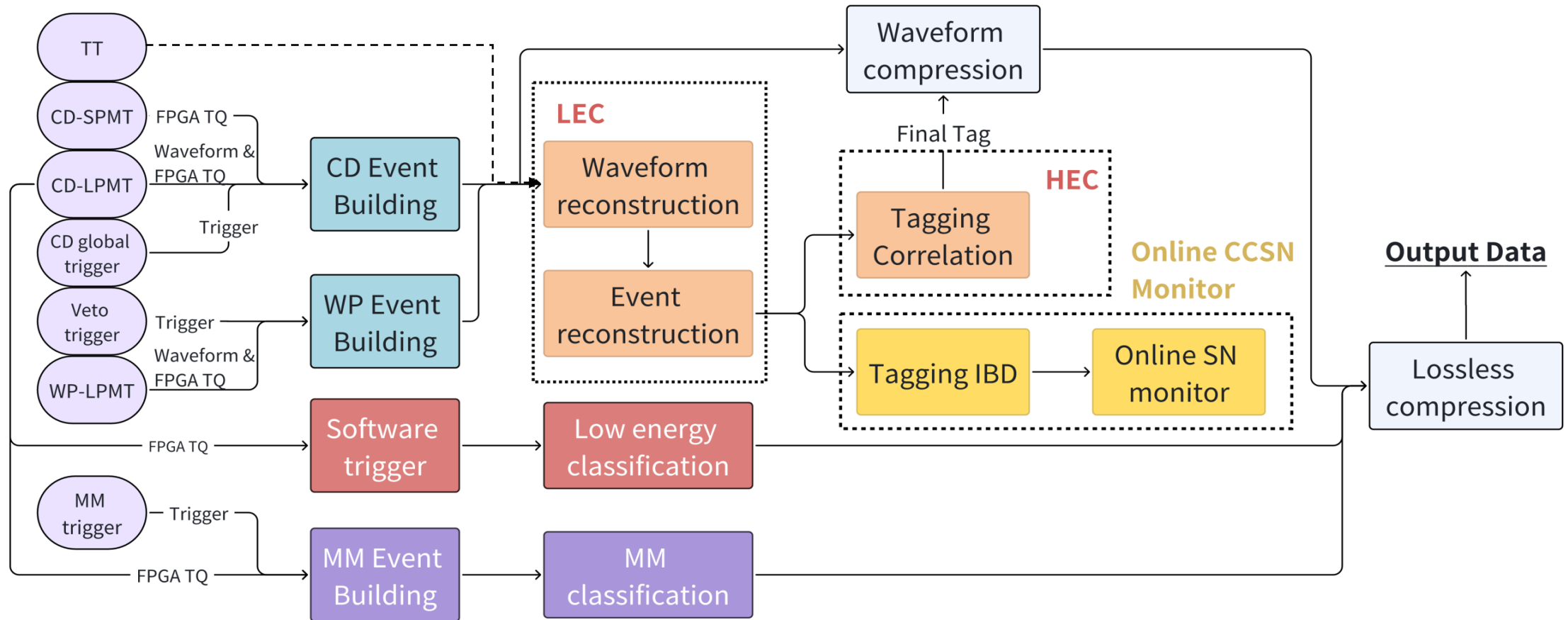
J23.1.0.rc8 Elecsim (1kHz with low trigger threshold) + J24.1.1 OEC (Next plan, use J24 detsim data sample)

	Mean (s)	Max (s)
CD Waveform recon.	0.08	2.68
WP Waveform recon.	0.17	0.83
Energy/vertex	0.22	2.16
Muon track	0.02	0.1
Atmo. classification	0.01	0.05
LEC total	0.3	3.25
HEC total	0.01	0.7



