

Coincidence Trigger and Retiming

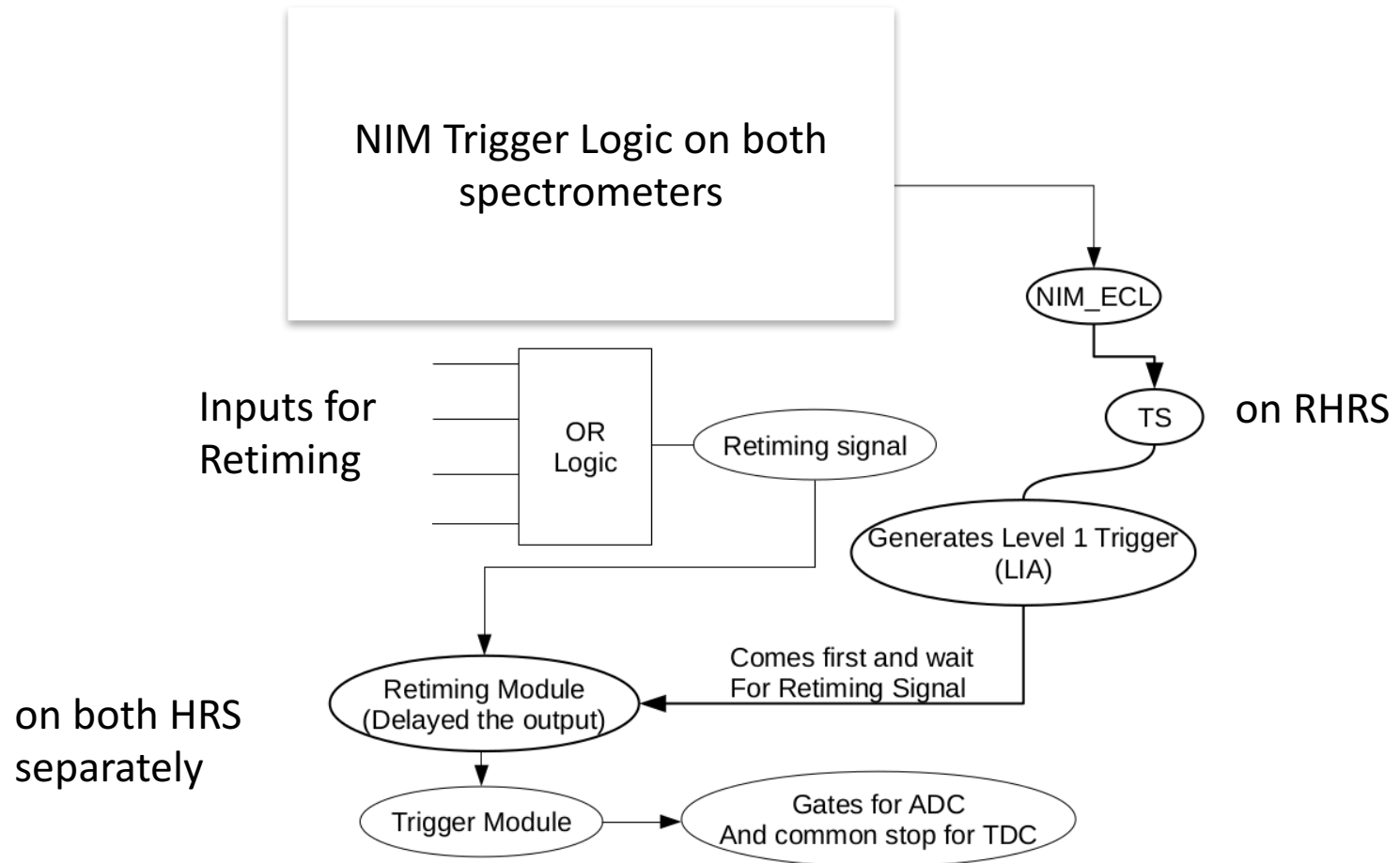
Florian Hauenstein

14th March 2017

Overview

- LHRS Trigger Setup
- RHRS Trigger Setup
- Coincidence Trigger
- L1A Accept and Retiming
- ADC gate
- (Modifications from first setup)
- (What has to be changed for fall)

Introduction



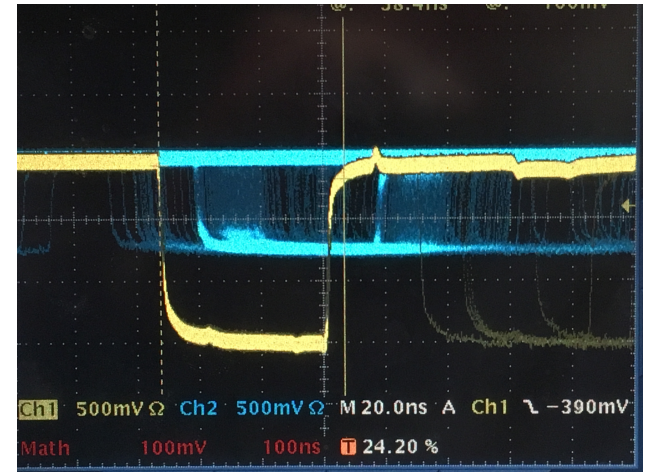
LHRS: S0 & S2 Coincidence

before changes

S0 (blue)

S2 (yellow)

S0 defines time



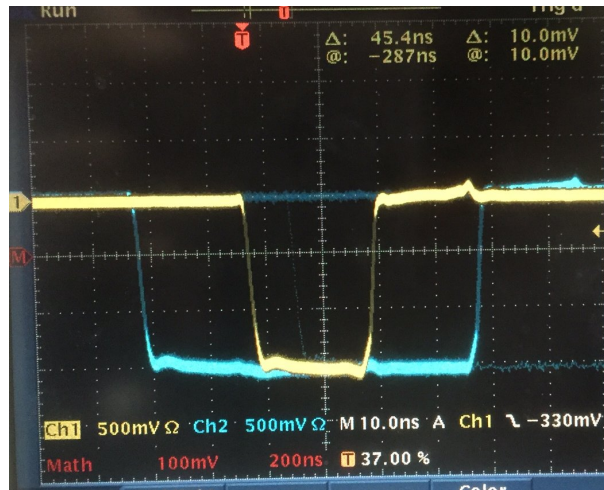
after changes

S0 (blue)

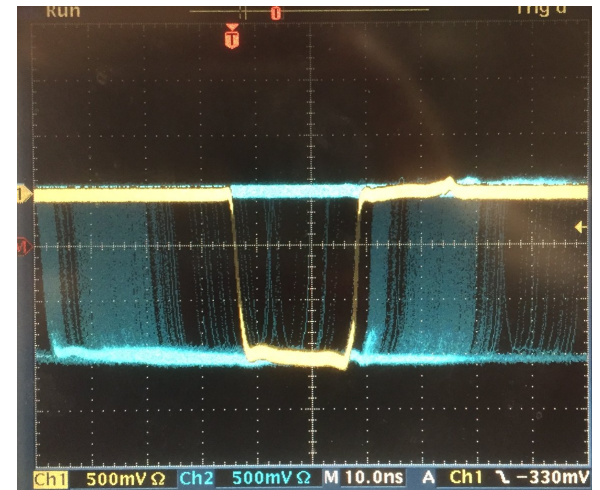
S2 (yellow)

