Beamtime Data Analysis

February 2025

Dachi Okropiridze

Outline

Run Information Summary

Run Details:

- Start time: 2025-02-16 01:52:45
- Run number: 3505
- Tag: 2025/prod/bmon_sts_trd1d_trd2d_tof_rich_write_2nvme

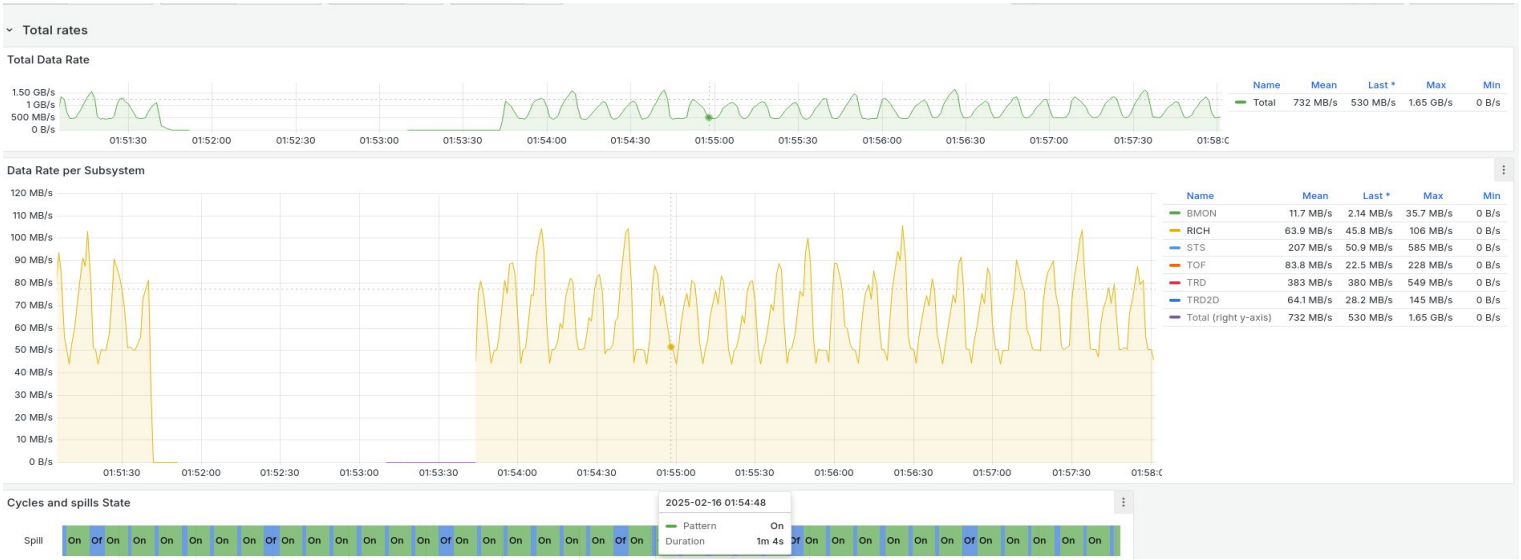
Beam parameters:

- First run with new energy: T=1.23 AGeV
- Beam intensity: 1.5×10^7 particles per spill

Target Configuration:

- Moved to position 5
- Material: Silver (thick)
- Thickness: 4.20 mm
- Position change occurred at run 3502

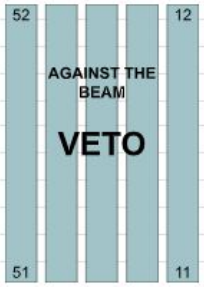
File: **3511_node10_00_0000.digi.root**



FSD, NCAL, VETO mapping

FSD, NCAL, Veto: HV & Dirich configuration

All Dirich Thresholds are set -50mV, All HV are negative polarity

Detektor	Detector Module	HV line / addr / ch	DIRICH Module	Adapter Input#	DIRICH Channel	Att. Factor	HV Value
	1	0 / 3 / 9	0x7902	7	25 / 27	~ 100	
	2	0 / 3 / 10	0x7901	6	21 / 23	~ 100	
	3	0 / 3 / 11	0x7901	3	09 / 11	~ 100	
	4	0 / 3 / 12	0x7902	6	21 / 23	~ 100	
	5	0 / 3 / 13	0x7901	4	13 / 15	~ 100	
	6	0 / 3 / 15	0x7902	3	09 / 11	~ 100	
	7	0 / 3 / 15	0x7902	4	13 / 15	~ 100	
Against the beam	*NCAL is on Crate 1 - "big"*						
	*Veto is on Crate 2 - "small" in the cave*						
	11	0 / 0 / 1	0x7904	4	13 / 15	~ 10	
	12	0 / 1 / 1	0x7904	6	21 / 23	~ 10	
	21	0 / 0 / 2	0x7903	2	05 / 07	~ 50	
	22	0 / 1 / 2	0x7904	7	25 / 27	~ 10	
	31	0 / 0 / 3	0x7903	3	09 / 11	~ 50	
	32	0 / 1 / 3	0x7903	8	29 / 31	~ 50	
	41	0 / 0 / 4	0x7904	8	29 / 31	~ 10	
	42	0 / 1 / 4	0x7902	5	17 / 19	~ 100	
	51	0 / 0 / 5	0x7903	5	17 / 19	~ 50	
	52	0 / 1 / 5	0x7902	2	05 / 07	~ 100	

FSD *beam direction*

#	1x1	1x2	1x3
DIRICH ADDR	0x7905	0x7905	0x7905
Dirich ch	3/1	5/7	11/9
ATTENUATOR	2.2k - 1k	2.2k - 1k	2.2k - 1k
Voltage	-1150	-1150	-1150
HV Channel	Crate 2, module 0, CH 6	Crate 2, module 0, CH 6	Crate 2, module 0, CH 6
#	2x1	2x2	2x3
DIRICH ADDR	0x7905	0x7905	0x7905
Dirich ch	13/15	17/19	21/23
ATTENUATOR	2.2k - 1k	2.2k - 1k	2.2k - 1k
Voltage	-1000	-1000	-1000
HV Channel	Crate 2, module 0, CH 7	Crate 2, module 0, CH 7	Crate 2, module 0, CH 7
#	3x1	3x2	3x3
DIRICH ADDR	0x7905	0x7905	0x7903
Dirich ch	25/27	29/31	23/21
ATTENUATOR	2.2k - 1k	2.2k - 1k	4.7k - 1.5k
Voltage	-1100	-1100	-1100
HV Channel	Crate 2, module 1, CH 6	Crate 2, module 1, CH 6	Crate 2, module 1, CH 6

	ISEG Board	ISEG IP Add:	Channel numbers:	crate module address
HV crate 1 (RICH)	3:7400041	10.203.0.74	ch a0,a1,a2,a3,a4,a5	u300,u301,u302,u304,u305,u306
HV crate 1 (NCAL)	3:7400041	10.203.0.74	a9,a10,a11,a12,a13,a14,a15 (ncal)	u303,u307,u308,u309,u310,u311,u312,u313,u314,u315
HV crate 2 FSD, Veto	0:7400121 0:7400122	10.203.70.2	kein script	

Note: There are two versions of NCAL and Vetos , this document belongs to the one in mCBM cave

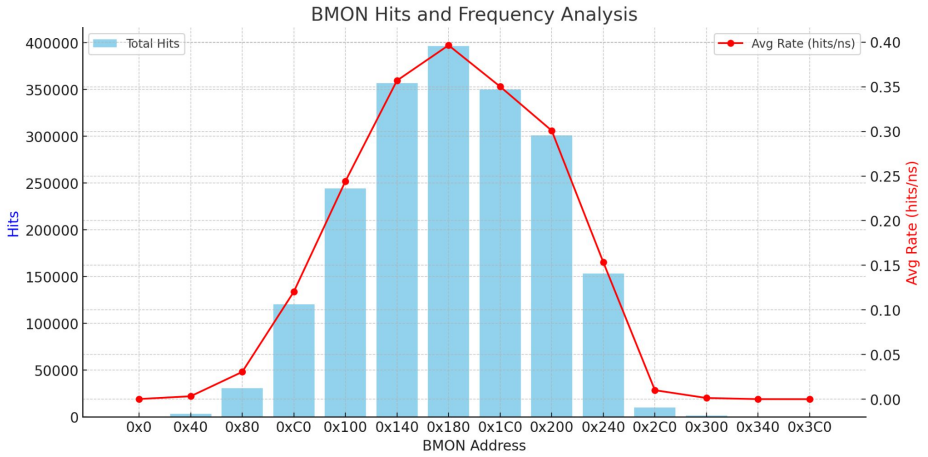
BMON Digi Analysis Summary

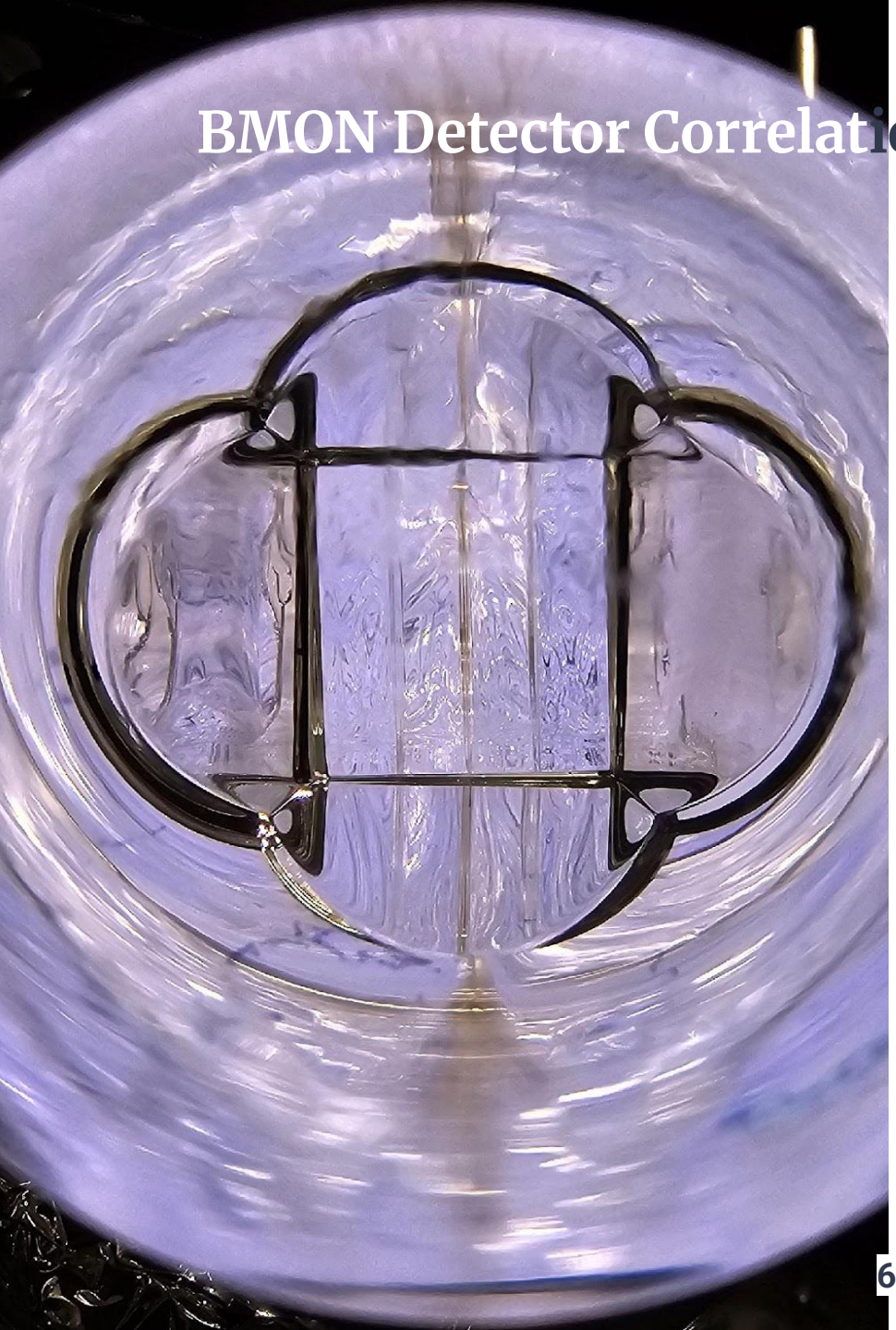
Dataset Size:
- 1,967,749 total BMON digis across 12 tree entries
- 383,614 BMON digis in first entry alone

Detector Characteristics:
- 14 unique BMON addresses detected
- Most active addresses: 0x01802806 (20.15%) and 0x01402806 (18.14%)
- Five addresses account for >80% of all hits (0x01002806 through 0x02002806)

Signal Properties:
- Digi structure includes Address, Time, and Charge
- Time values measured in nanoseconds
- Data stored in fAddress, fTime, and fCharge branches in ROOT file

Address Distribution:
- Highly non-uniform distribution across address space
- Peripheral addresses (0x00002806, 0x03C02806) show minimal activity (<0.01%)
- Middle addresses show highest activity concentration





BMON Detector Correlation Analysis: Key Points

Purpose: Analyzes timing correlations between Beam Monitor (BMON) and other CBM detectors (NCAL, FSD, VETO)

Time Management:

- Uses 150 ns correlation window
- All times referenced relative to TimeSlice start (each ~129 ms)
- No cross-TimeSlice correlations permitted

Correlation Method:

- Maps BMON hits by address and time
- Uses binary search to efficiently find hits within time window
- Calculates delta time (dt = detector_time - bmon_time)