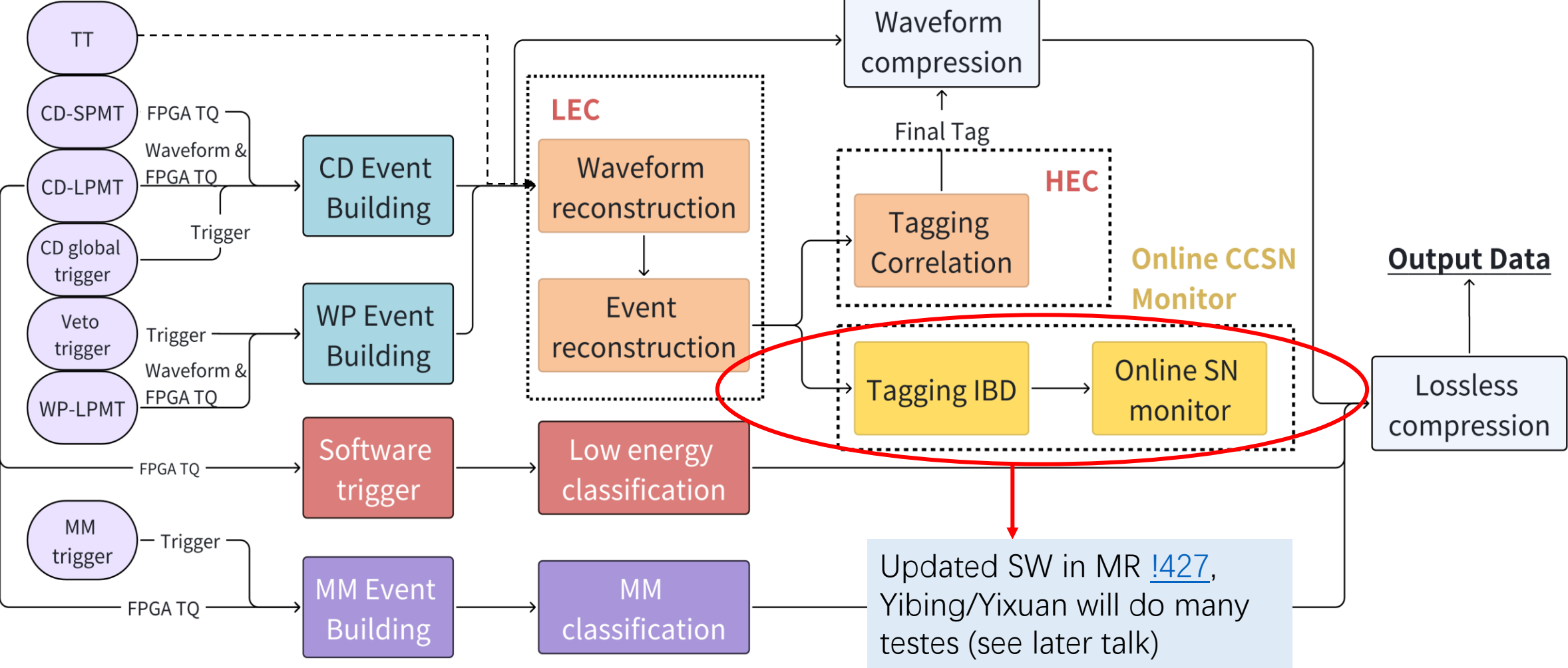
- The average consumption time basically meets the requirements