S2 defines time

→ better timing

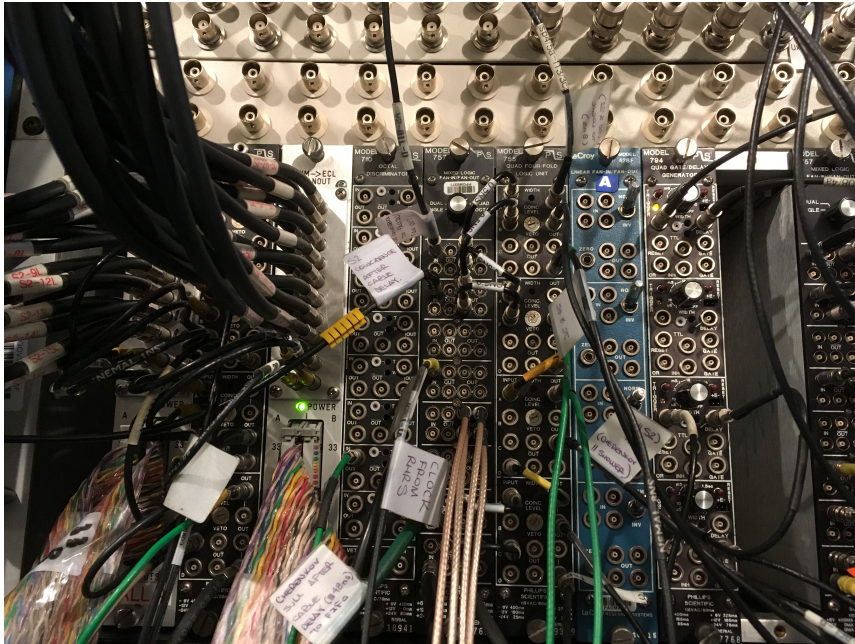


clock

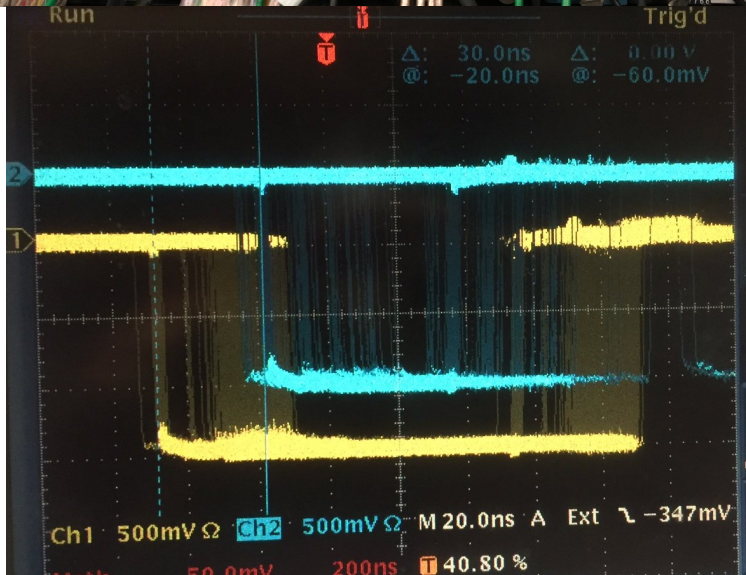


cosmics

LHRS Trigger Pictures



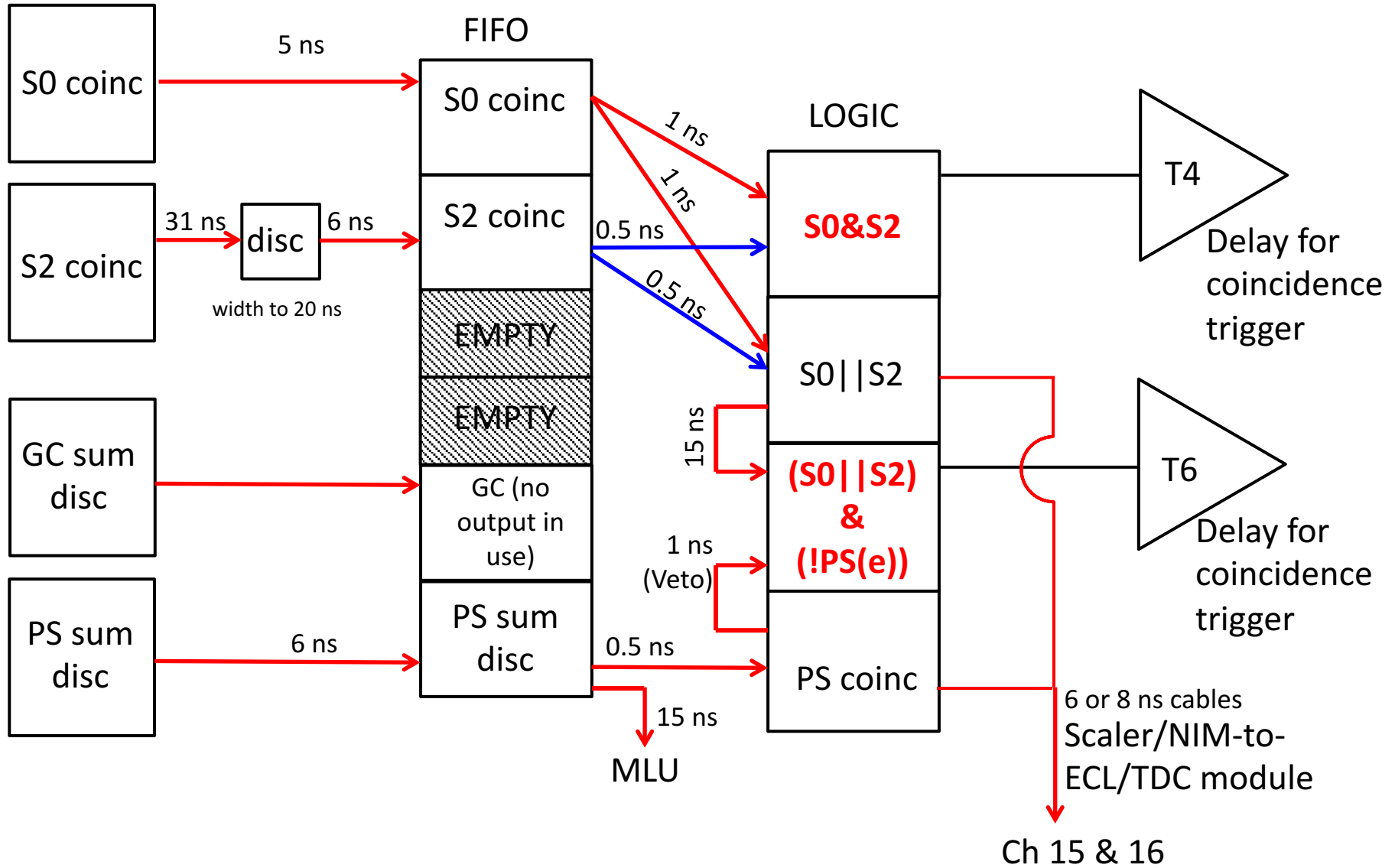
Middle Rack (R2),
Top NIM Crate (N1)
Modules 2 - 11



External trigger S0&S2

S0 || S2 (yellow)
GC || PR (blue)

Schematics of Trigger Setup RHRS



GC: Gas Cherenkov

PS: Preshower/shower

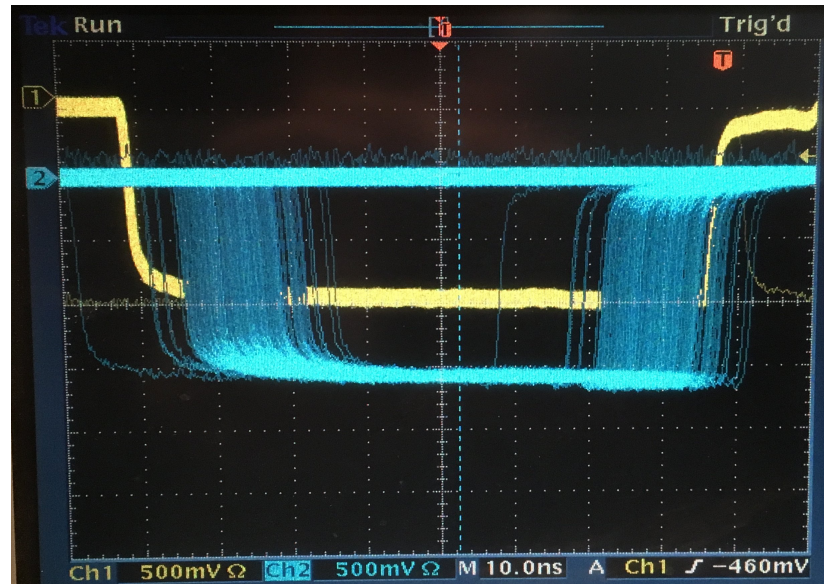
RHRS: S0 & S2 Coincidence

before changes

S0 (blue)

S2 (yellow)

S0 defines time



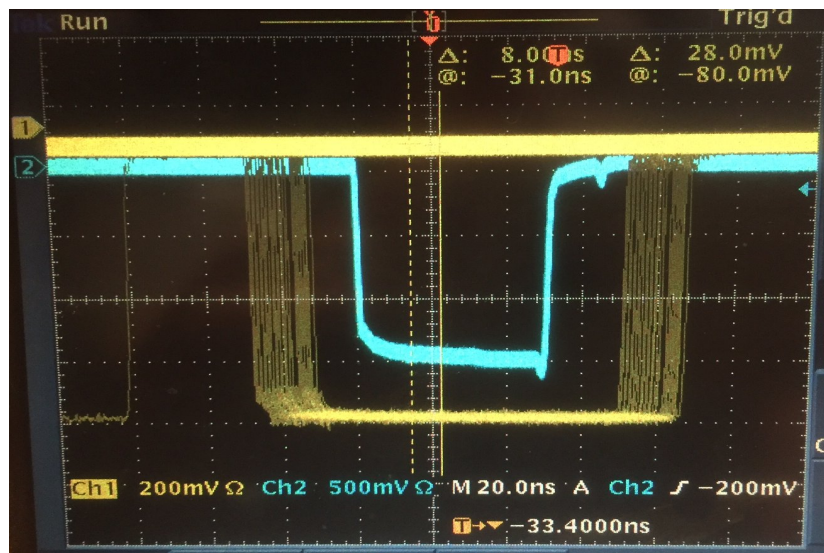
after changes

S0 (yellow)