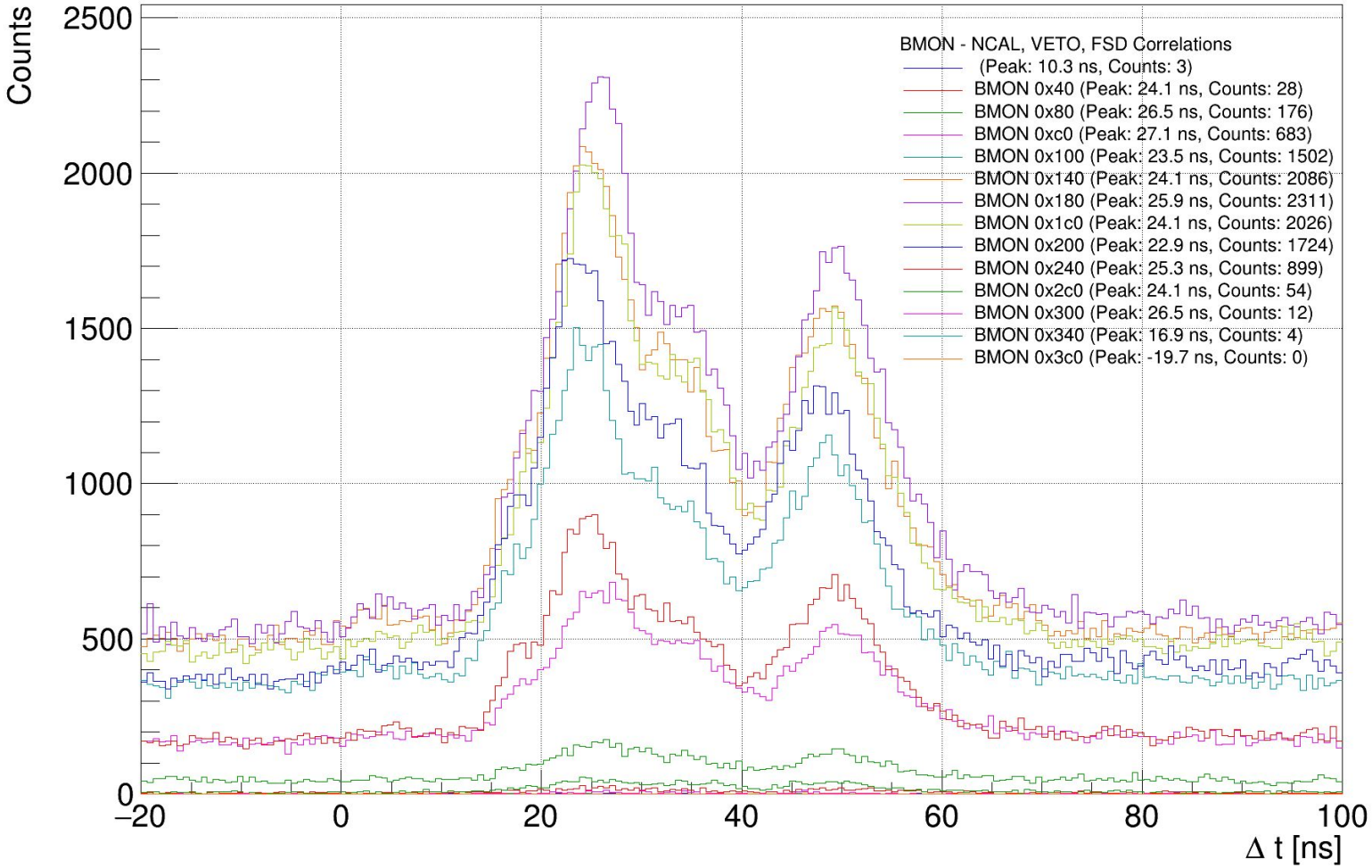
Technical Implementation:

- Processes detector data separately by type and channel
- Optimized with sorted time arrays and binary search
- Outputs organized in hierarchical directory structure

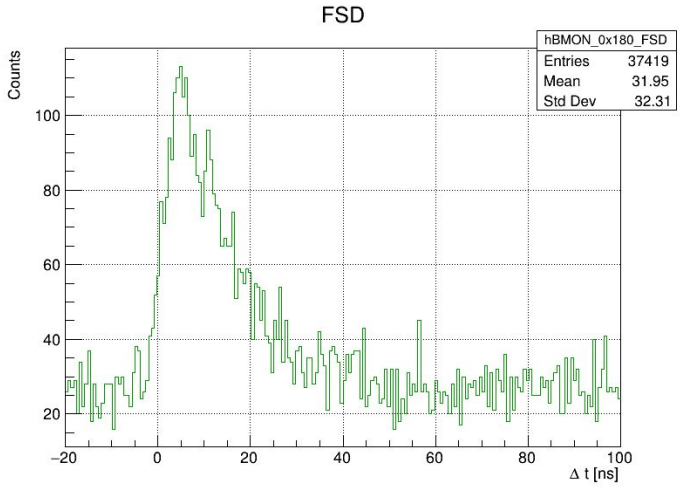
Result Visualization:

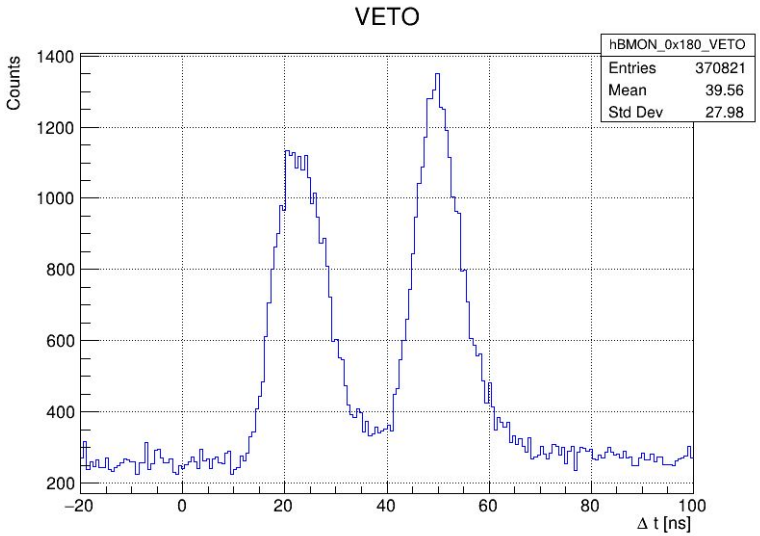
- Time difference histograms (-20 to 100 ns range, 0.6 ns/bin)
- Separate analysis by detector type, DiRICH board, and channel

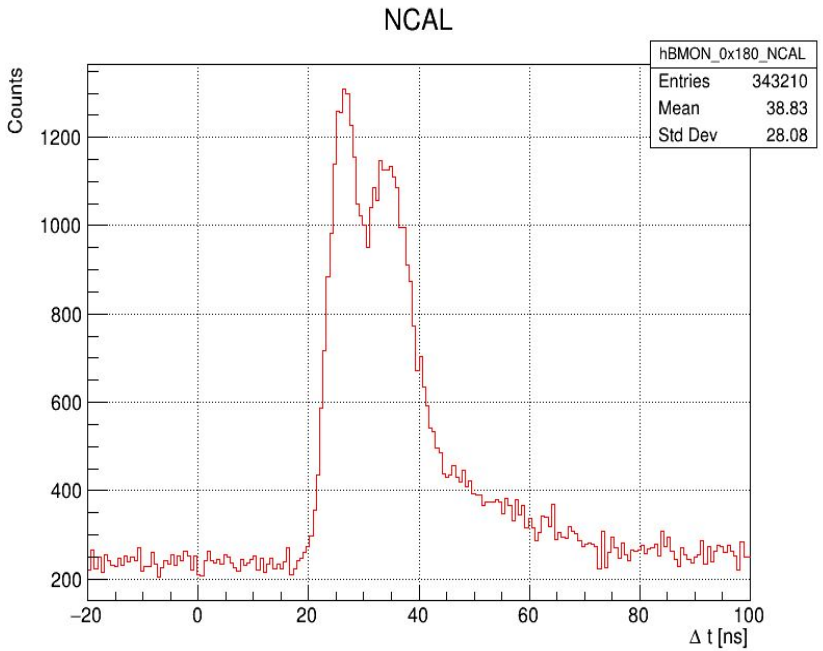
BMON channels vs NCAL, FSD, VETO combined correlations



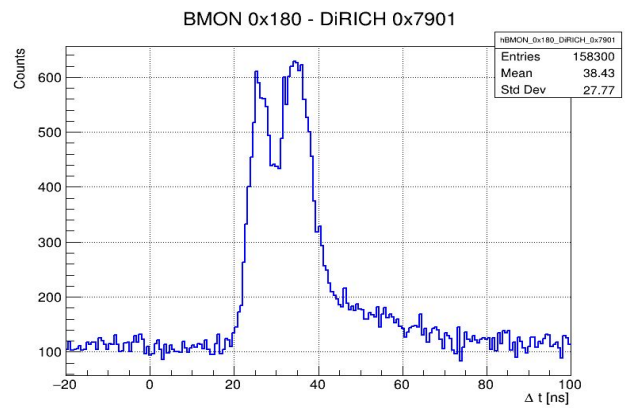
BMON 0x180 vs FSD, NCAL, VETO

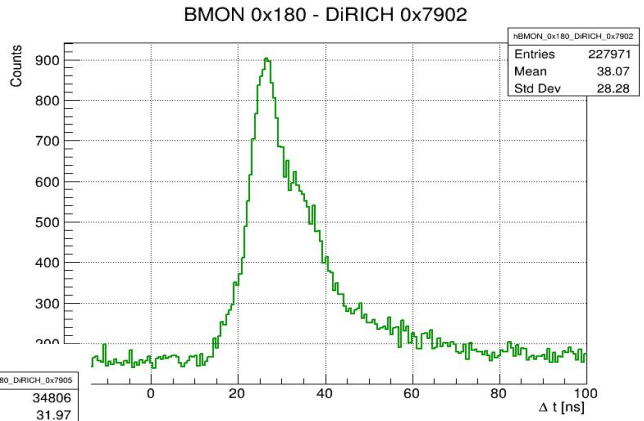


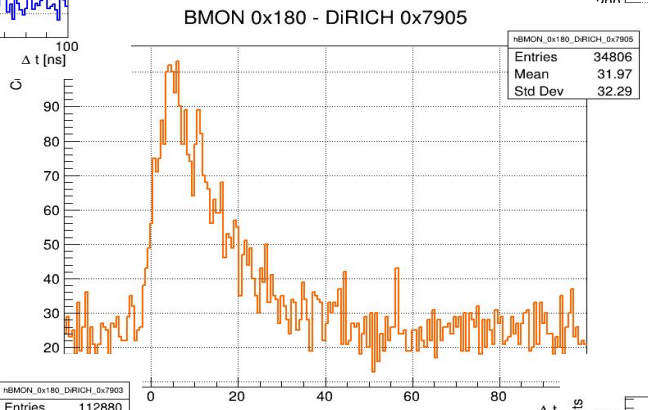


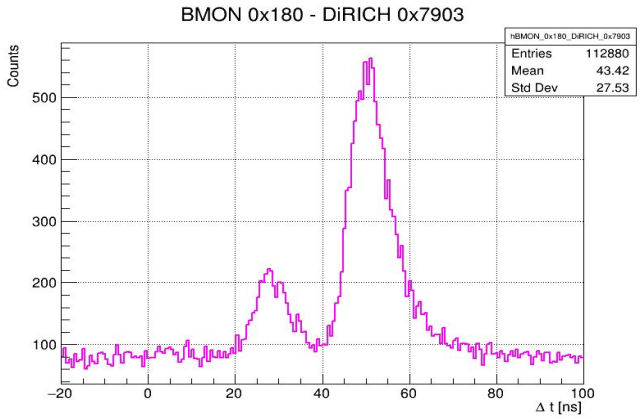


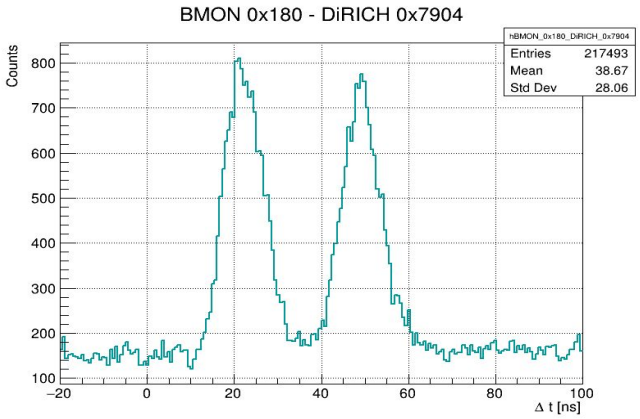
BMON 0x180 vs DiRich



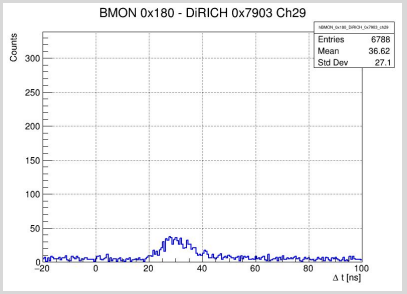


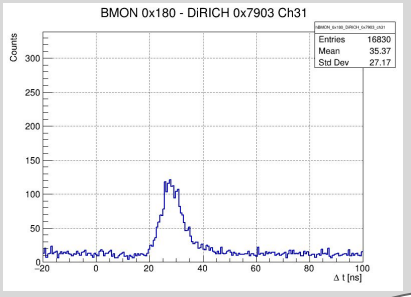




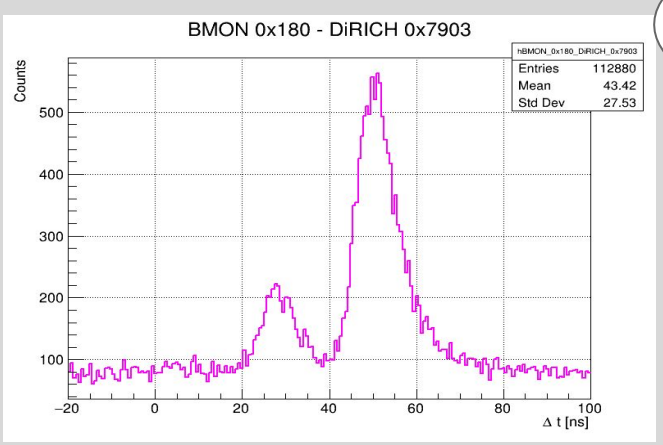


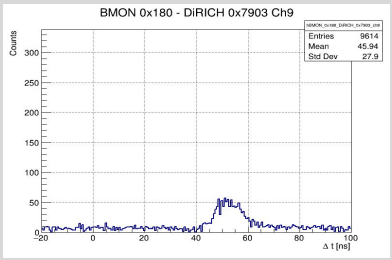
BMON 0x180 vs Veto Channels

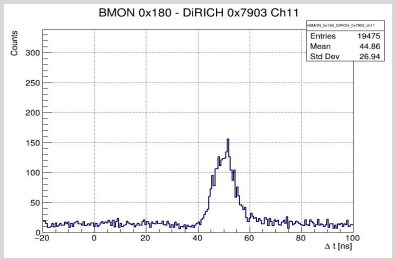




VETO 32

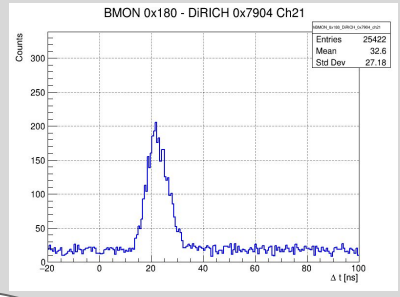


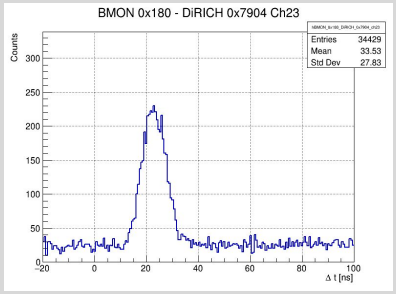




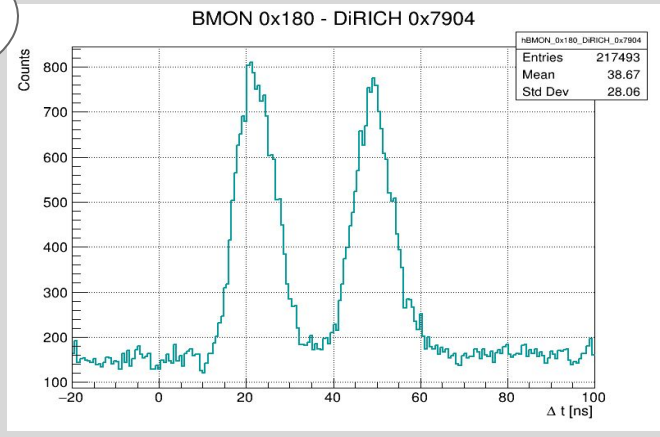
VETO 31

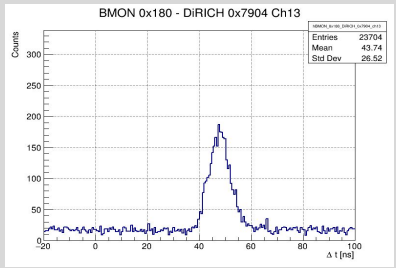
Is our system not centered on the beam plane?