Online data stream

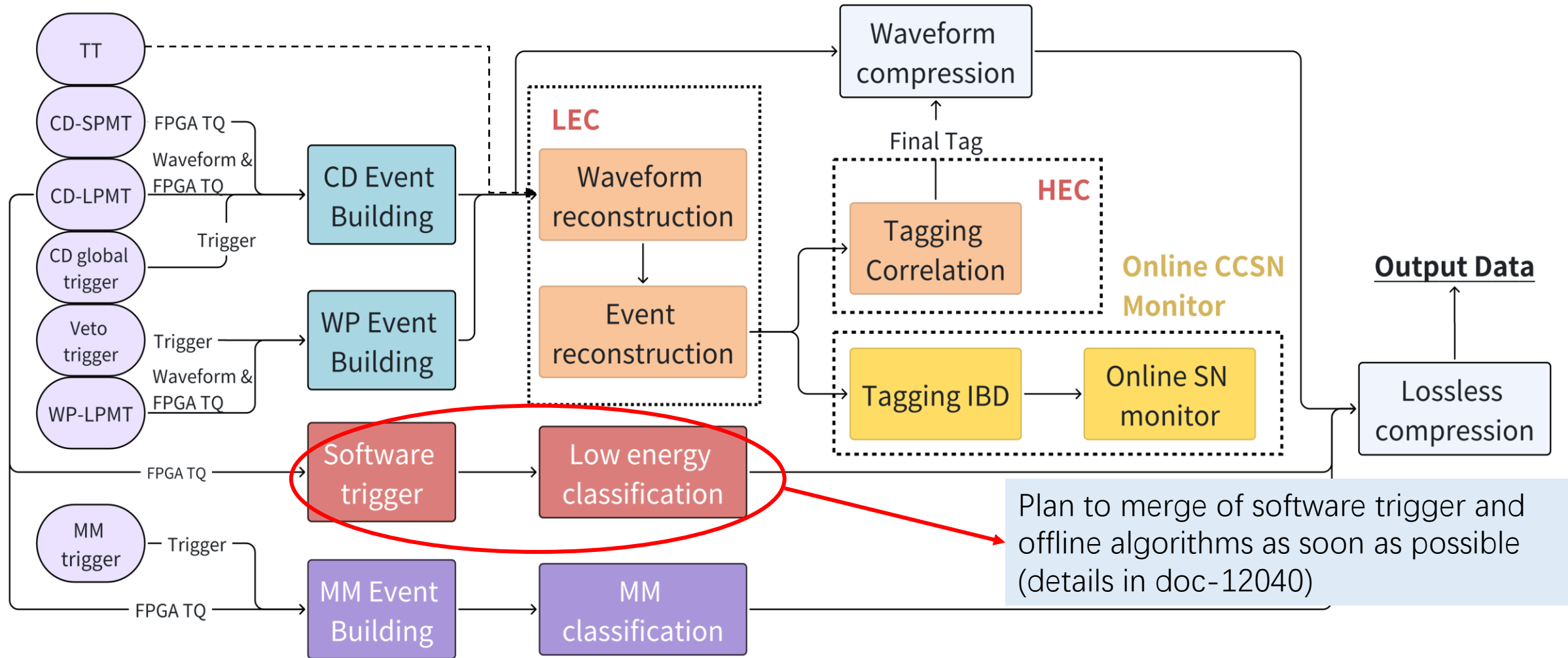


- The online SN monitor will use the IBD events tagged by OEC to give alerts.
- OEC will handle the data just like a normal physical event, regardless of whether an SN occurs or whether there is an alert from prompt monitor or MM monitor.
- Considering GCU only outputs high-gain TQ, the OEC must reconstruct the waveform for the low-gain