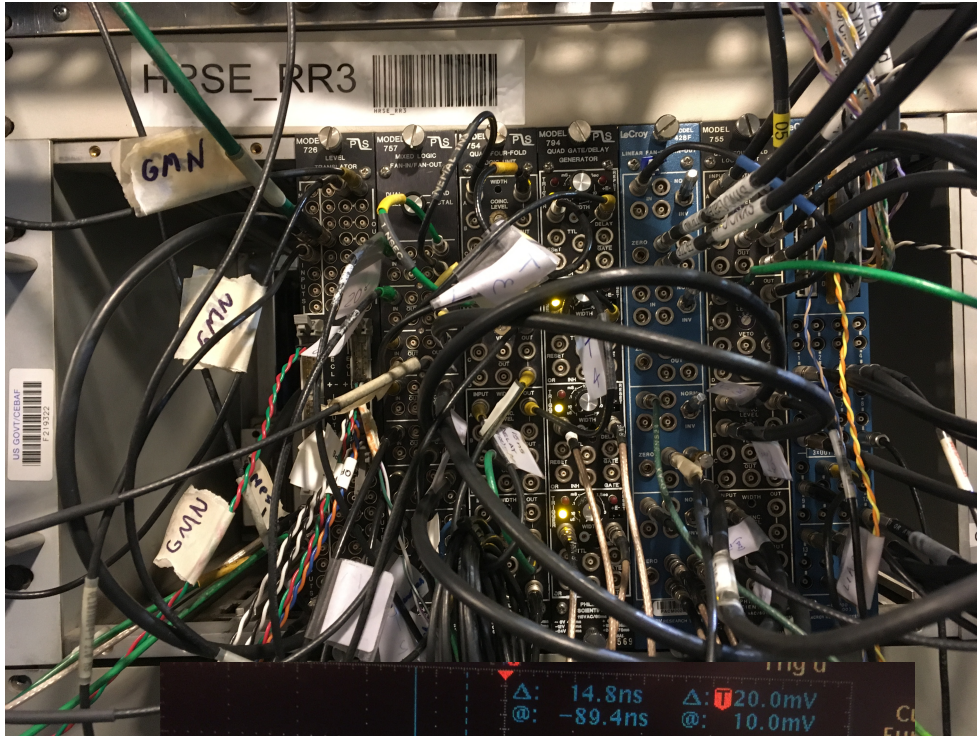
S2 (blue)

S2 defines time

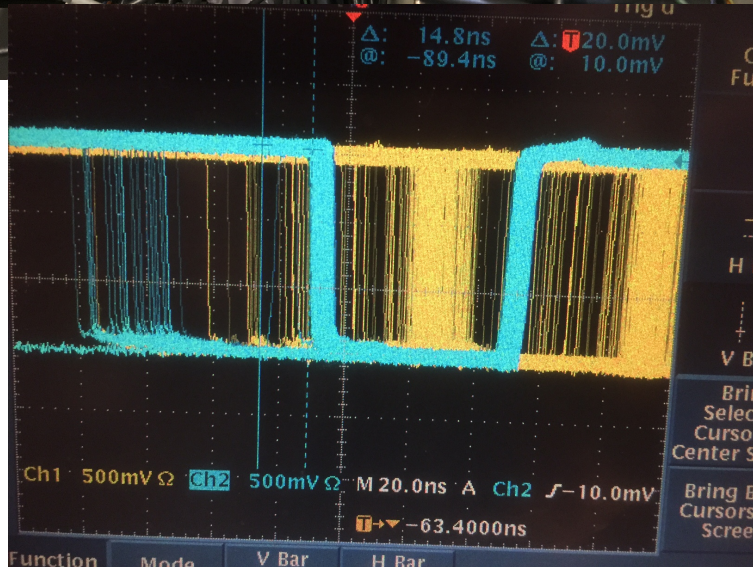
→ better timing



RHRS Trigger Pictures



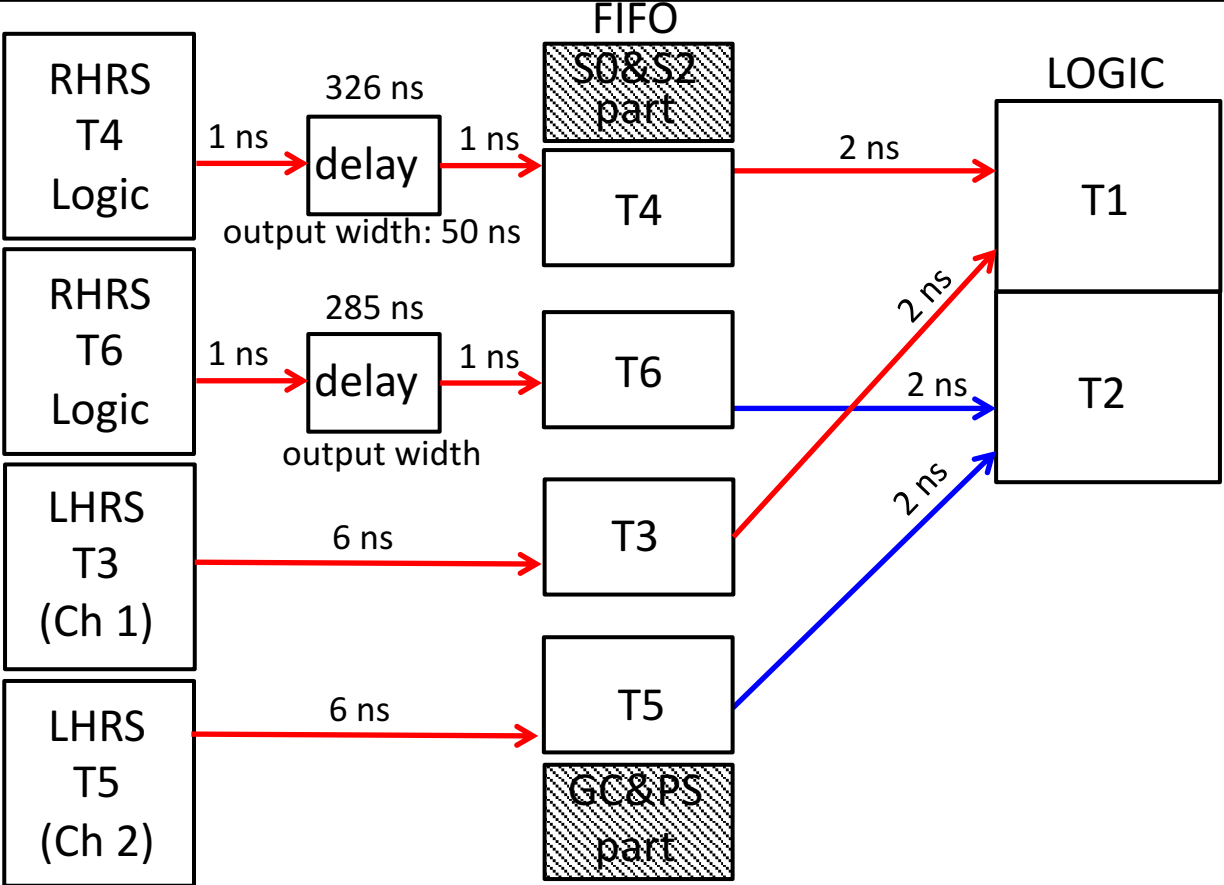
Middle Rack (R3),
Top NIM Crate (N1)
Modules 4 - 9



Test PS veto

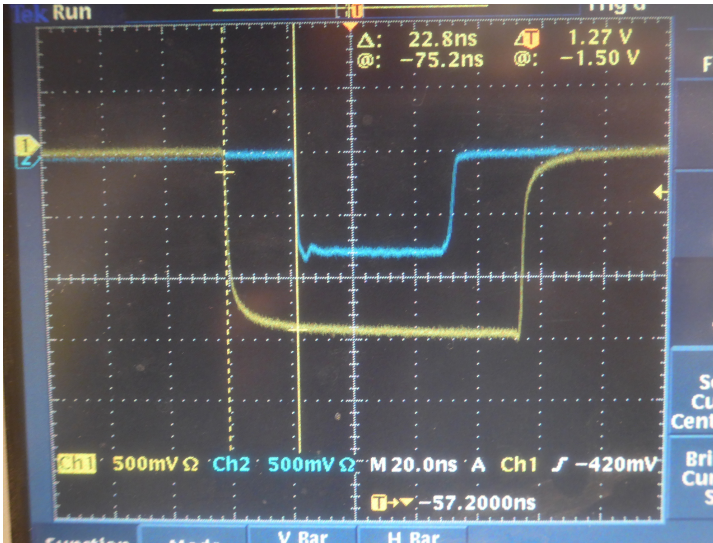
S0 | S2 (yellow)
PS (blue)

Coincidence Schematics (on RHRS R3, N1)