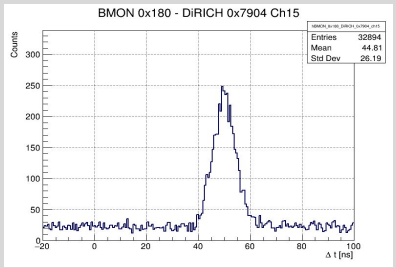




VETO 12

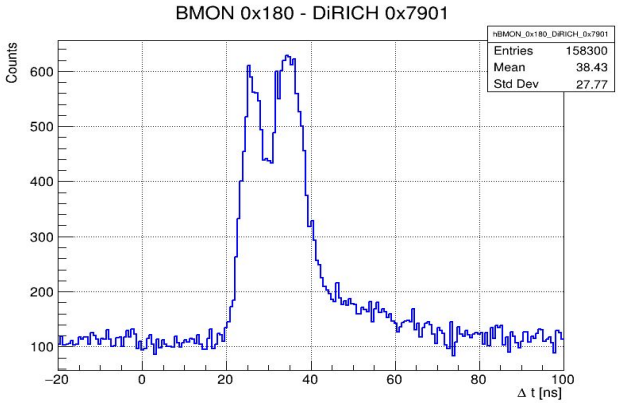


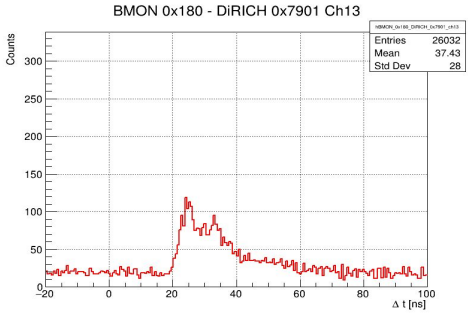


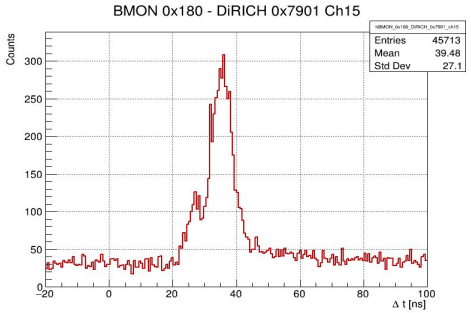


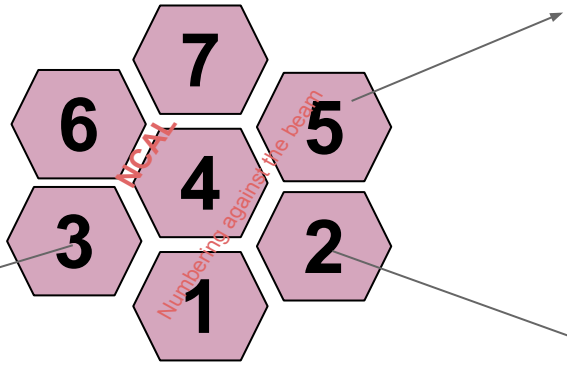
VETO 11

BMON 0x180 vs NCAL 7901 Channels

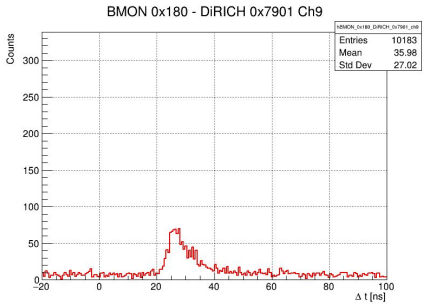


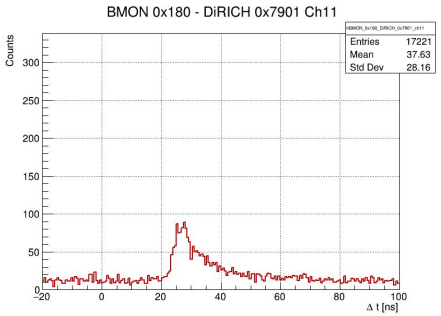


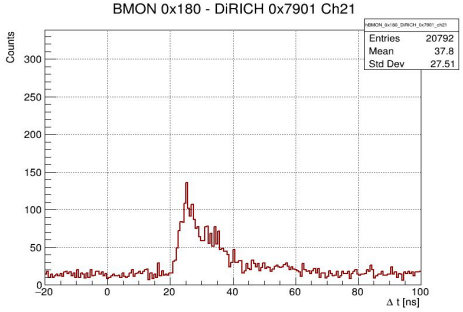


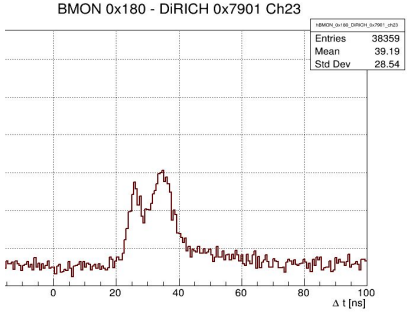


Beam closer to the top?

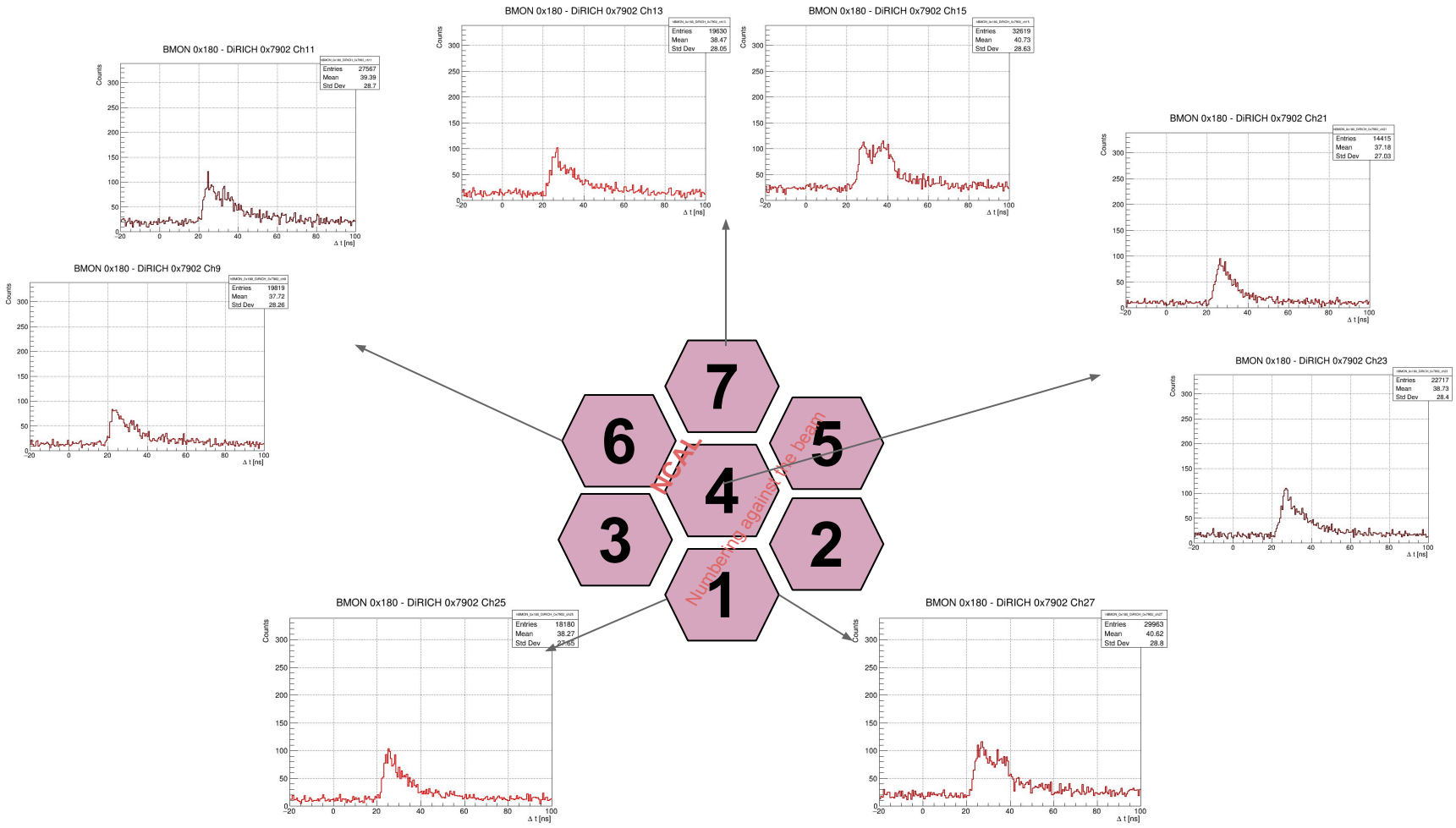




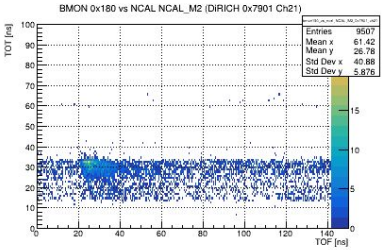


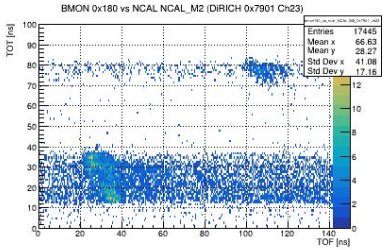


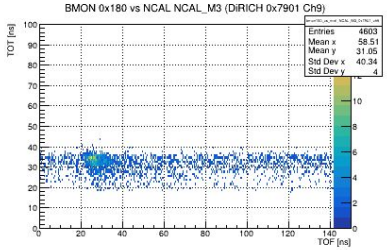
BMON 0x180 vs NCAL 7902 Channels

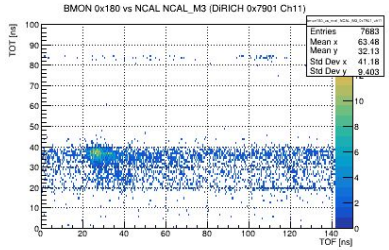


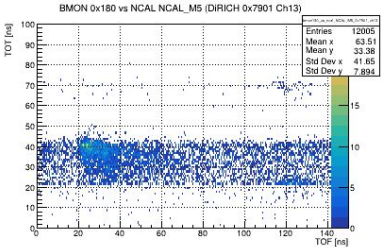
BMON 0x180 vs NCAL: TOF vs TOT

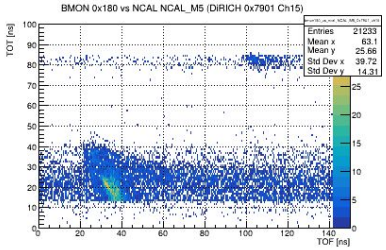


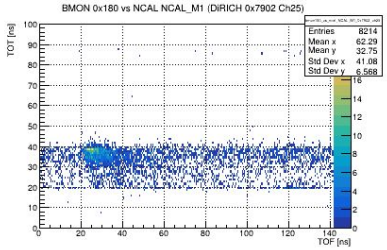


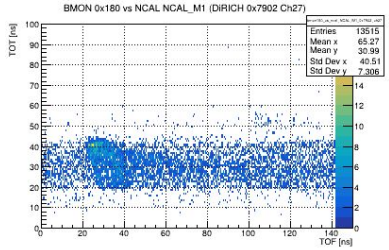


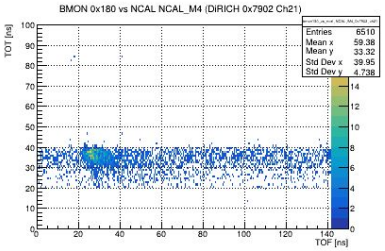


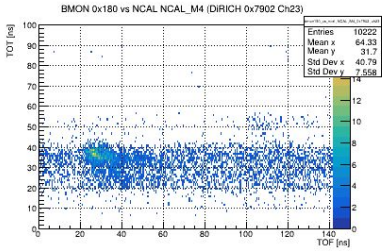


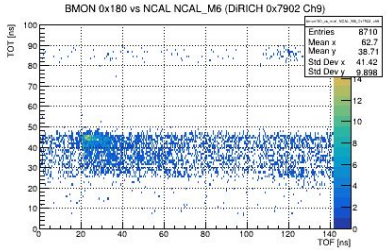


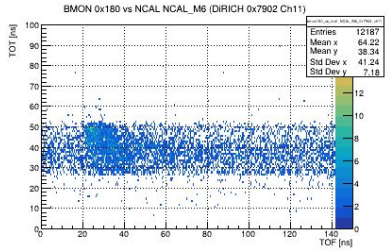


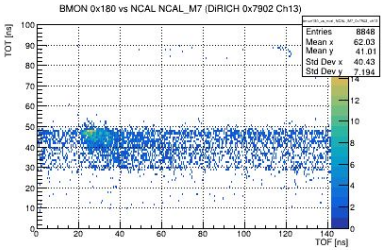


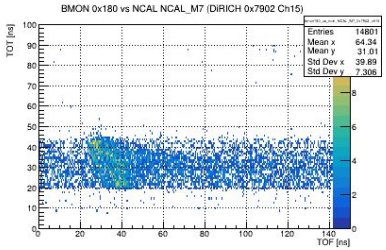












VETO – NCAL correlations / exclusions

Correlation Method:

- Analysis performed within each TimeSlice separately
- VETO correlation window: ±40 ns
- Hits are matched using local timeslice times
- Binary search for efficient hit finding

Three Categories per Channel:

- Total ToT distribution (black)
- VETO-correlated hits (red)
- VETO-excluded hits (blue)

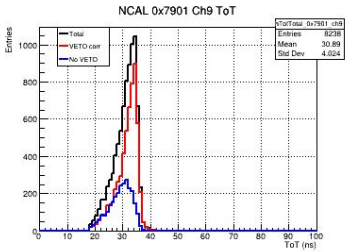
Channel Types:

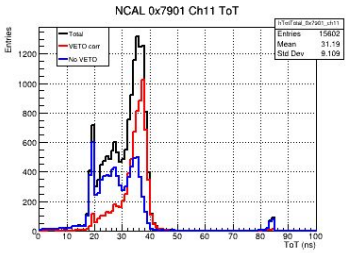
- NCAL (0x7901, 0x7902): ToT range 0-100 ns
- FSD (0x7903, 0x7905): ToT range 10-50 ns
- VETO (0x7902-0x7904): Used for correlation

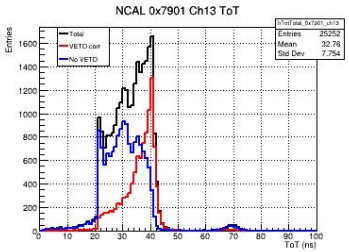
Output:

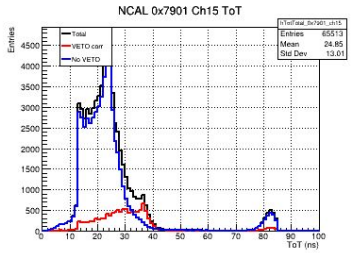
- Individual channel histograms
- Linear and log summary plots
- Correlation statistics per channel