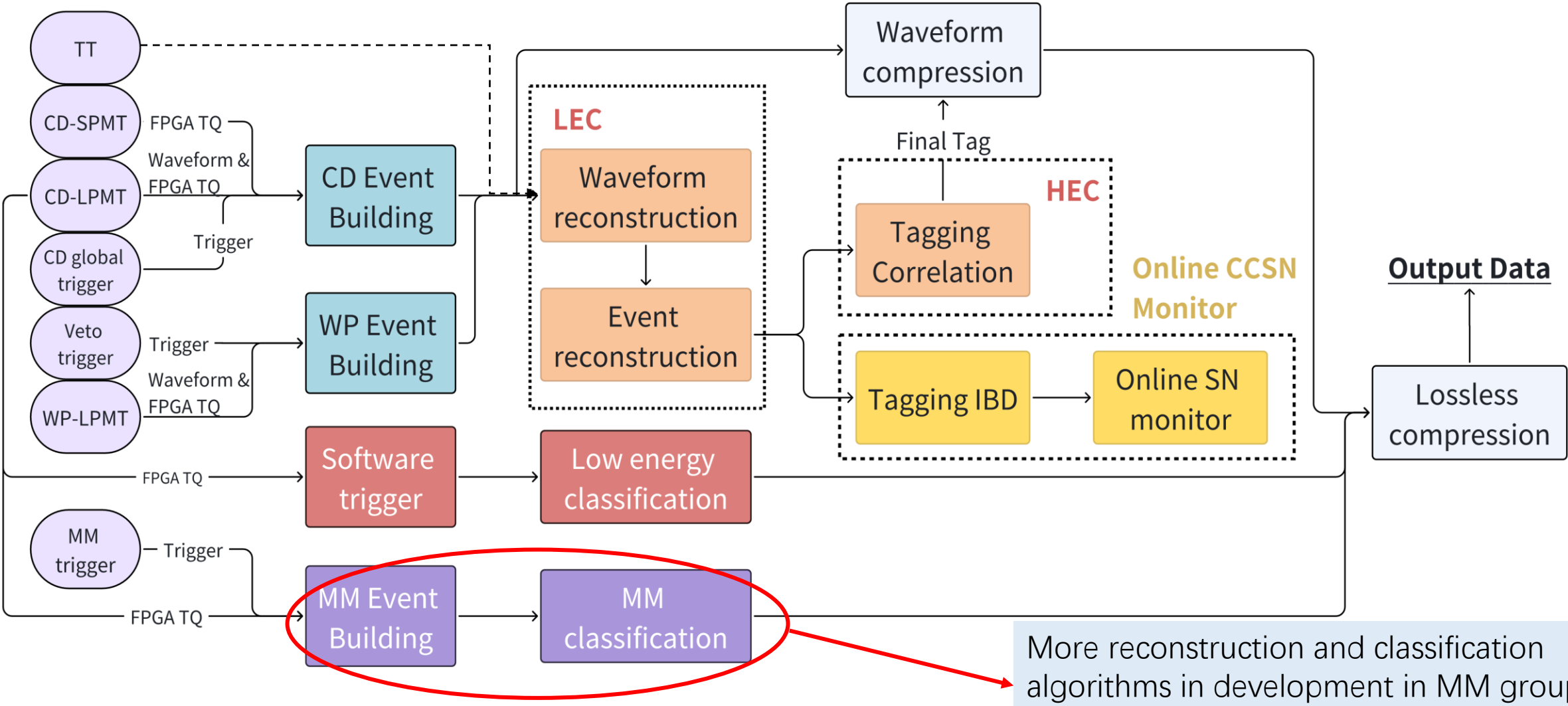
Online data stream



Online data stream



Online data stream



OEC task

OEC task list

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	Group	ID	Task group	Task type	Task title	Minimum required level	Assignee 1	Assignee 2	Assignee 3	#	Supervisor	Institution	In progress	Done	Priority (1-highest)	Task description	Points/Duration	Points obtained
8	OEC	7	Reconstruction	Testing	Test multithreading: New MtSniper	developer				0			<input type="checkbox"/>	<input type="checkbox"/>	2	Modify the muon track rec algorithm to adapt to the new framework (RecCdMuonAlg)	1	
41	OEC	13	Validation and testing	Testing	Compare online and offline algorithms performance on MC data	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	waveform rec.	1	
14	OEC	16	Validation and testing	Testing	Compare online and offline algorithms performance on MC data	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	muon track rec.	1	
15	OEC	17	Validation and testing	Commissioning	Compare online and offline algorithms performance on commissioning data	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	waveform rec.	1	
16	OEC	21	Software Configuration	Commissioning	Provide extra OEC configurations	student				0			<input type="checkbox"/>	<input type="checkbox"/>	2	Estimate event rate and data rate during dry run	1	
26	OEC	31	Validation and testing	Testing	Tagging efficiency	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Muon	1	
28	OEC	33	Validation and testing	Testing	Tagging efficiency:TQ OECWFRec↔FPGA (COTI) comparison	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Atmospheric neutrino	1	
29	OEC	34	Validation and testing	Testing	Tagging efficiency:TQ OECWFRec↔FPGA (COTI) comparison	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Spallation neutron and ¹² B	1	
30	OEC	35	Validation and testing	Testing	Tagging efficiency:TQ OECWFRec↔FPGA (COTI) comparison	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Muon	1	
32	OEC	37	Validation and testing	Testing	Tagging efficiency: Abnormal condition	student				0			<input type="checkbox"/>	<input type="checkbox"/>	2	Increased radioactivity rate	1	
35	OEC	40	Reconstruction	Development	Atmospheric classification	student				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Water pool	1	
37	OEC	43	Software trigger	Development	Develop software trigger algorithm in DAQ during water phase	developer				0			<input type="checkbox"/>	<input type="checkbox"/>	2	Software trigger to remove DN if we need to lower threshold	1	
40	OEC	46	Calibration	Development	Optimizing existing HEC correlation analysis	developer				0			<input type="checkbox"/>	<input type="checkbox"/>	1	Remove the calibration events	1	
41	OEC	48	Reconstruction	Testing	Evaluation: Algorithm replacement					0			<input type="checkbox"/>	<input type="checkbox"/>	2	Energy↔NHit or totalPE	1	
42	OEC	49	Reconstruction	Testing	Evaluation: Algorithm replacement					0			<input type="checkbox"/>	<input type="checkbox"/>	2	Vertex↔Center of charge	1	
43	OEC	50	Reconstruction	Development	Optimizing the waveform steering method	developer				0			<input type="checkbox"/>	<input type="checkbox"/>	2	Optimizing OECWFRec, use the difference between the baseline before and after the waveform to perform steering	1	
66	OEC	80	Reconstruction	Development	muon track reconstruction and classification	developer				0			<input type="checkbox"/>	<input type="checkbox"/>		develop muon track reconstruction and	2	



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- Close data taking, **need more carefully to check and optimize** reconstruction/classification performance
- Provide more WF storage configurations in case of unexpected situations (increased radioactivity level)

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Welcome to join us to ensure that OEC is robust and reliable

- Lots of task has not been claimed
- Close data taking, **need more carefully to check and optimize** reconstruction/classification performance
- Provide more WF storage configurations in case of unexpected situations (increased radioactivity level)

Needs

- Waveform storage strategy during commissioning has been proposed in commissioning workshop before some days
[See details in doc-11984](#)
- Light-on test expected will be done around July 10th with OEC on DAQ server

If you have any needs for waveform storage during water filling or LS filling or full LS, please contact us as soon as possible