Delay: Delay generator

Coincidence Trigger

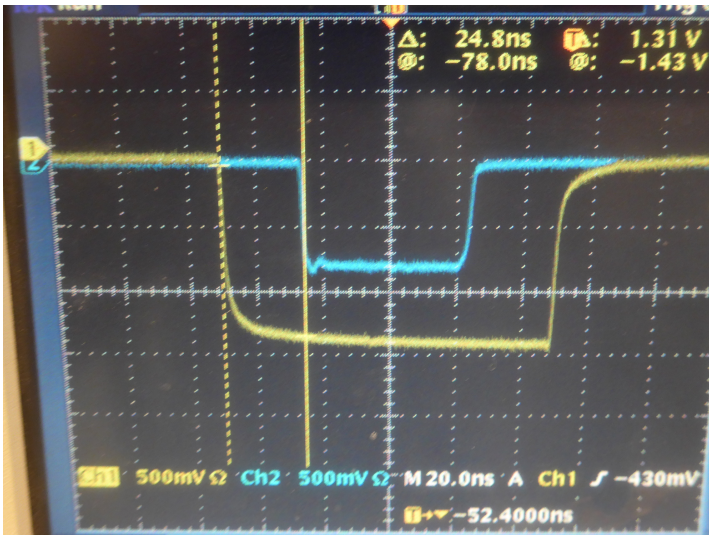


T1 coincidence

T3 (yellow)

T4 (blue)

→ Coincidence window and signal width changed later



T2 coincidence

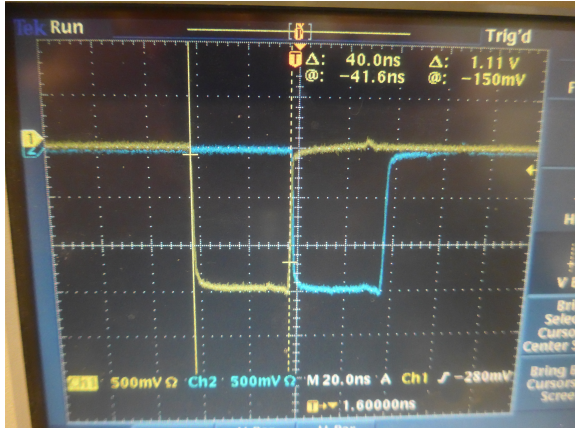
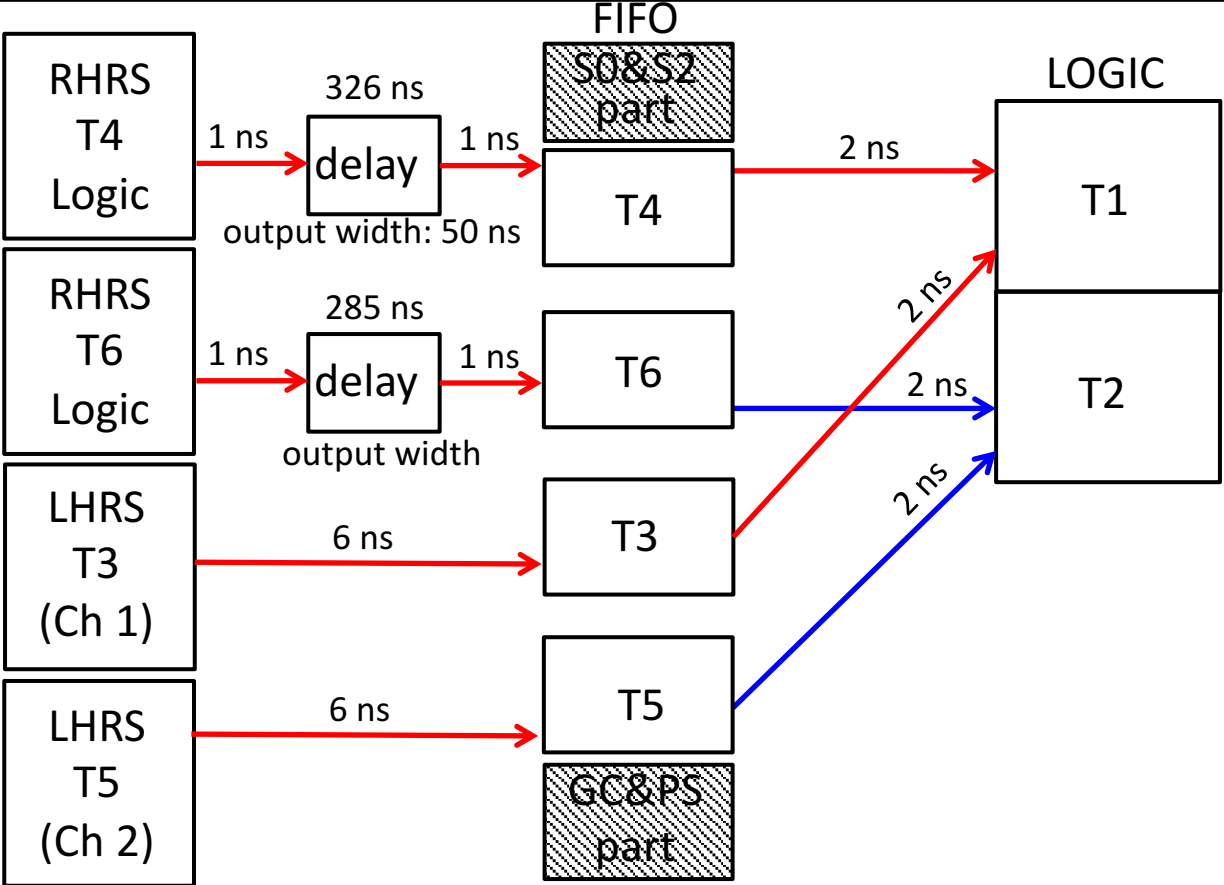
T5 (yellow)

T6 (blue)

→ Coincidence window and signal width changed later

→ Coincidence simulation with clock

Coincidence Schematics (on RHRS R3, N1)



T1 (blue)

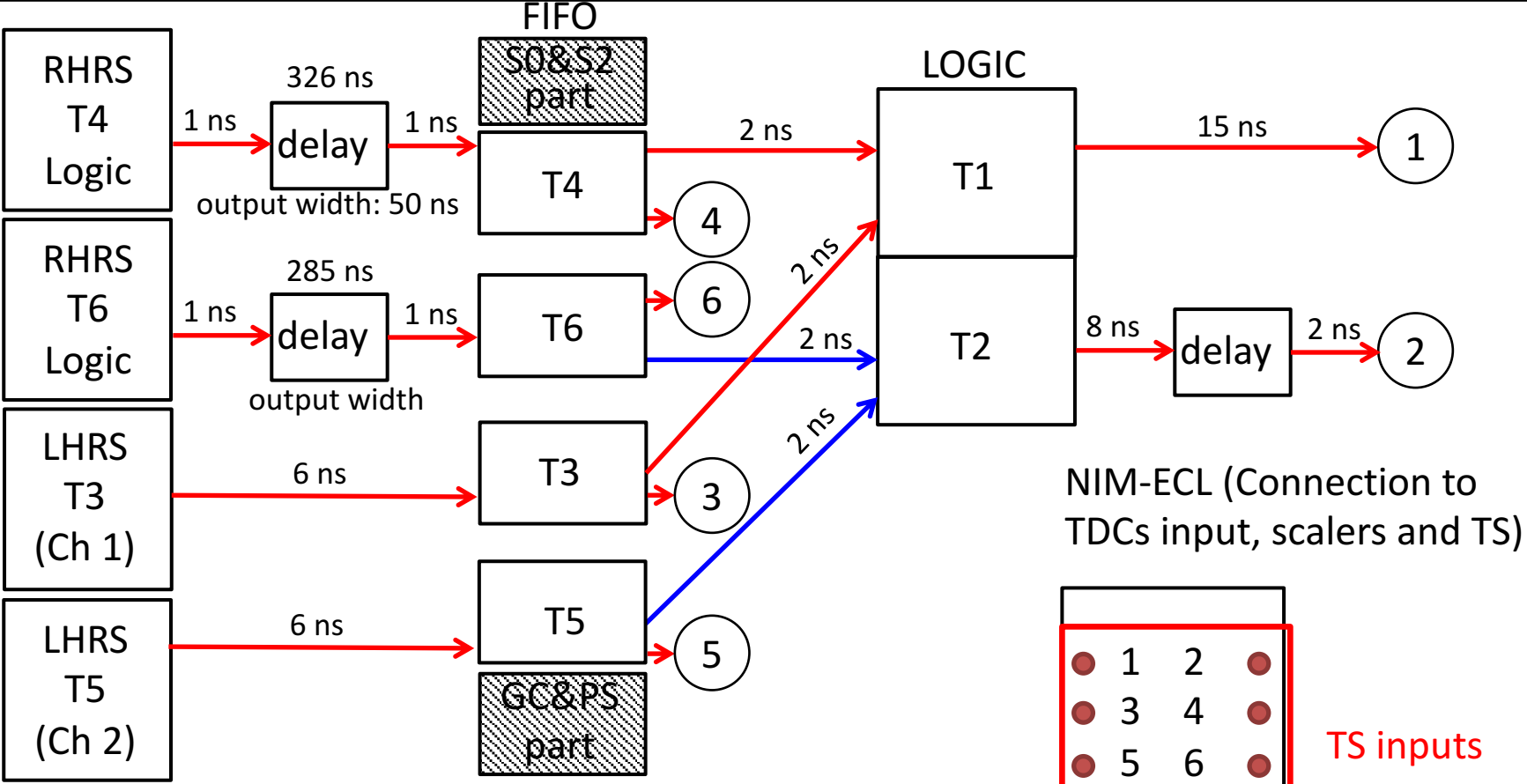
T2 (yellow)

