CDCTRG firmware

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- To do list for each CDCTRG module
 - To be done in 1 month
 - Longer-term plan

• Latency issue



- H033d_s is basically stable for phase3. Most of the functionalities have been prepared in this version.
- H033d_s \rightarrow H033f_s: 15 TS version.
 - Cosmic test at the next week.
 - Guideline for compilation: I hope Kai can take over the compilation work. https://confluence.desy.de/download/attachments/98077342/20190821_TSF_H033f_s.pdf?version=1&modificationDat e=1566288647881&api=v2
 - Latency reduction is included. \rightarrow Should see a 130 ns reduction.
 - Switch for N_TS: Some of them is not using $N_TS = 15$ (e.g. TSF8).
 - TSF 6,7,8 have no B2L.
 - New unpackers/DQM are ready?
 - Officially move to H033f_s within September?
- N_TS and missing B2L: could be tried step-by-step in autumn run.

- Also, the main update should be moving 15 TS version.
 - Firmware $(N_TS = 10)$ is ready.
 - Cosmic test at the next week.
 - New unpackers/DQM are ready? I guess no.
- To be done in autumn run:
 - Increase N_TS step-by-step.
 - Latency reduction looks too difficult for now. \rightarrow Longer-term work.
 - Should not be critical change in main logic in (near) future.
 → Track counting reduction will be studied/done in GRL.
- New feature: t0 by using fastest pt in 2D tracks.
 - Prepared in both 10 TS (present working version) and 15 TS.
 - Beside the cosmic test for 15 TS versions, I will take another cosmic test at next week dedicating to this new timing source.

2D t0

- 2D t0: pick up the fastest pt among all TS associated to tracks.
- 2D outputs tracks' pt (4 tracks per dataclk) of the 5 (or 4) TS.



- If a TS is found this this clock, its found time (A,B) would be earlier than the present cc (A',B').
 - To extend the 9 bits pt into 13 bits, we can't directly use (A',B,C).
- Logic:
 - If B <= B' in this present clock, A should be the same as A'. \rightarrow (A',B,C)
 - If B > B', A' should be already the next recolution. \rightarrow (A'-1,B,C).

2D t0 (cont'd)

- 1 track has 4~5 TS. 4 tracks will be found per dataclk in a 2D board.
 - In every dataclk, 2D will send the fastest one among the 20 TS.
- How to determine a "faster" pt?
 - Generally, pick up the smaller value.
 - To consider the corner effect: If t1 > 10239-300 and t2 < 300,
 → t1 is faster.



- GRL will receive 4 pt from 4 2D boards per dataclk.
 - Similarly, GRL sends the fastest one among the 4.
 - Only the t0 in the beginning of a window will be sent to GDL.



500 ns window for track counting

Faster t0 would also happen in later clock. → But to consider them, we need to wait. Now we are using GTH to send this t0 to GDL.

2D fitter and conventional 3D

- 2D fitter: All the TSIM preparation work is done recently.
 - A pure 2D fitter firmware (using 3D skeleton) is under making now.
 → Check the resource usage of it.
 - There will be also cosmic run dedicating for it.
- 3D:
 - Making 15 TS version is not a problem, in terms of resource usage and compilation time.
 - Unpacker/DQM? I can help it if no one will work on it.
- 2D fitter + 3D:
 - Resource usage? Compilation difficulty? etc.
 - Latency of 2D fitter: Additional 28*7.8 ~ 220 ns.
 → Need more investigation to reduce it.
 - Larger width of event buffer for B2L needs to be prepared.
- Longer-term plan: 3D should be 1 more GTH lane to send more info to GRL.

Latency issue

- This issue can be simply explained by these plots:
 - t3 (3D) and ty (NN) without any delay in these plots.
 - Both 3D and NN are inclusive counting. t_3* or ty_* will be sent to GDL when GRL gets the info.
 - Possible usage for 3D and NN: fffy or fffz.
 - L1 limit: ~ the 21^{st} clock.



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- 2D fitter: +220 ns for 3D
- TSF 15 TS version: -130 ns
- 2D latency reduction: -130ns or less (not promising).
- FE ADC cut: +260 ns

Summary

- TSF: H033d_s \rightarrow H033f_s
- 2D: $10 \rightarrow 15$ TS version.
 - Test the new 2D t0 function.
- 2D fitter firmware \rightarrow 2D fitter + 3D firmware
- Cosmic run at the next week:
 - Test all 15 TS firmwares.
 - 2D t0.
 - Pure 2D fitter firmware.
- All the CDCTRG firmware updates should be finalized in Sep. as well as the new unpacker, and then use the global cosmic run in early Oct. for confirmation.