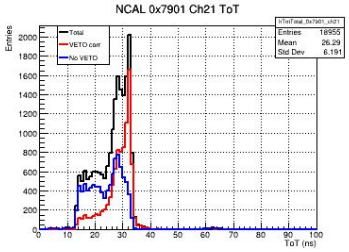
Veto NCAL correlations - 40 ns window

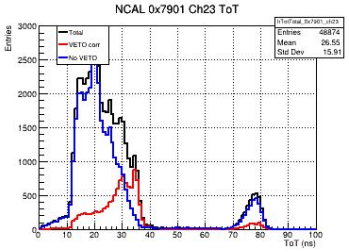


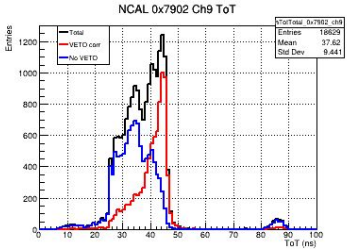


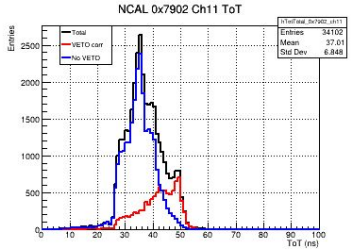


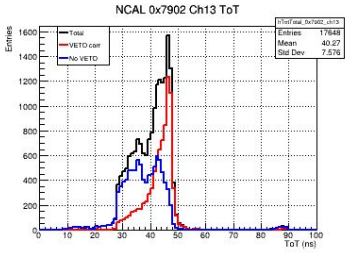


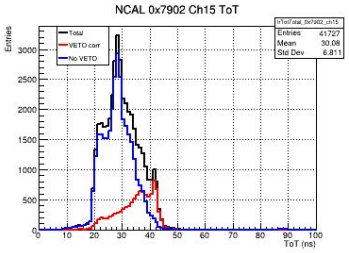


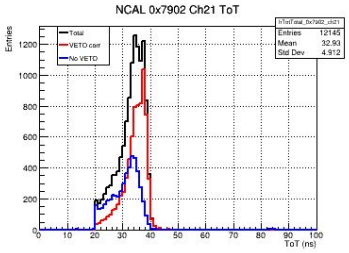


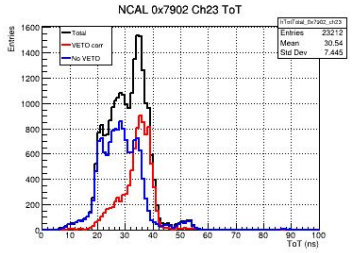


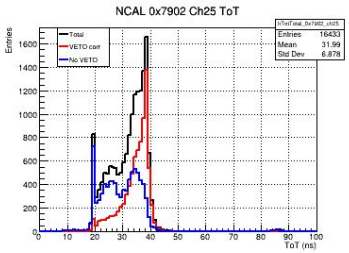


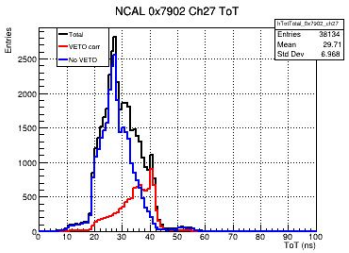




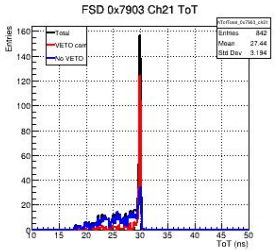


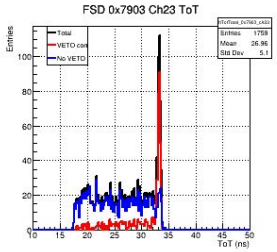


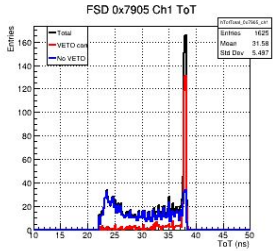


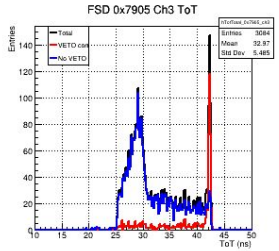


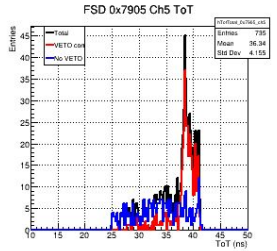
Veto NCAL correlations - 40 ns window

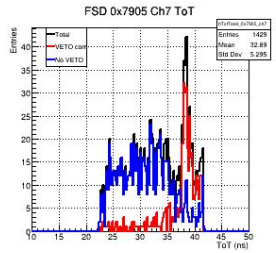


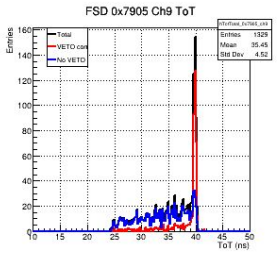


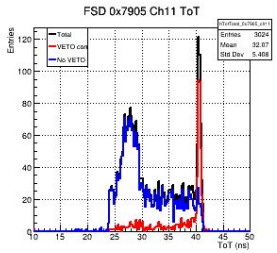


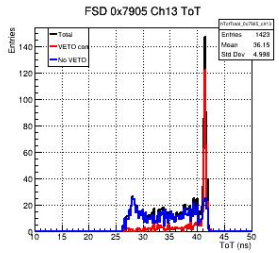


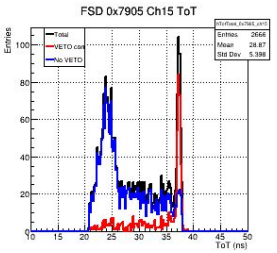


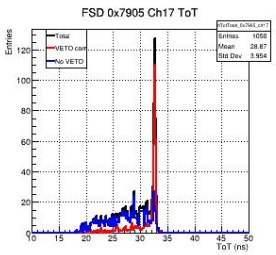


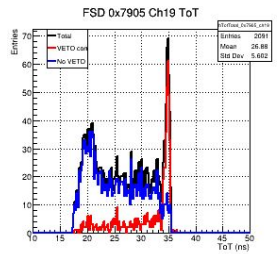


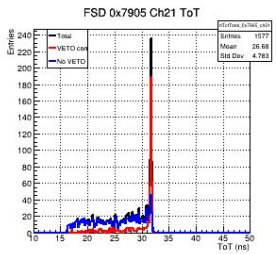


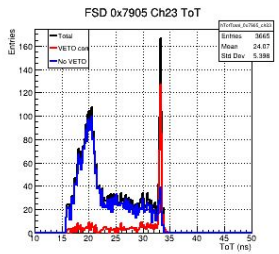


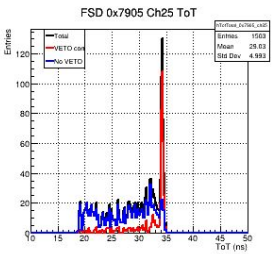


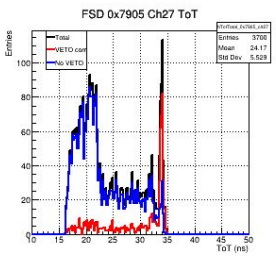


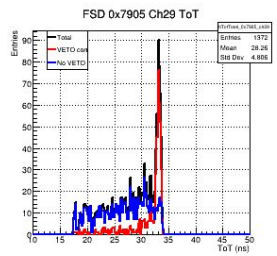


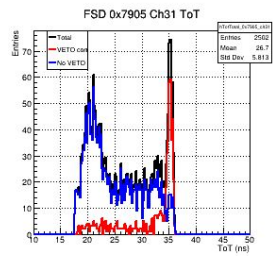




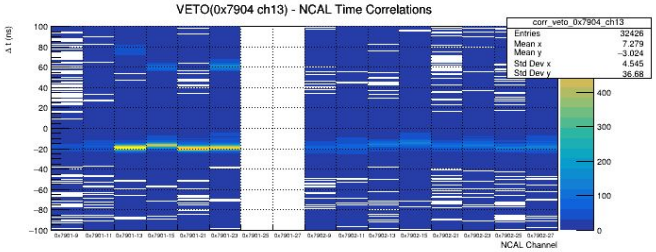


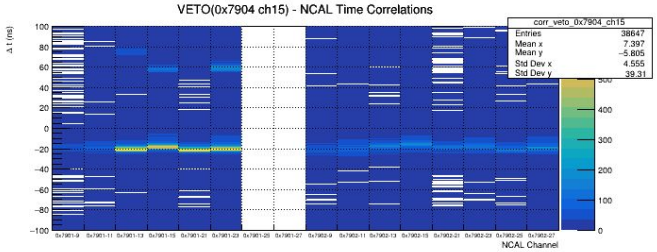


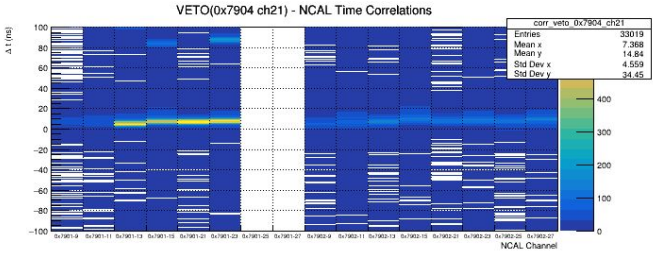


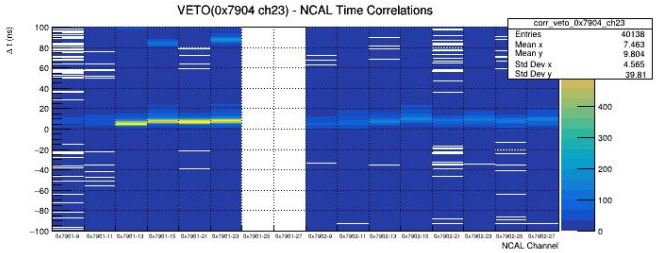


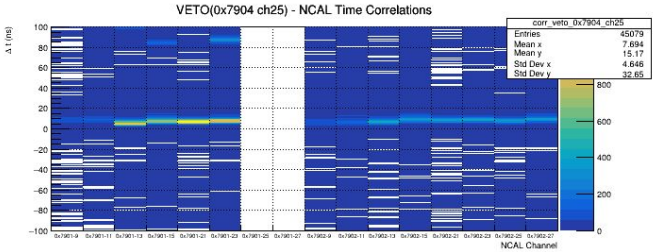
Veto NCAL correlations

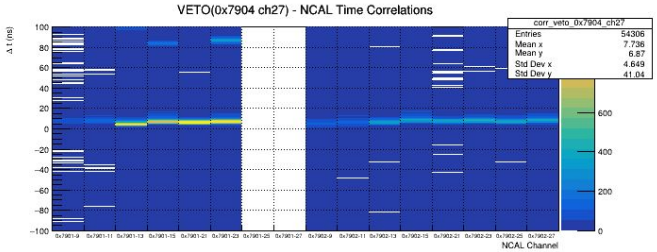


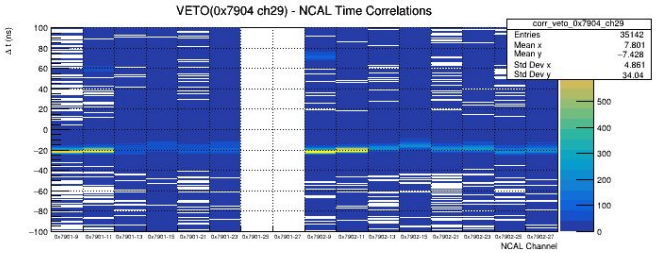


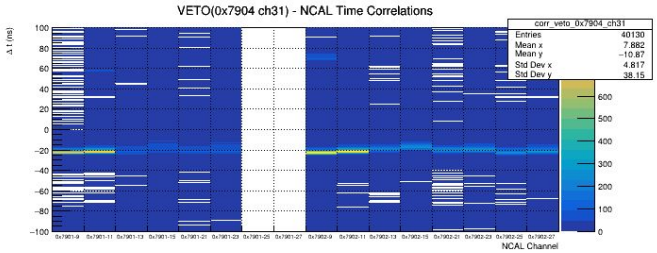




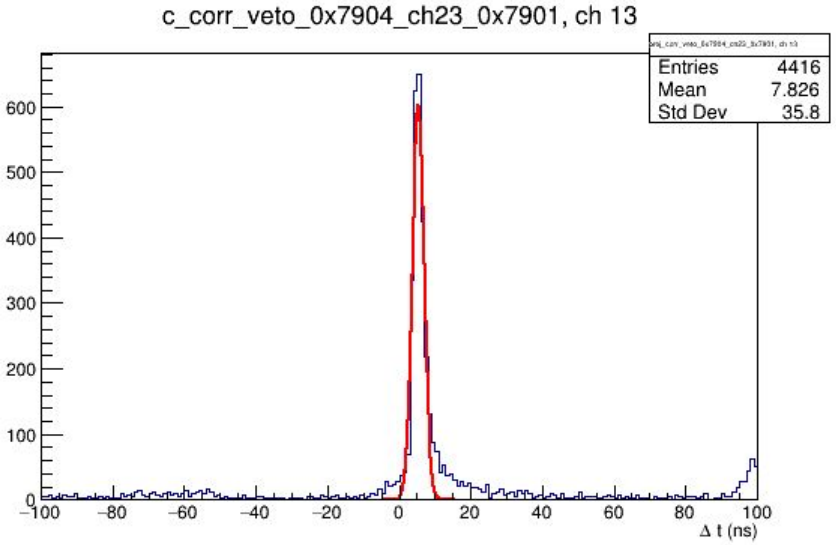


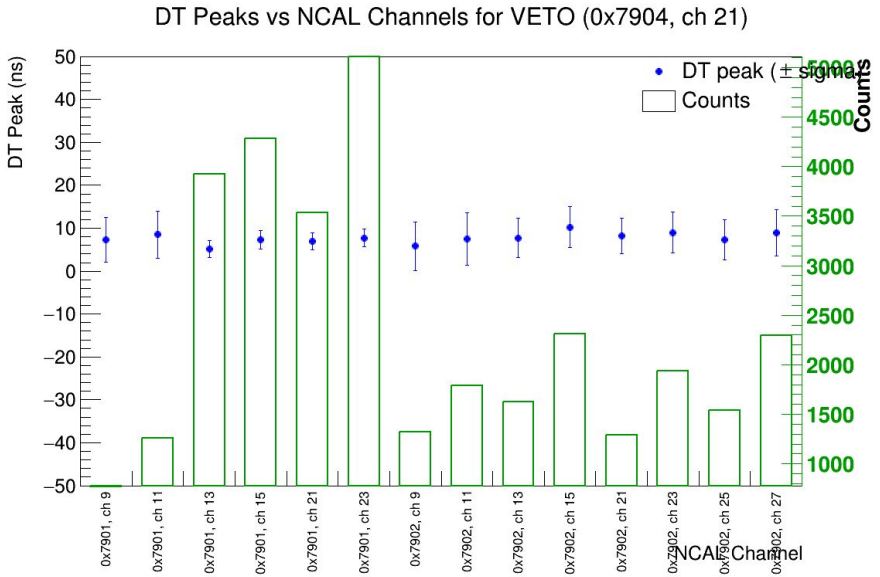




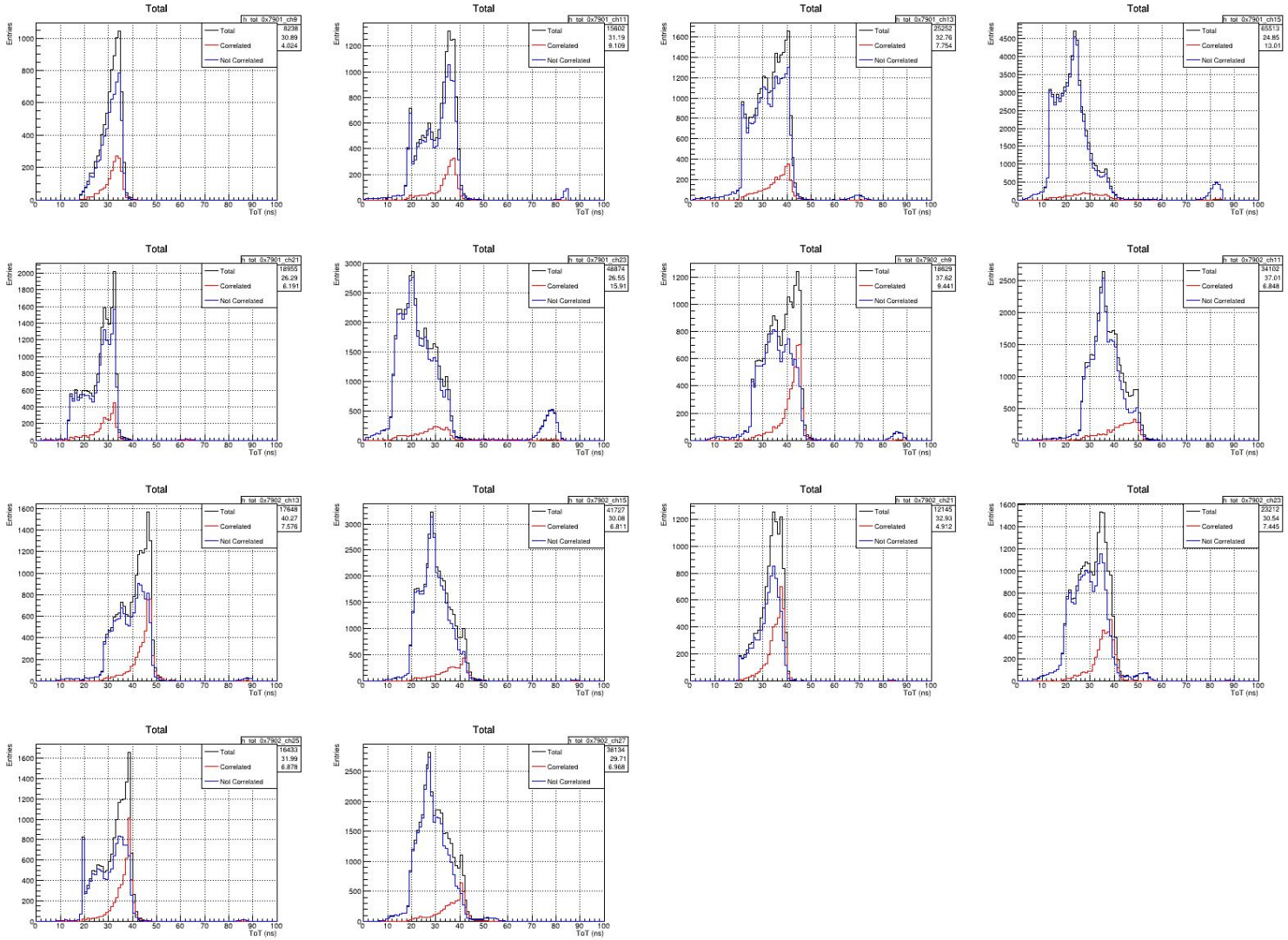


Veto NCAL correlations

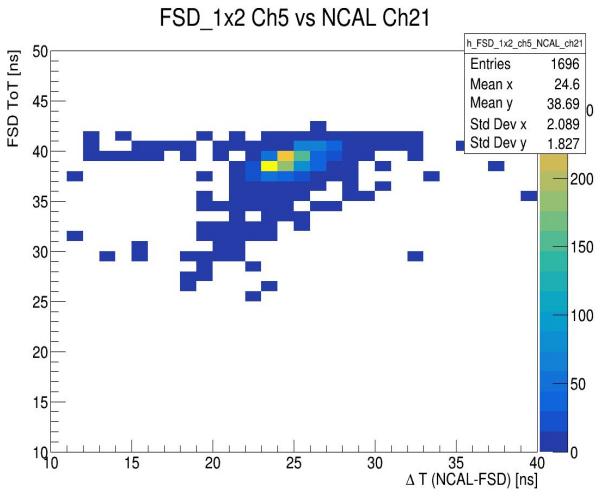


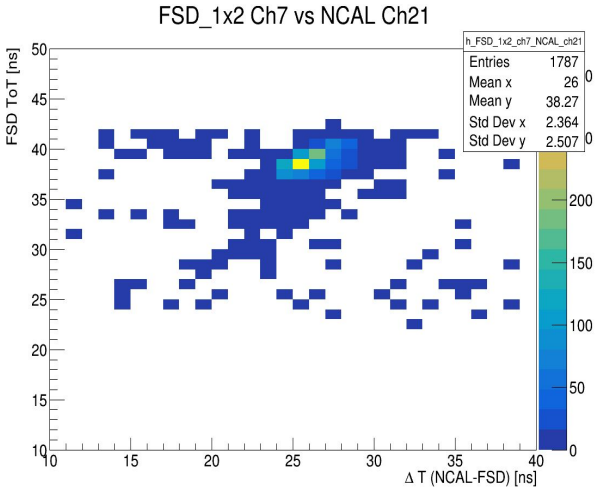


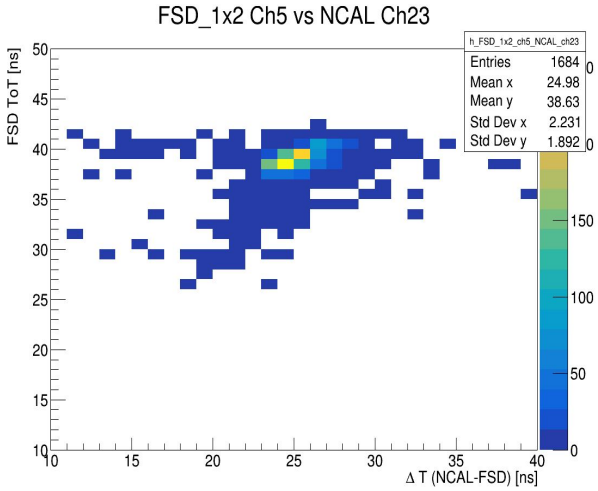
Veto NCAL correlations - variable 3 sigma window