→ want to have other order

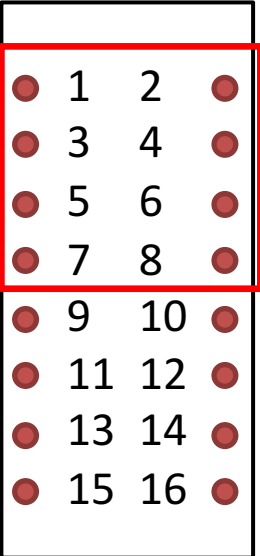
- Delay of all trigger with respect to T1 to get order **T1 – T3 – T2 – T5 – T4 – T6**
- Trigger Supervisor (TS) minimum time difference 10 ns
- $T3 - T1 = 10 \text{ ns}$, $T2 - T3 = 15 \text{ ns}$, $T5 - T2 = 15 \text{ ns}$, rest same
- $T6 - T1 = 70 \text{ ns}$ (Note: By mistake the differences to T5 and T6 were smaller than wanted)

Delay: Delay generator

Coincidence Schematics (continued)

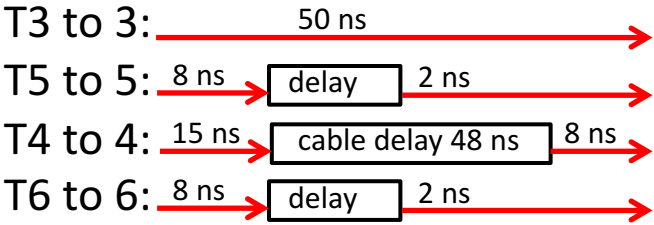


NIM-ECL (Connection to TDCs input, scalers and TS)

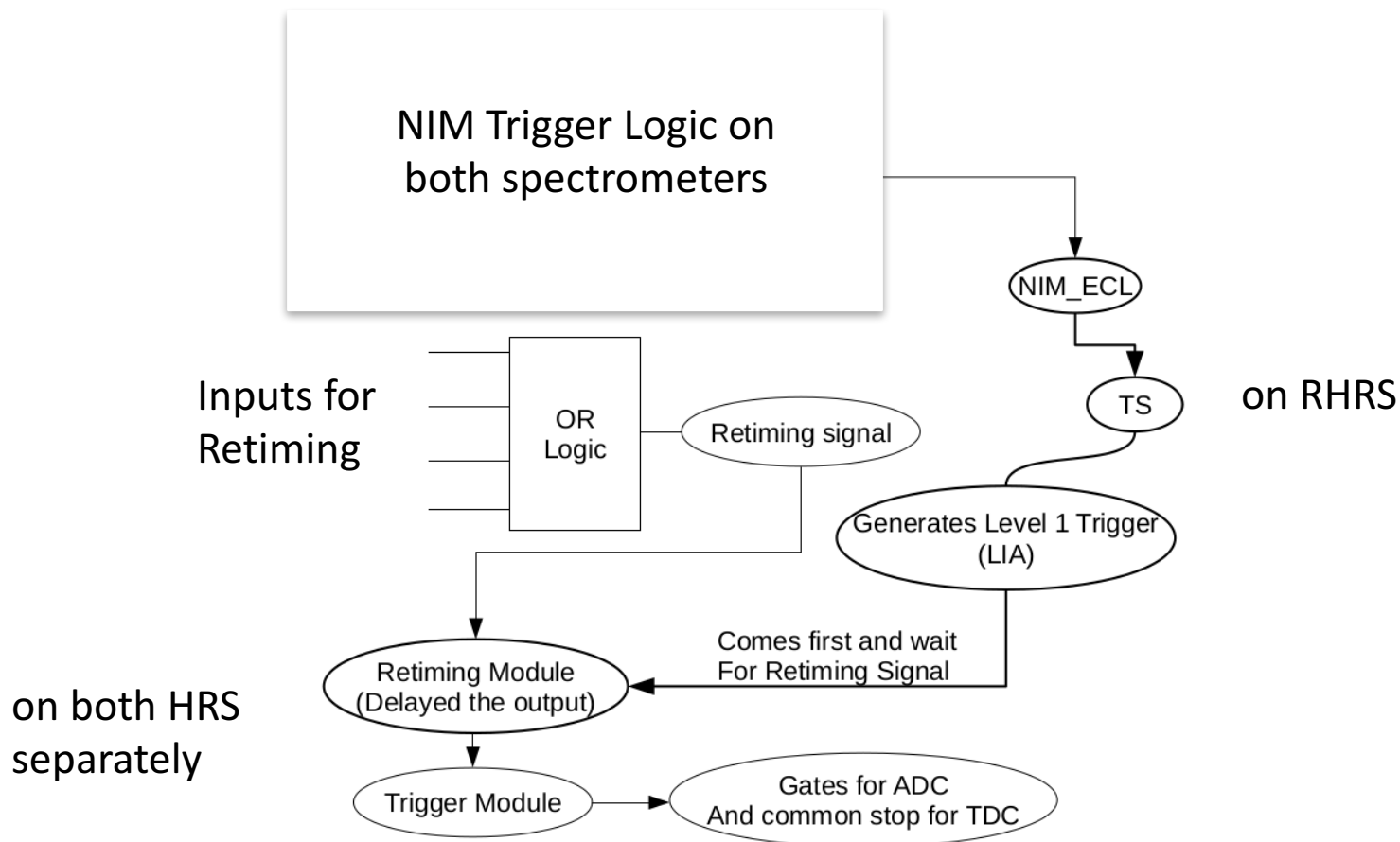


TS inputs

NIM-ECL Connections



Delay: Delay generator



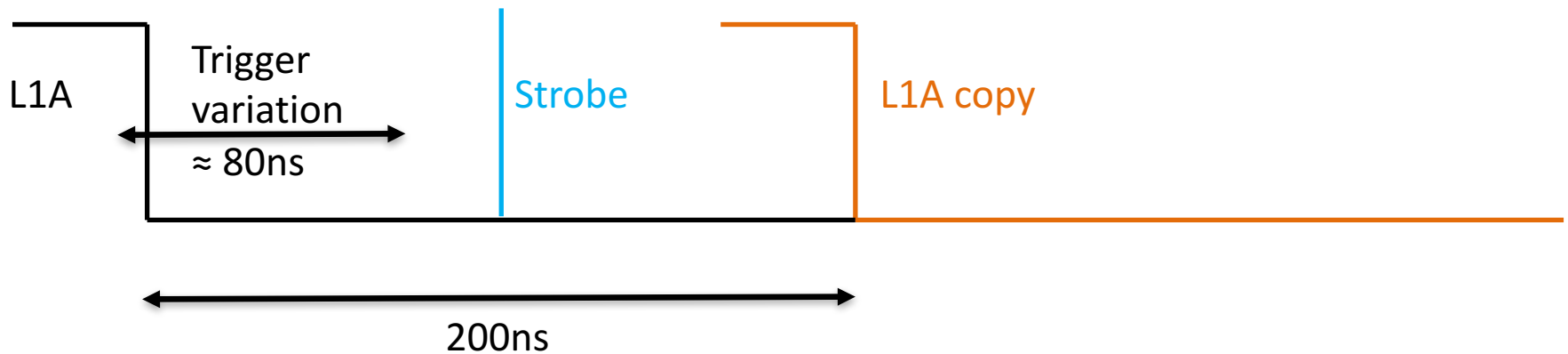
Retiming / Strobe Signal

- Why?
 - Common stop of TDC and ADC gate identical for same events i.e. one peak TDC spectrum
 - Can not be achieved when TDC stop results from L1A signal since it depends on the trigger delays
 - Use independent signal in detector for common stop and ADC
 - Ensure that common stop is existing even for events without a “real” signal i.e. triggered by clock or only on one arm

