ECOgas weekly meeting

Time resolution studies with the ALICE RPC

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Overview

- Data set for time resolution studies
- Mixtures tested and setup
- Results
- Possible studies of trigger jitter (preliminary)

Dataset

- **Time resolution studies**
  - Only data at source OFF (explained why in the next slide)
  - STD gas mixture + all HFO/CO2 mixtures studied (from 0 up to 40% HFO)
  - Used the DT5742 CAEN digitizer

- **PMT jitter**
  - Only at source OFF
  - Same digitizer as for time resolution

Time resolution

Setup for the measurements - 1

- Digitizer has a f**ixed number of samples per trigger** (1024) but **different sampling** frequencies (1, 2.5 and 5 Gs/s)
  → According to the sampling frequency, the length of the acquisition window changes

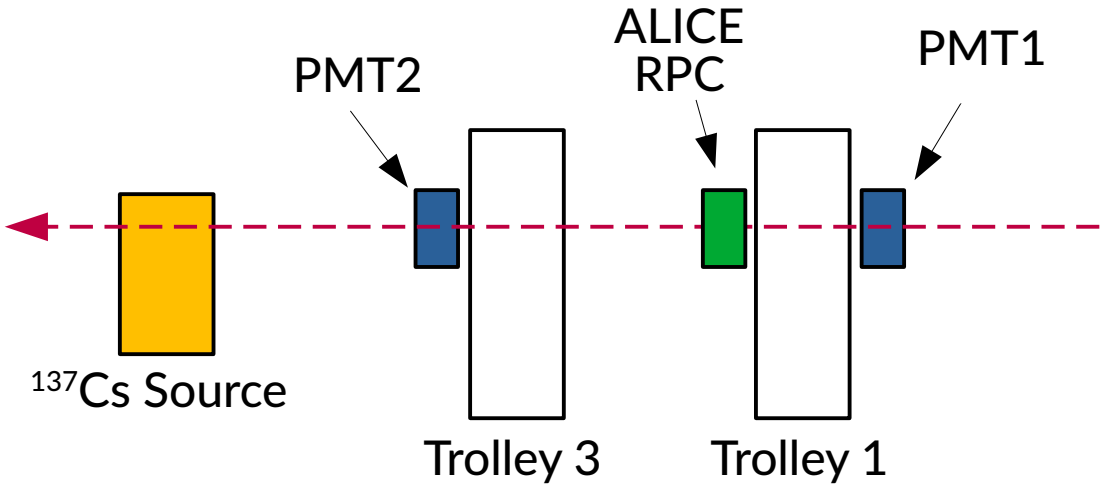
- To maximize precision I used **5 Gs/s**
  → Time window of ~ **204 ns** (1 sample every 200 ps)

- If the coincidence of internal + external scintillators is used
  → **Delay between trigger and RPC signal > 500 ns**, so not possible to use the 5 Gs/s mode

- To solve this problem
  → **Only the coincidence of the internal scintillators** is used
  → This works only with source OFF