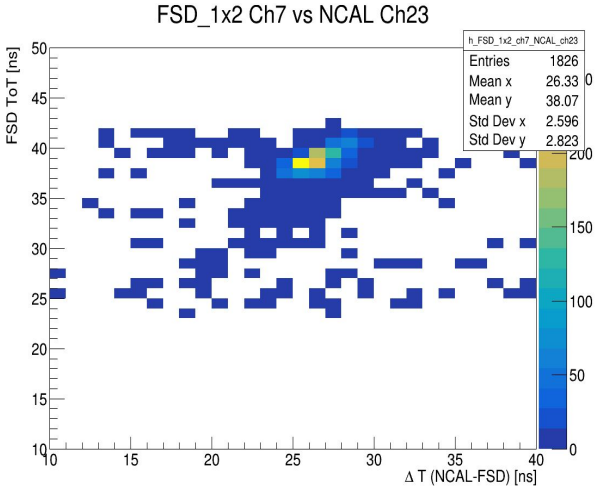


FSD – NCAL Correlations: TOT vs dT

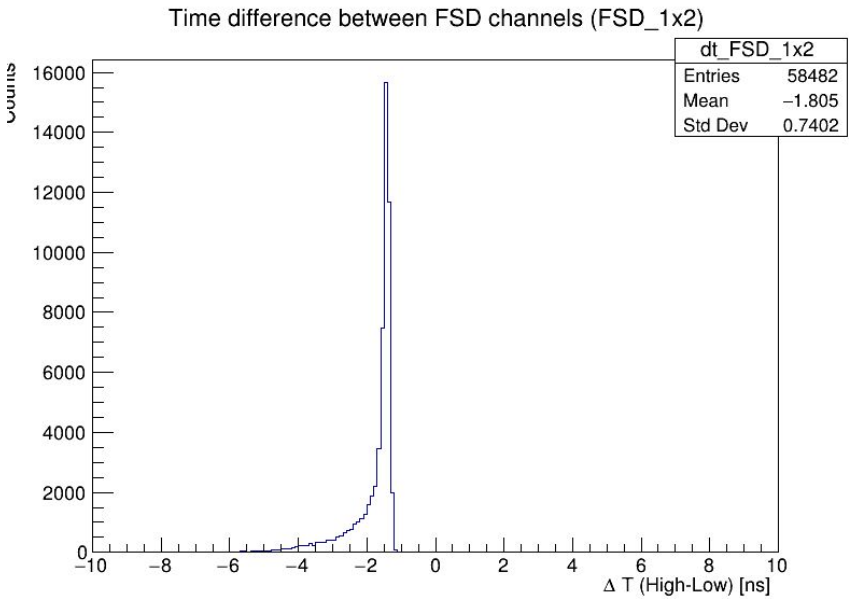


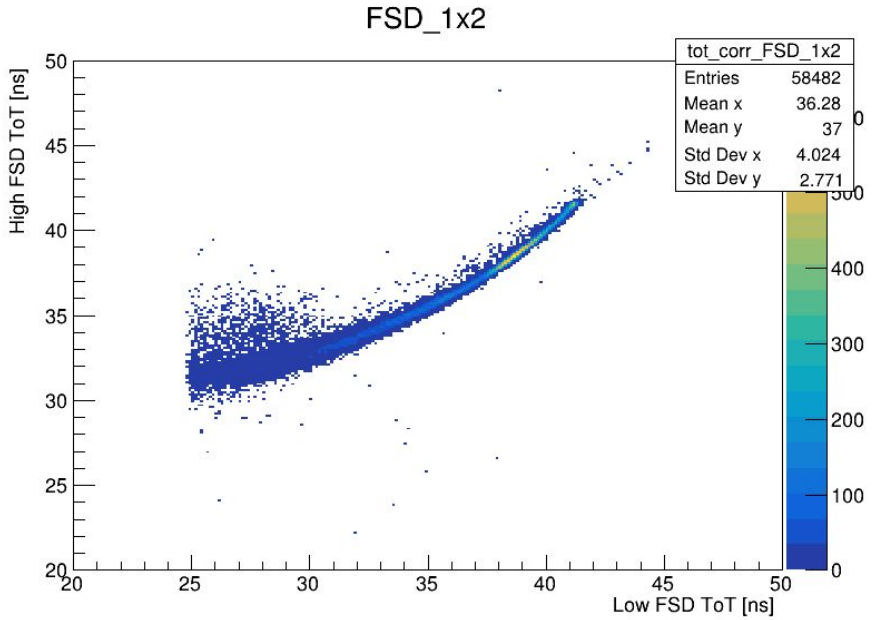




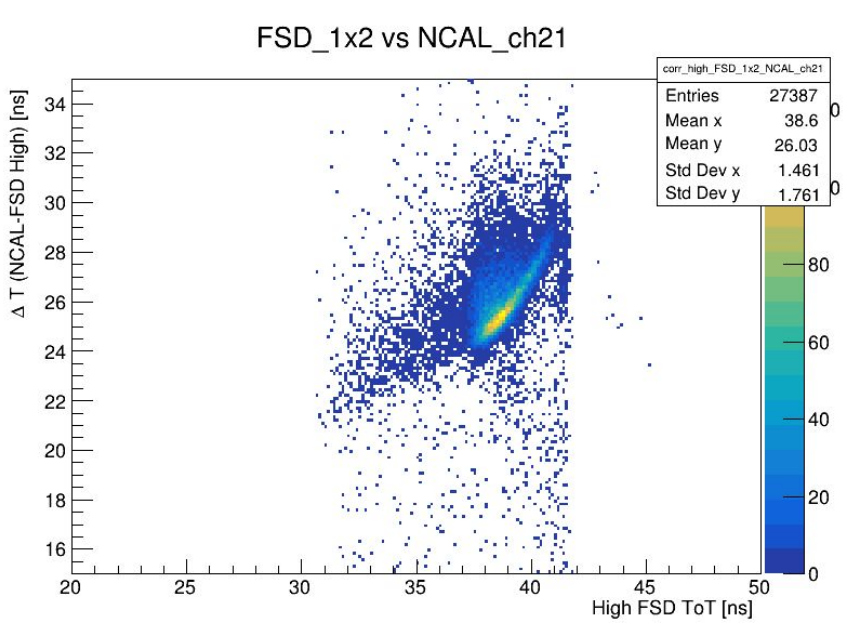


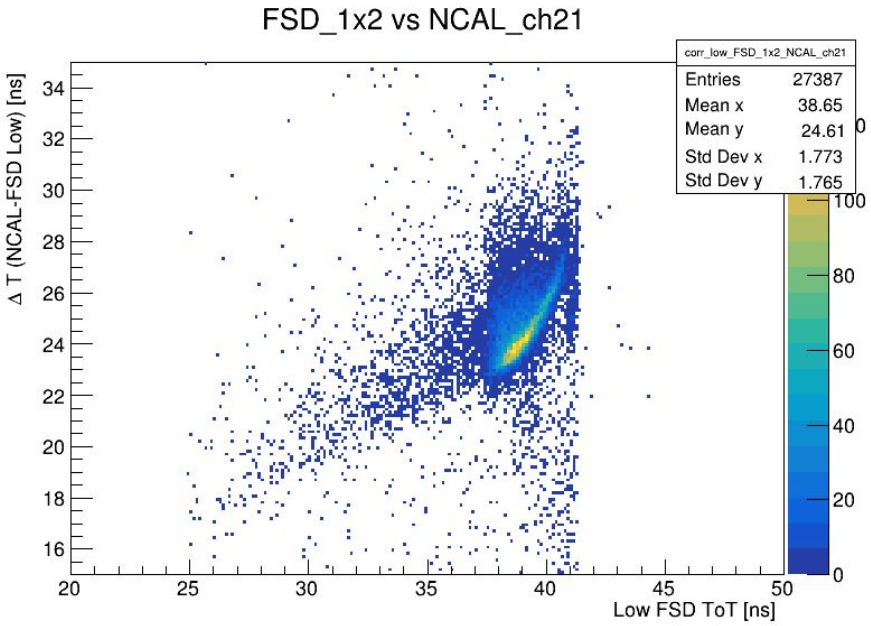
FSD high - FSD low correlations



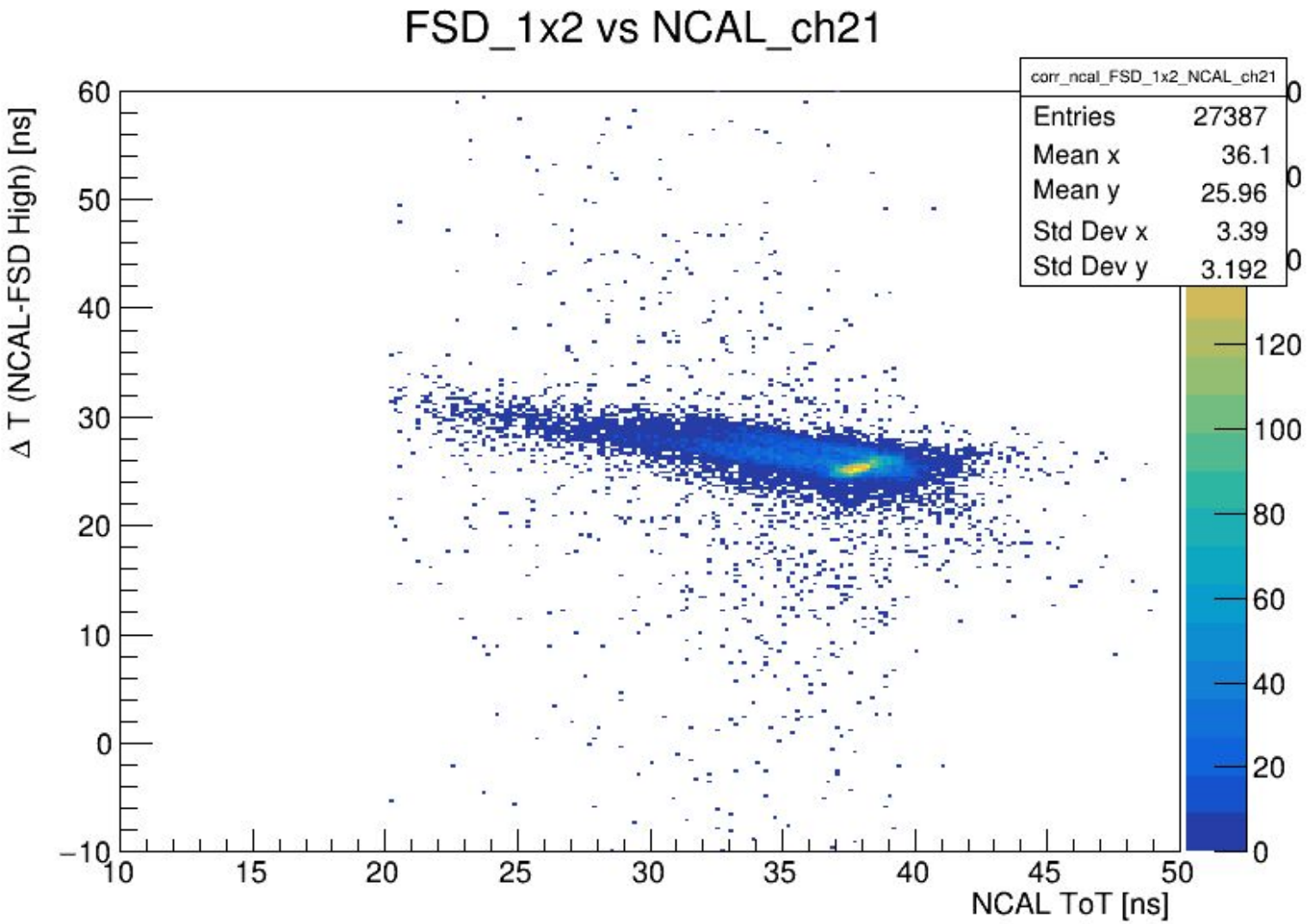


FSD TOT vs dT NCAL Correlations

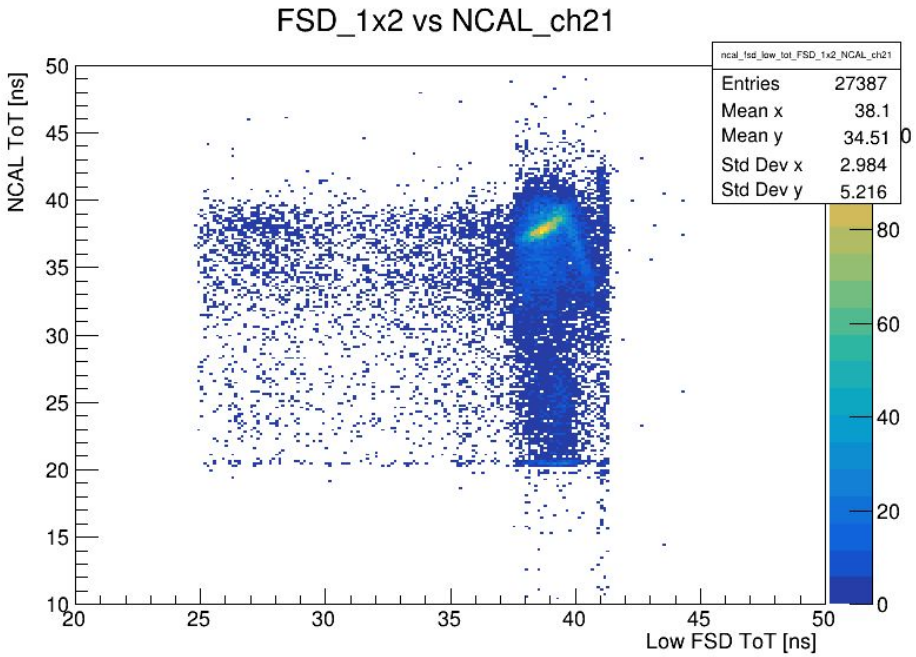


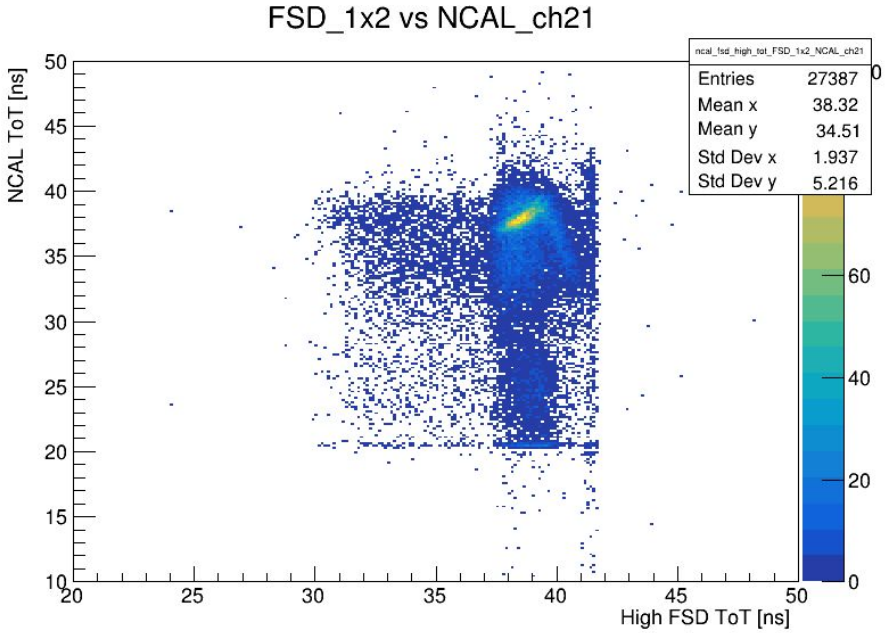


NCAL TOT vs dt FSD

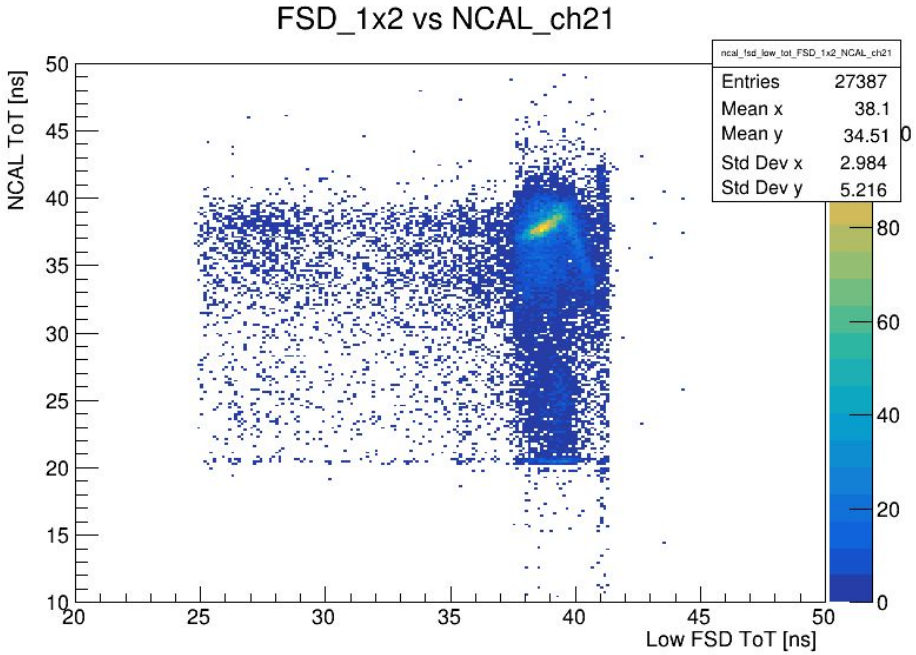


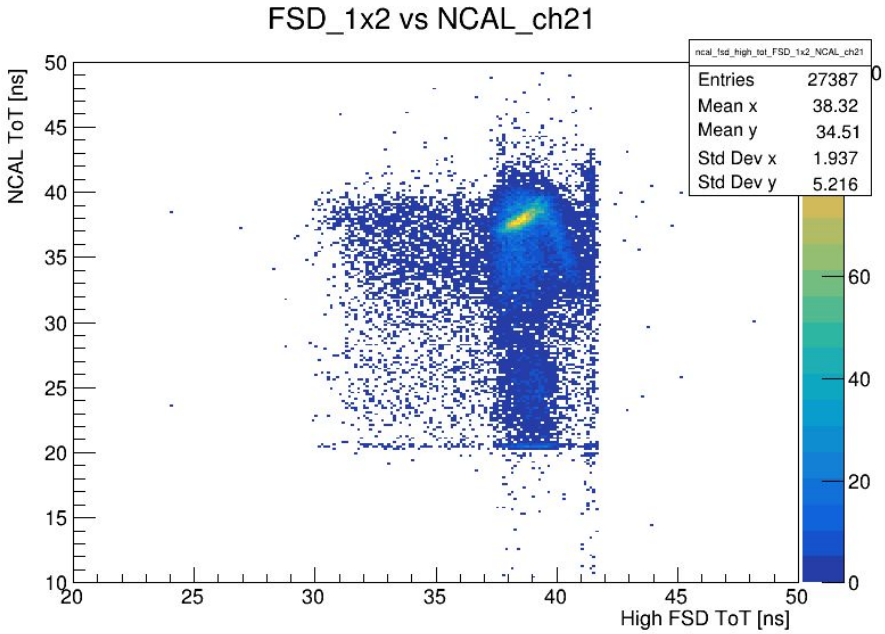
FSD TOT vs NCAL TOT



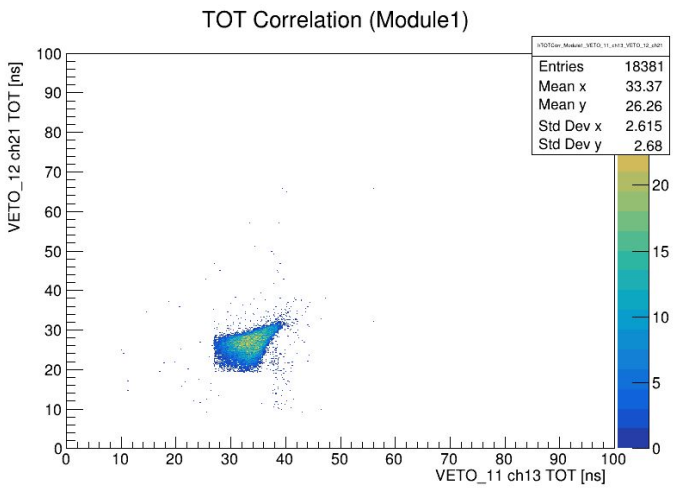


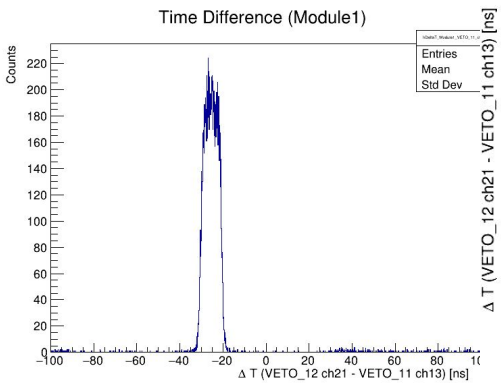
FSD TOT vs NCAL TOT

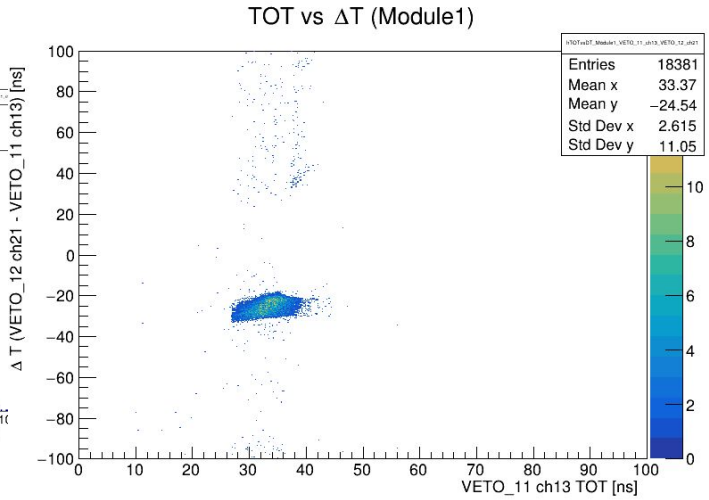