Retiming / Strobe Signal continued

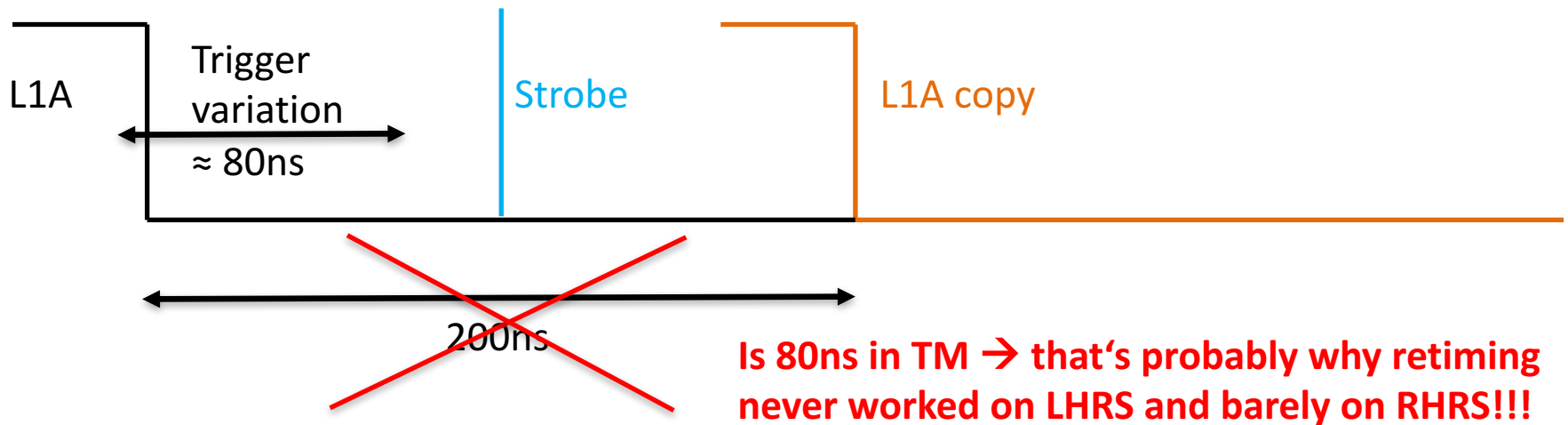
- How?
 - Use detector information to get common stop
 - Only one Strobe per event and spectrometer (RT module)
 - LHRS strobe: S0 | | S2 (S2 before S0)
 - RHRS strobe: T1 | | T2 | | T3 | | T4 (could be improved)
 - Coincidence with L1A accept (RT module)
 - After 200 ns delayed copy of L1A for coincidence (according to DAQ manual)

Retiming / Strobe Signal continued



- Strobe between 100 ns to 200 ns after earliest trigger (T1)
- Random accidentals vary more but this gives only flat background \rightarrow does not matter
- Common Stop for TDCs and ADC gate signal is derived from the upper coincidence signal

Retiming / Strobe Signal continued



- Strobe between 100 ns to 200 ns after earliest trigger (T1)
- Random accidentals vary more but this gives only flat background → does not matter
- Common Stop for TDCs and ADC gate signal is derived from the upper coincidence signal

LHRS Strobe

S0 || S2 = Strobe

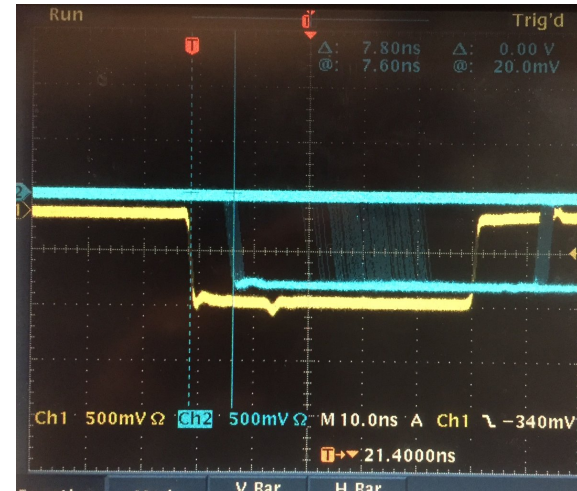
S0 (blue)

S2 (yellow)

S2 defines time of strobe

Strobe is sent to delay generator

for coincidence with L1A



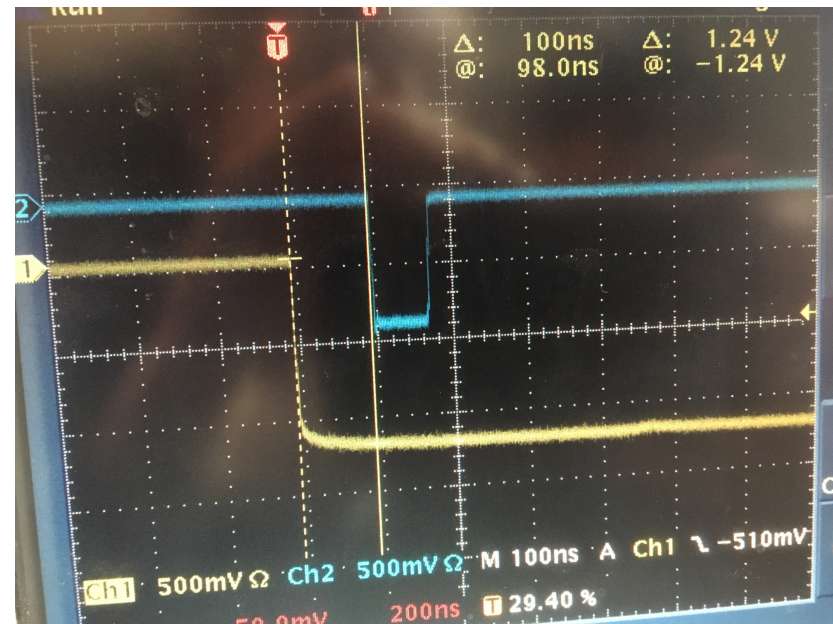
L1A and Strobe Timing

Strobe (blue)

L1A (yellow), T3 trigger

Strobe 100ns after L1A (changed several times later)

Strobe (before delay) is sent to RHRS (ch 5) into TDC & scaler to get coincidence retiming → ideally L-strobe stopped by R-strobe



RHRS Strobe

T1||T2||T3||T4 = Strobe

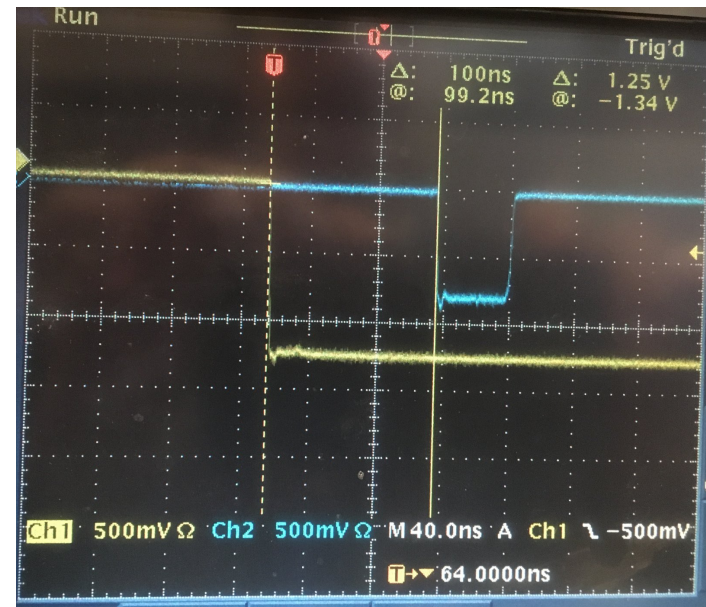
No picture available

L1A and Strobe Timing

Strobe (blue)

L1A (yellow), T4 trigger

Strobe 100ns after L1A (changed later)

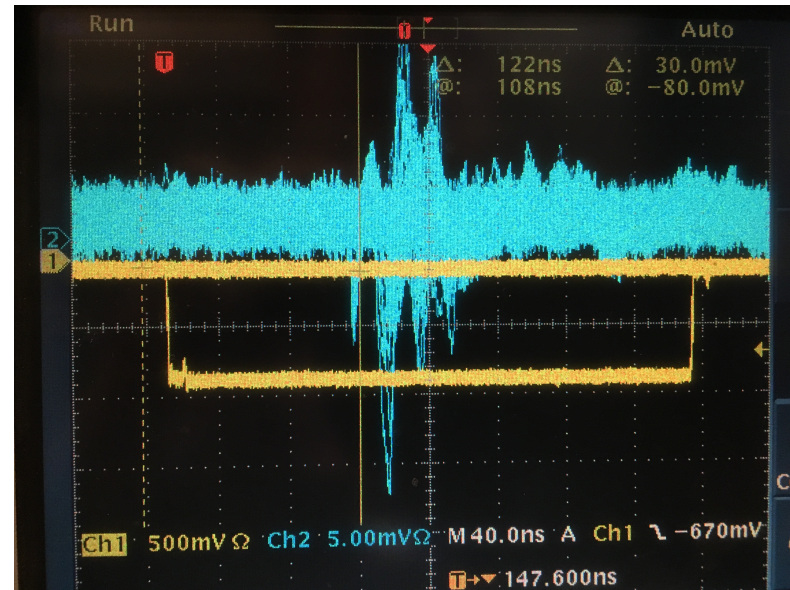


ADC Gates

LHRS Gate

S0 PMT signal (blue)
ADC gate (yellow)

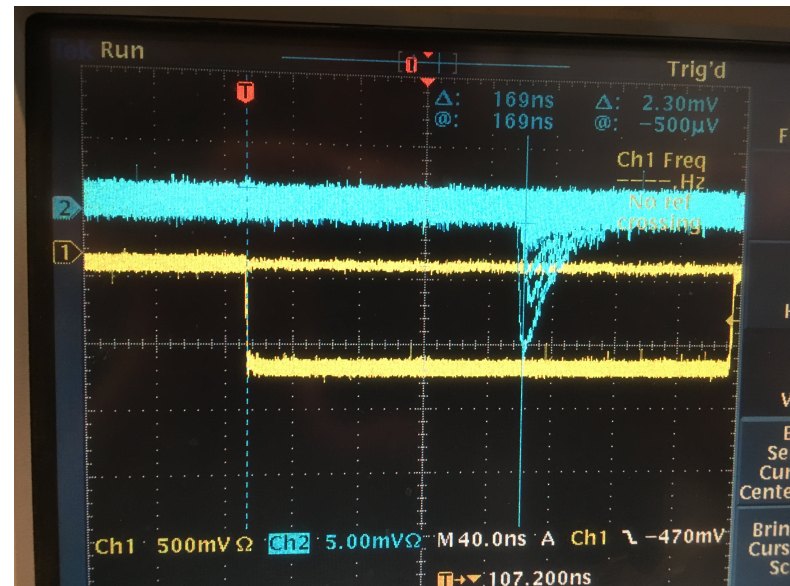
Broad ADC gate (>300ns)
Most of the signal is cross talk
probably induced by EDTM (was
better after we switched it off)



RHRS Gate

S0 PMT signal (blue)
ADC gate (yellow)

Change of ADC gate width to
400ns on **both arms** on 02/24/17



Outlook

- Overview over modifications through beam time
- Mistakes and what to avoid
- Further improvements for next beam times

Coincidence Trigger and Retiming

Part 2

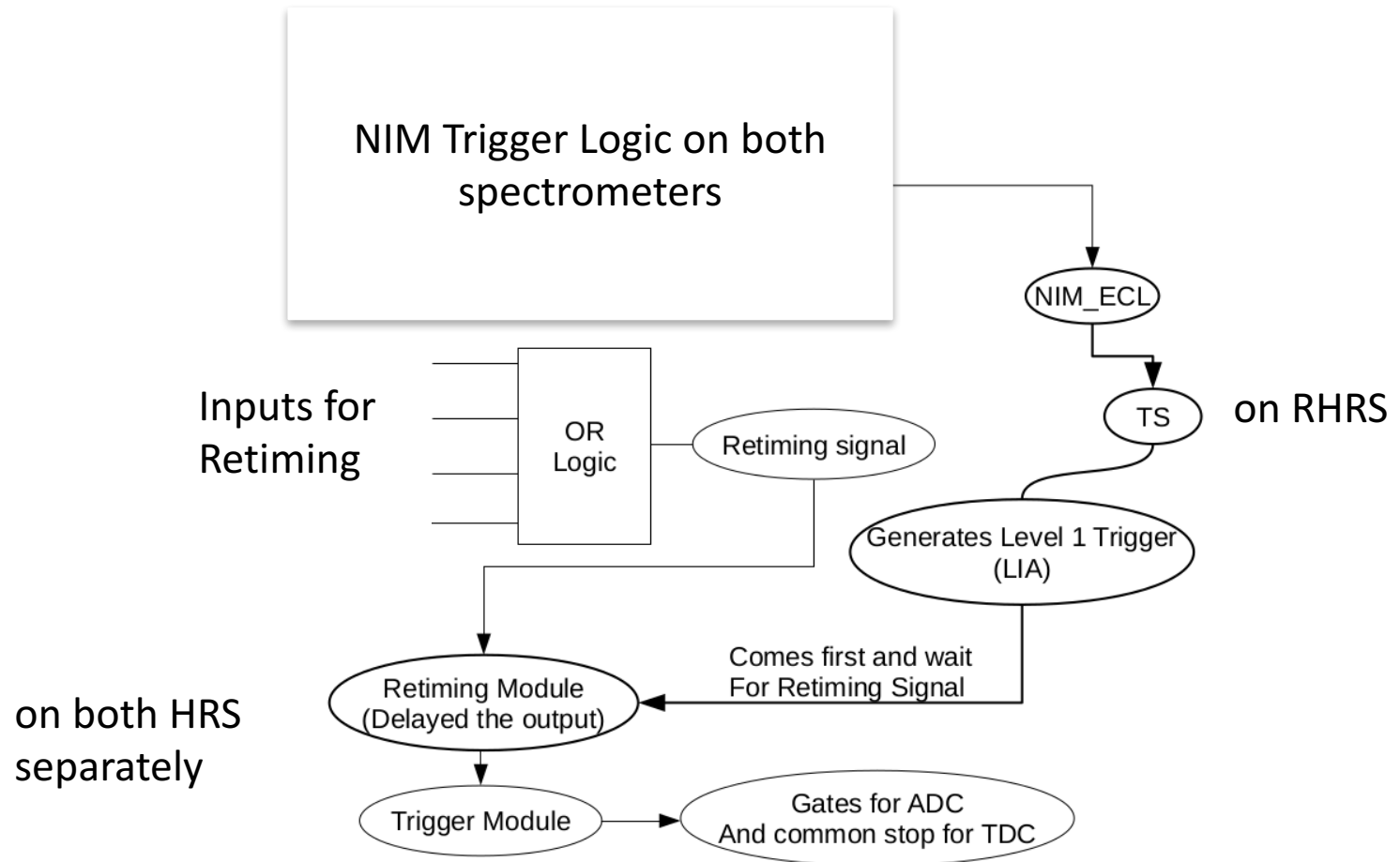
Florian Hauenstein

21th March 2017

Overview

- Modifications during beam time (usually needs new pedestal and time calibrations)
- Errors and corrections
- Improvements for fall 17/ spring 18

Introduction



Run 138 - 271

- Start of beam time on 17th Feb 17 with run 138
- Commissioning phase in kinematic setting 1
- Main Issue: Problem at high beam current due to bypassing of RT module (fixed later see 20th Feb, after run 359)

Run 272 - 314

- Commissioning phase in kinematic setting 1
- Double access to change retiming on LHRS as well as ADC gates (see elog 3459978 & 3460036) around run 276
- Additional access at 280 to change it again (see 3460044)
- Changes done see 3460097
 - ADC gate to 600ns
 - Strobe delay to 65ns on LHRS

Run 315 - 359

- 19th February
- Production phase in kinematic setting 1
- After run 359 fix of DAQ problem at high rate
- Solution and explanation for DAQ problem (3460533 & 3460558)
 - Multiple gates per L1A trigger due to bypassing TM module for ADC gate generation
 - EDTM and gate signal on LHRS scaler (ch 14 & 15)

Run 369 - 416

- Production in kinematic setting 1
- 21st Feb:
 - Access after run 402 to increase coincidence window for T1 and T2 to 300ns
 - Further modification: L-Strobe (S0 | | S2) created by extra logic module. S2 signal comes first

Run 426- 529

- Kinematic setting 3
- No changes to DAQ

Run 543 - 648

- Kinematic setting 4
- 24th Feb 17 (3462216)
 - Coincidence window decreased to 200ns for T1 and T2 (too much accidentals)
 - L-Strobe delay changed to 100ns
- 24th Feb 17, night, run 556 (3462378)
 - Set both strobe delays to 200ns
 - Adjust ADC gates
 - New values beyond run 559

Run 543 - 648

- Kinematic setting 4
- 24th Feb 17 (3462216)
 - Coincidence window decreased to 200ns for T1 and T2 (too much accidentals)
 - L-Strobe delay changed to 100ns
- 24th Feb 17, night, run 556 (3462378)
 - Set both strobe delays to 200ns
 - Adjust ADC gates
 - New values beyond run 559

Run 665 - 772

- Kinematic setting 5
- 28th Feb 17 during spectrometer move
 - Correct delay values for trigger T4 and T6
 - Set both strobe delays to 150ns and width of the signals to 15ns (RHRS) and 20ns (LHRS)
 - L-Strobe delay changed to 100ns
- EDTM switched off during run 708