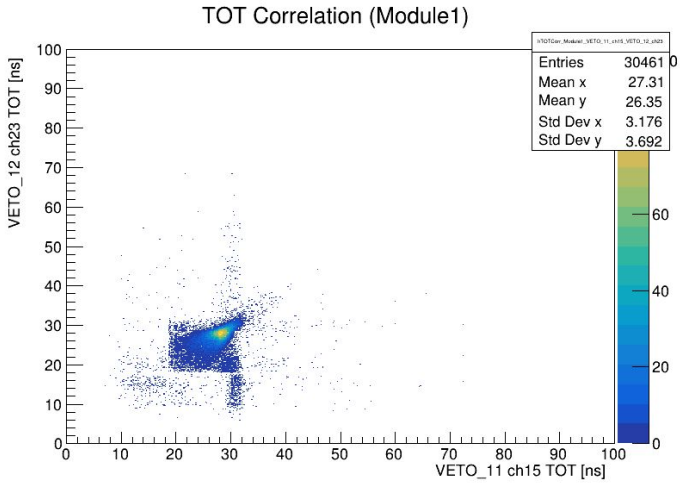


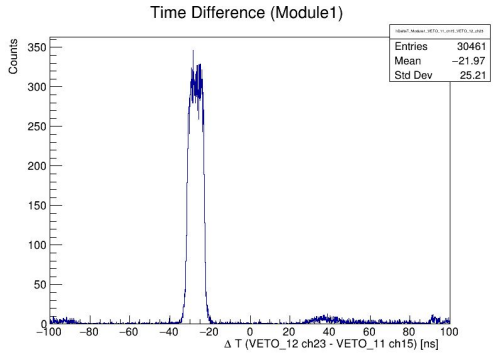
VETO Correlations

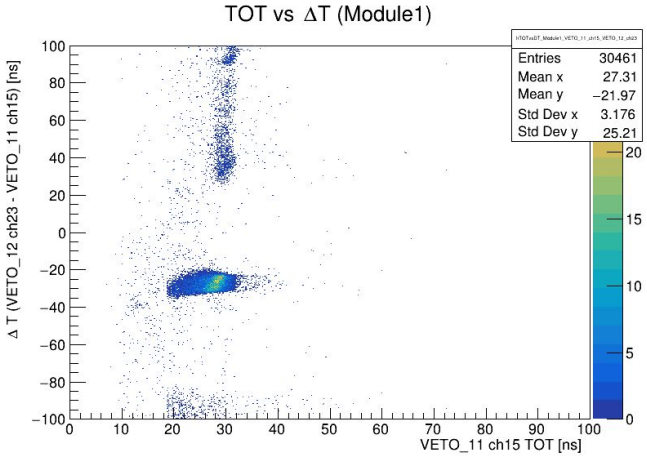






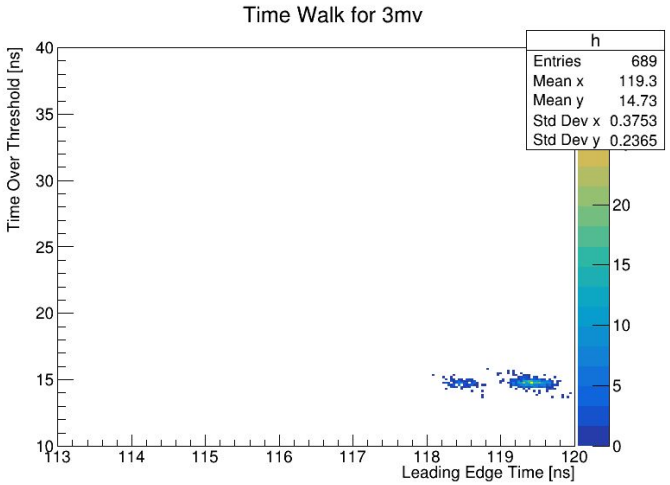


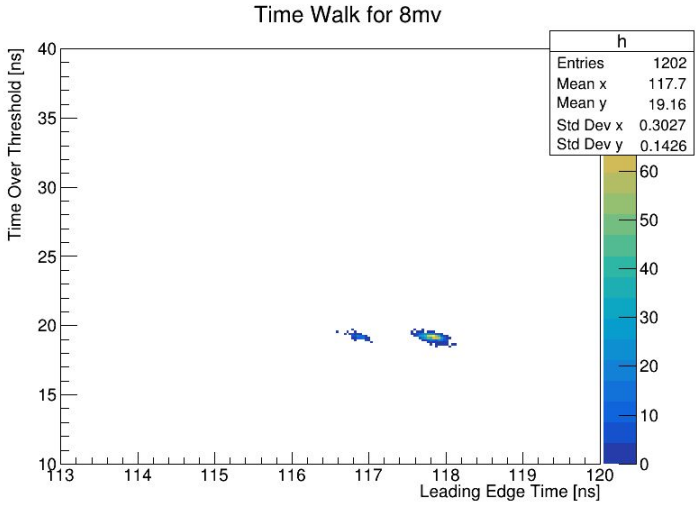


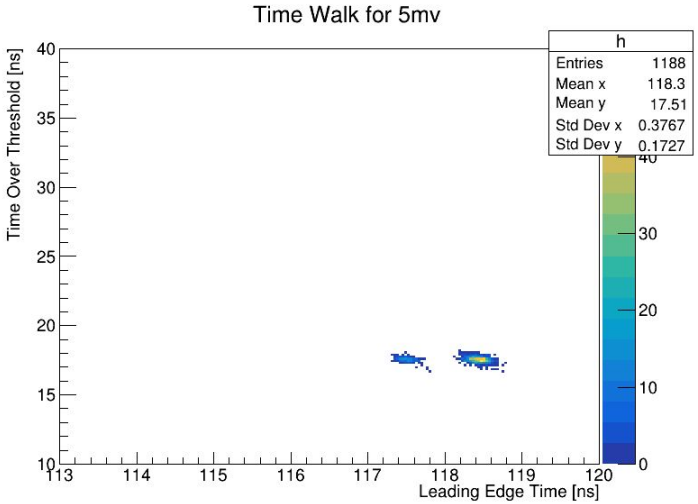


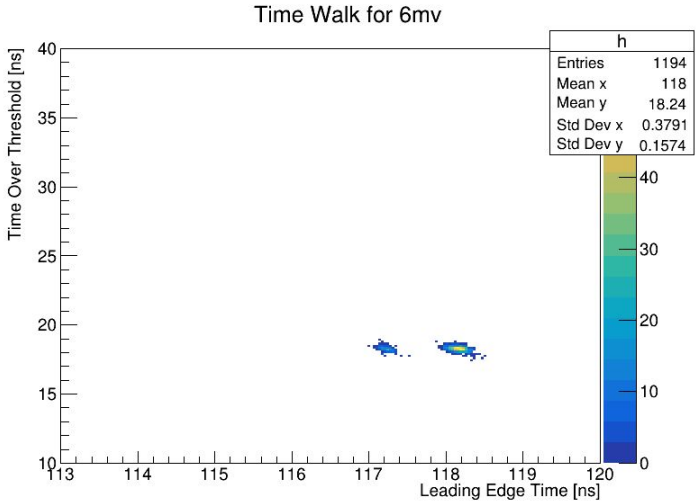
Time Walk - Generated signal

Time Walk - Generated signal





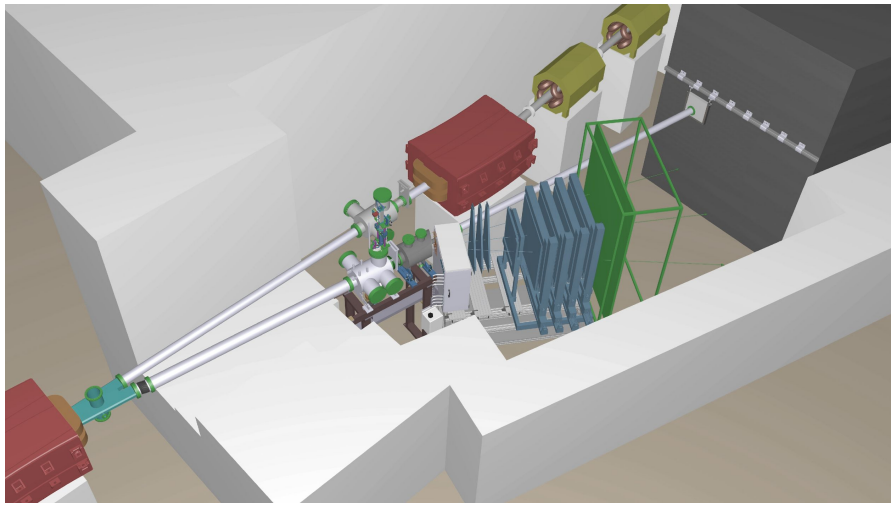




Outlook

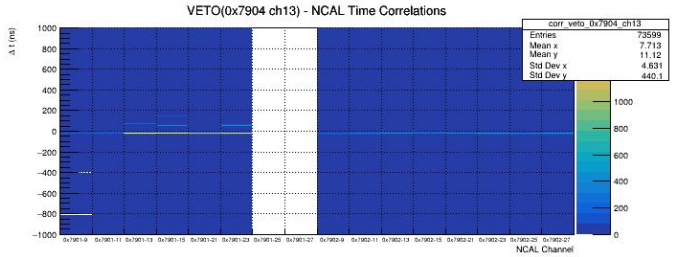
- BMON NCAL TOF TOT 2D distributions
  - VETO-correlated and VETO-excluded distributions
    - FSD correlated
  - Trigger ON run analysis

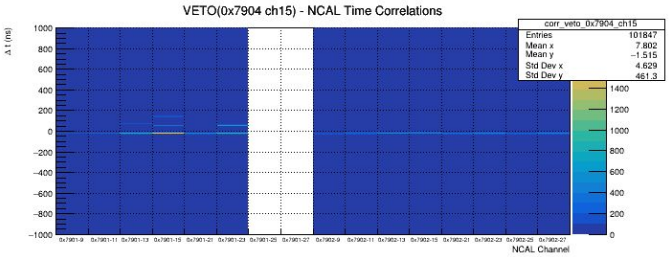
- Calibrations MUST be performed before the next beam time
  - Cosmics
  - Pulse generator data tacking

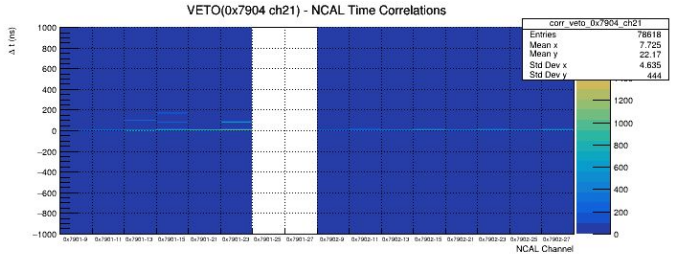


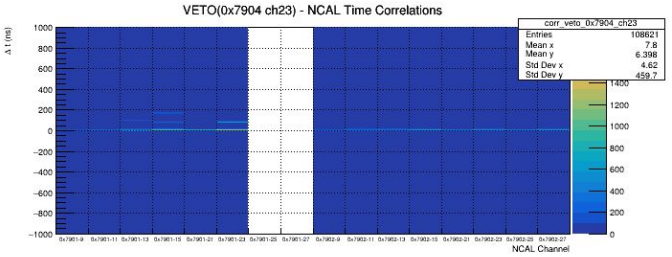
Questions and Discussions

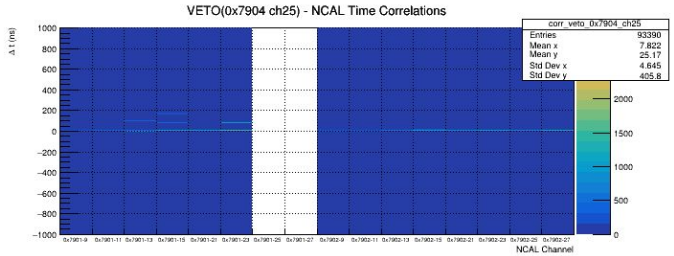
Questions and Discussions

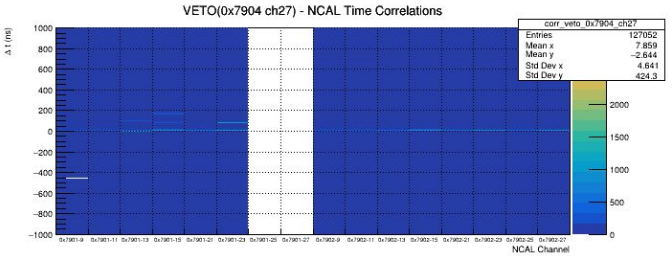


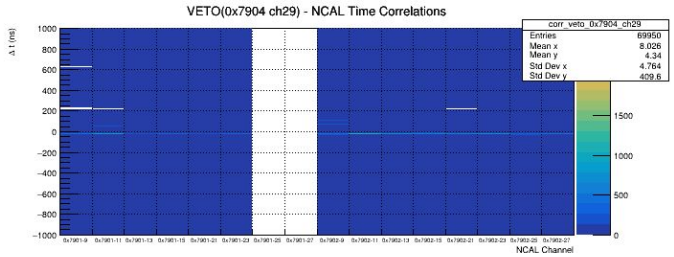


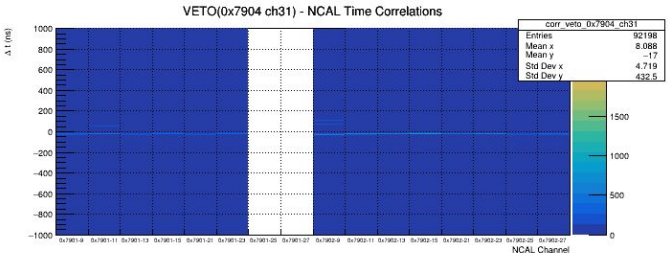




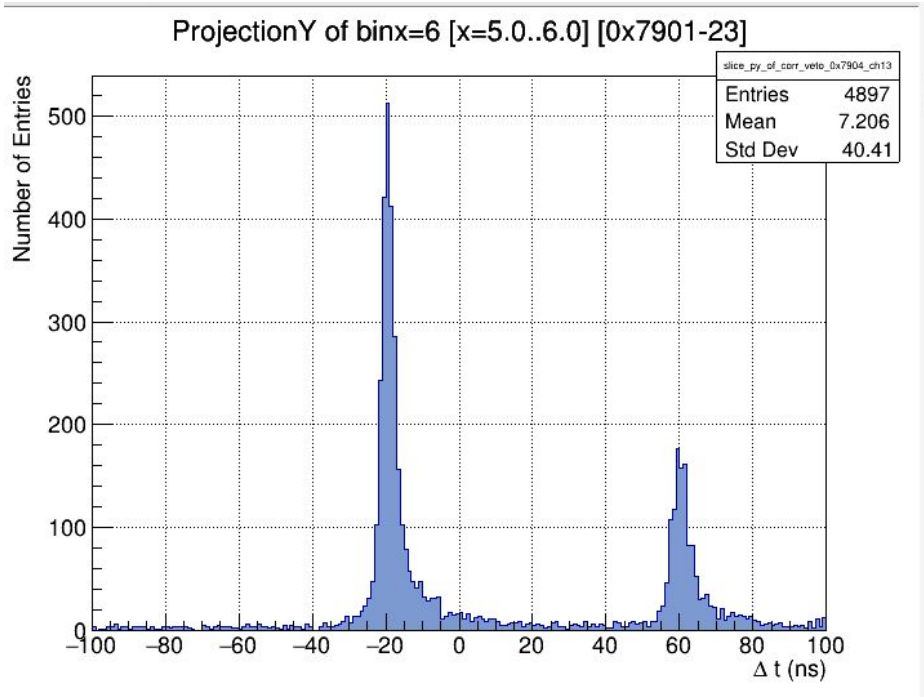


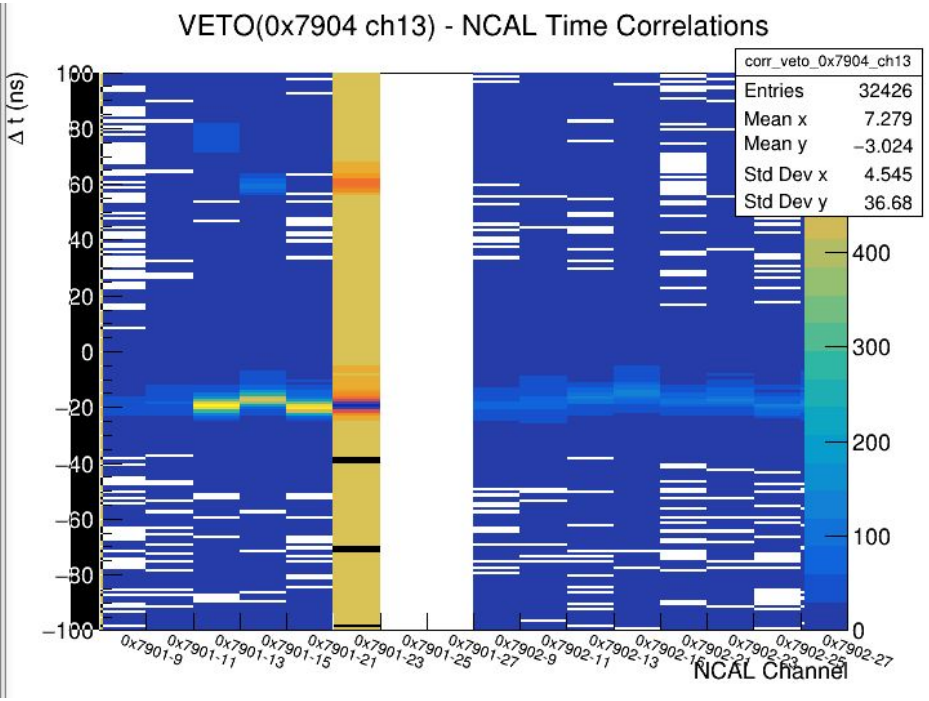




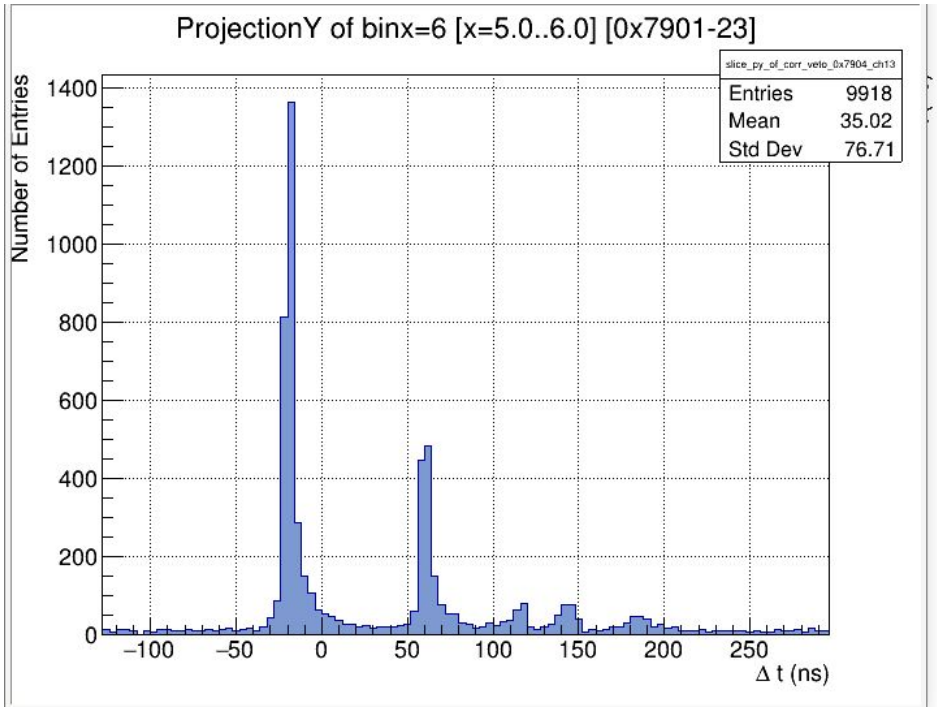


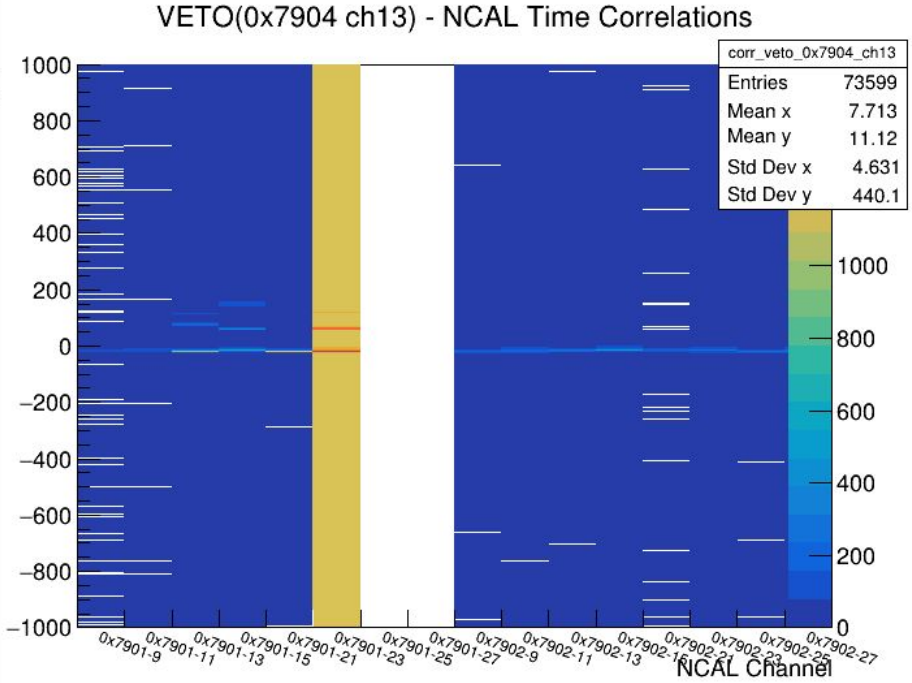
Questions and Discussions



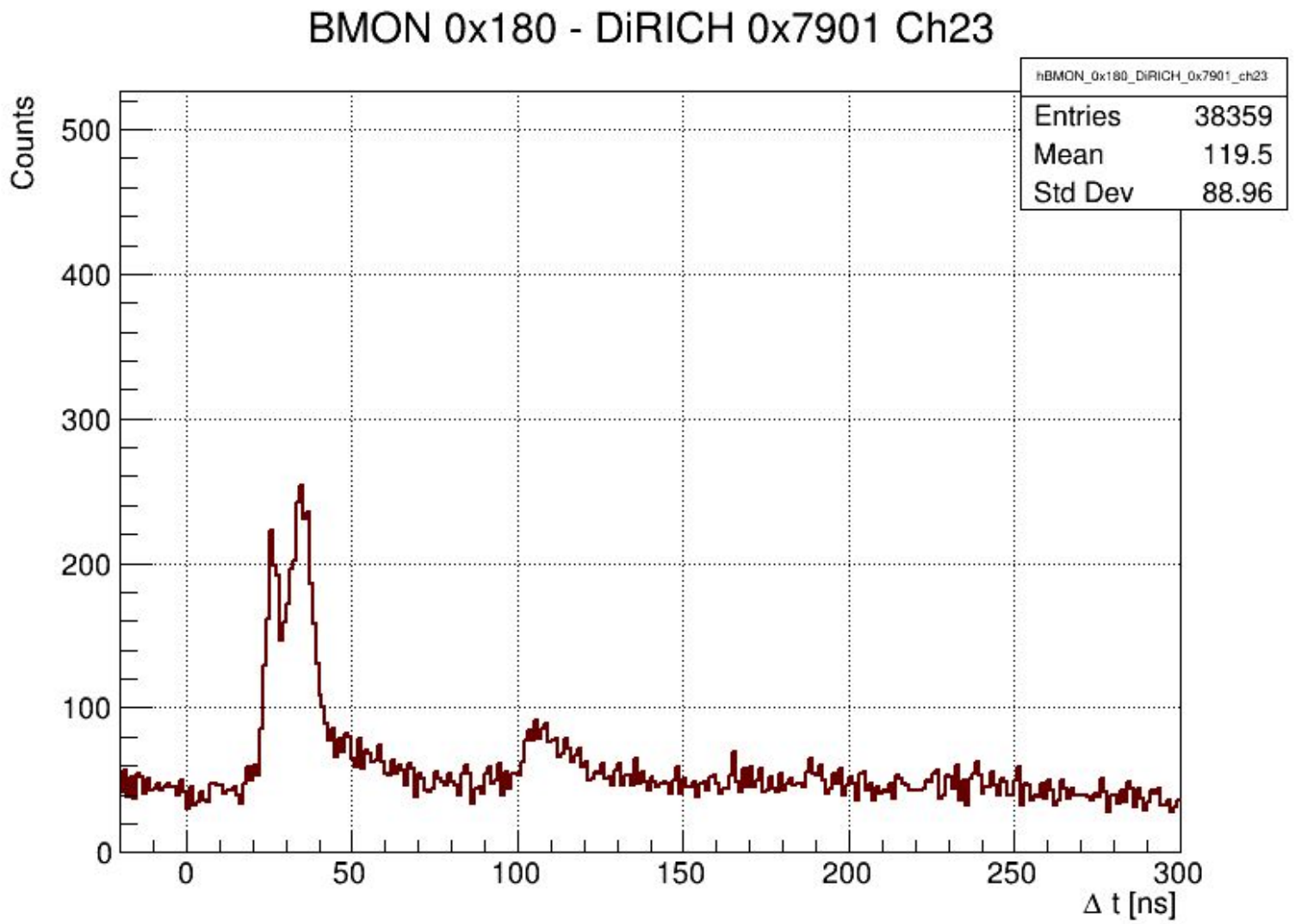


Questions and Discussions





Questions and Discussions



Thank you for your attention!

Dachi okropiridze

03/03/2025, RUB