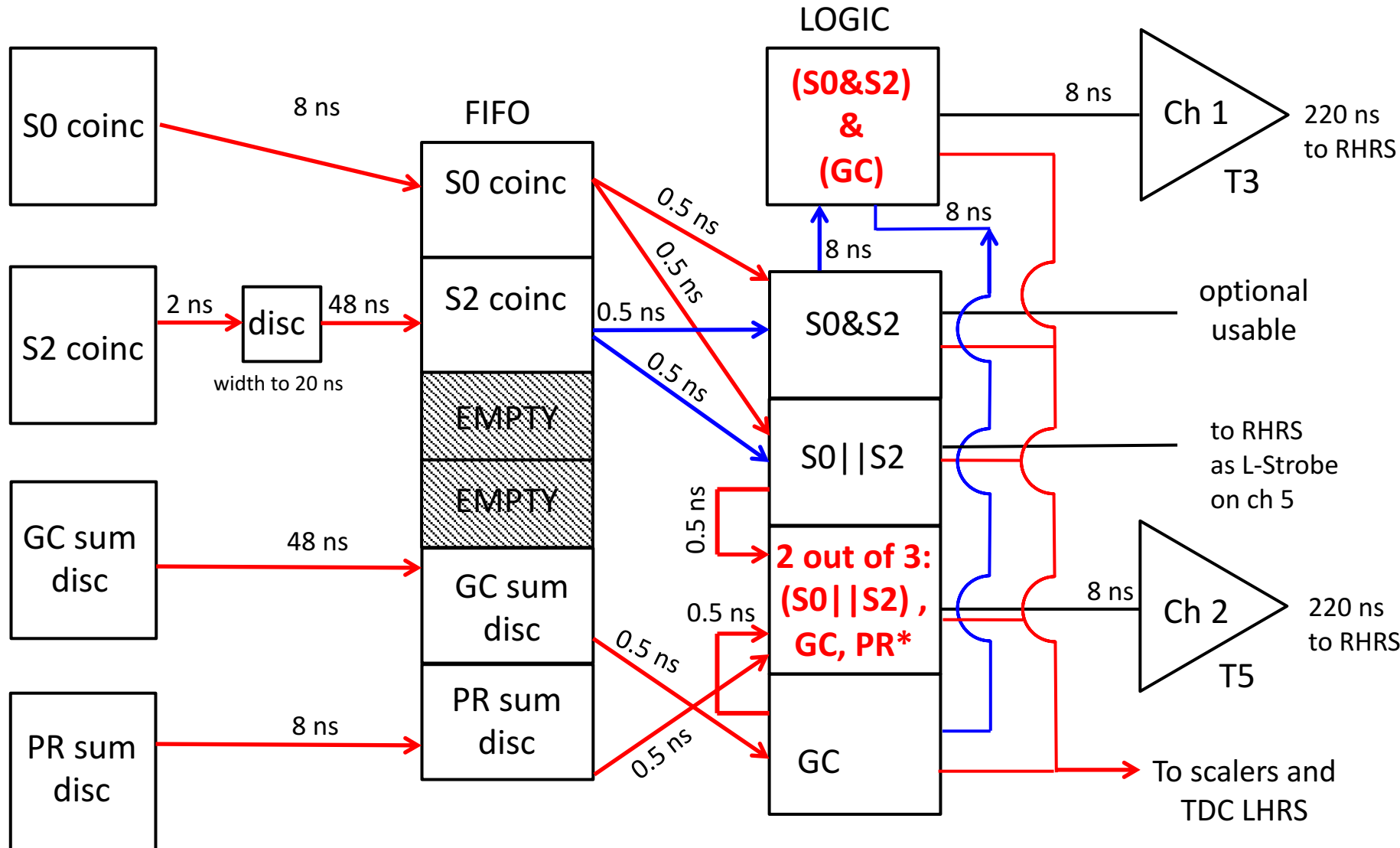
Run 776 - 885

- Kinematic setting 2
- No DAQ changes

Run 889- 907

- Kinematic setting 1
- 7th Mar 17:
 - Removed PR signal from T3 trigger
 - Modified as well T5 trigger (any two of three → see next slide)
- End of beam time due to cold compressor failure

Schematics of Trigger Setup LHRS (from 03/07/17 on)



$$* = \{(S0||S2) \& GC\} || \{(S0||S2) \& PR\} || \{GC \& PR\}$$

GC: Gas Cherenkov

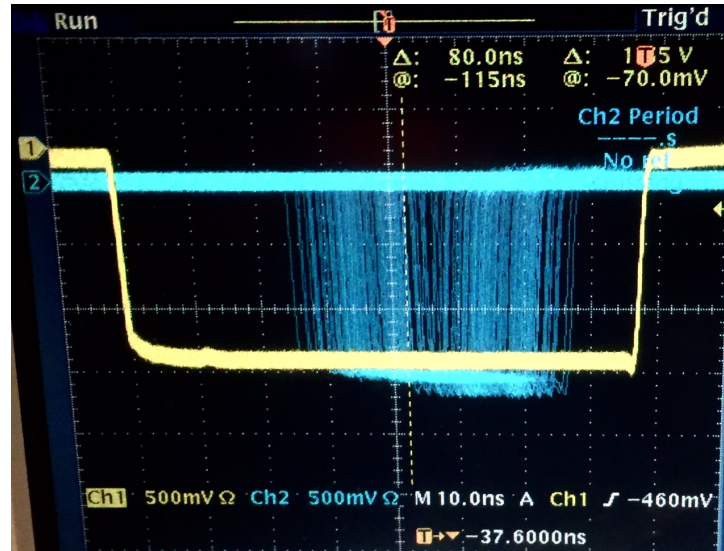
PR: Pion Rejector

S0 & S2 Coincidence Time Order

WRONG TIMING:

S0 (blue)
S2 (yellow)

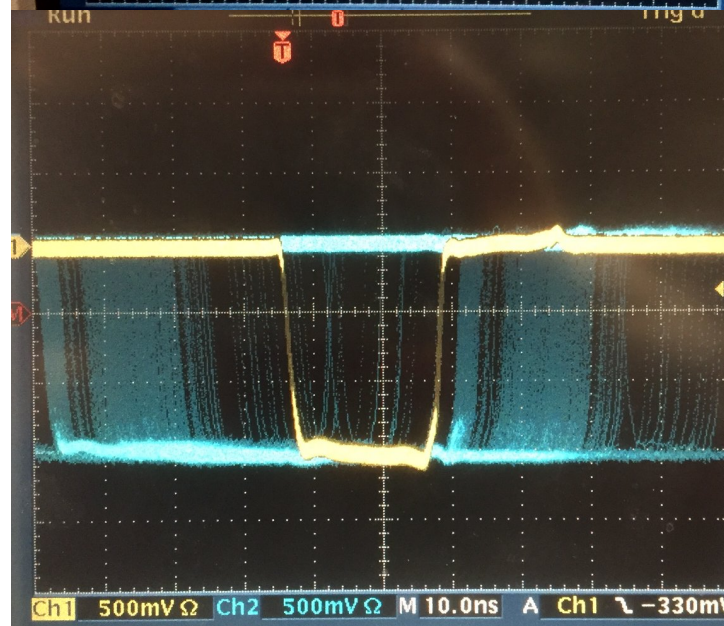
S0 defines time
→ high jitter



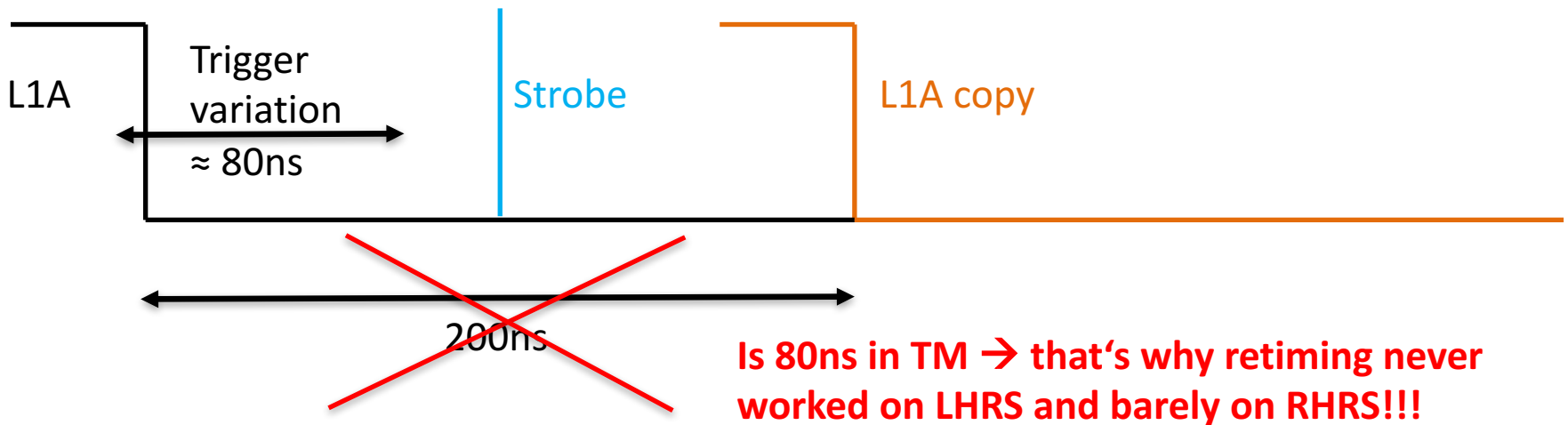
CORRECT TIMING:

S0 (blue)
S2 (yellow)

S2 defines time



Error for Retiming / Strobe Signal



- With 80ns window only the last triggers in the time order (T4 and T6) are within frame
- Still waiting for more manuals to be sure what happened

To do “better” for next beam time

- Settings for RT and TM module and “correct” circuit for retiming
- Independent scintillator & PMT for time measurements with cosmics (currently unknown cable delay between PMTs and electronics)
- Triggers and strobes timed to S2 signals
- Check discriminator thresholds
- Time differences between triggers shorter
- Strobe signals about 80ns after L1A
- Coincidence window broad enough (including e`d)
- NIM and MLU trigger coincidence?