Setup for the measurements - 2

- 7 strips from the ALICE RPC readout with the digitizer

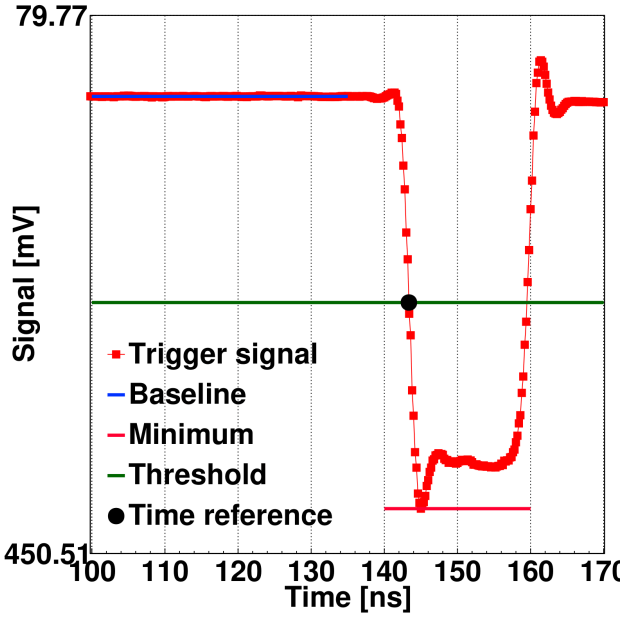


- **Trigger provided by the coincidence of PMT1 and PMT2**

- Fed to the **fast trigger** (low latency) input of the digitizer
  → Sampling frequency of this input is 117 MHz
  → Jitter of ~8.5 ns
  → **Important**: fast trigger signal is digitized as well

Measurement strategy - 1

- Acquire timestamp of the trigger

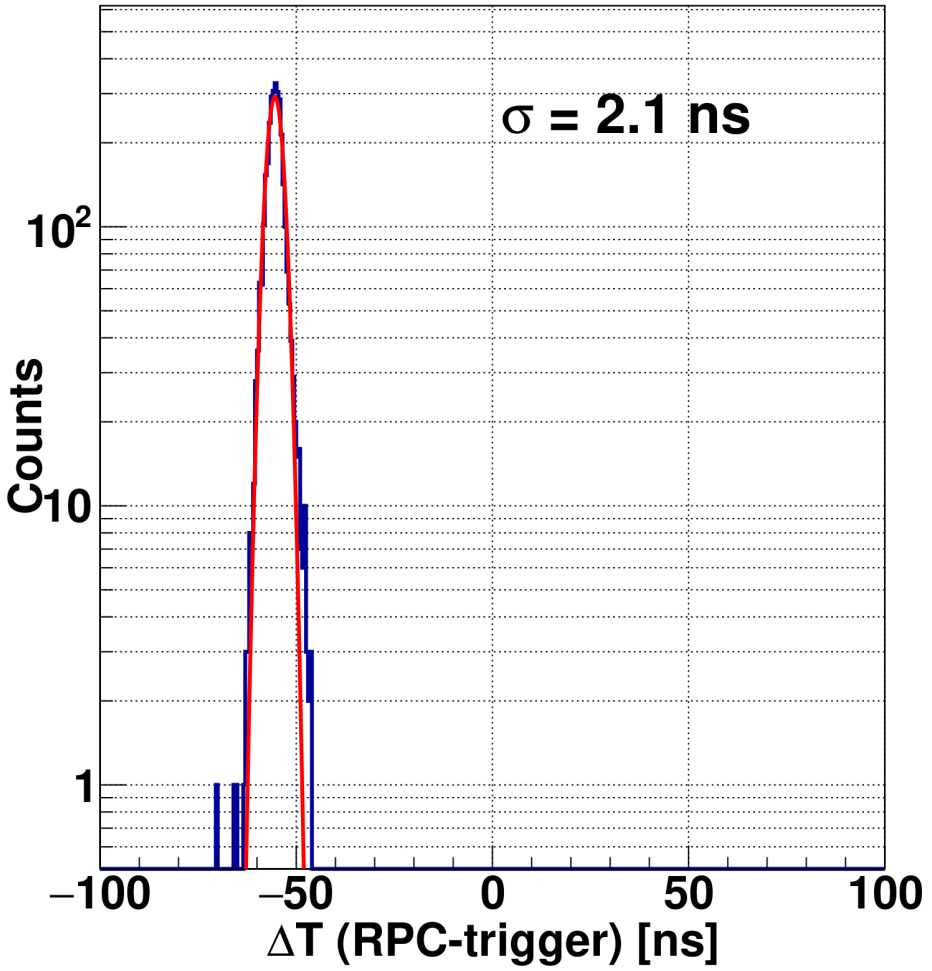


- I get the mean value of the **baseline** (before the trigger) and its **minimum**
- I find the value at 50% of the difference mimimum – baseline (**threshold**)
- I interpolate the two points closest to it (one sample before and one sample after) and find the **interesection with the threshold**

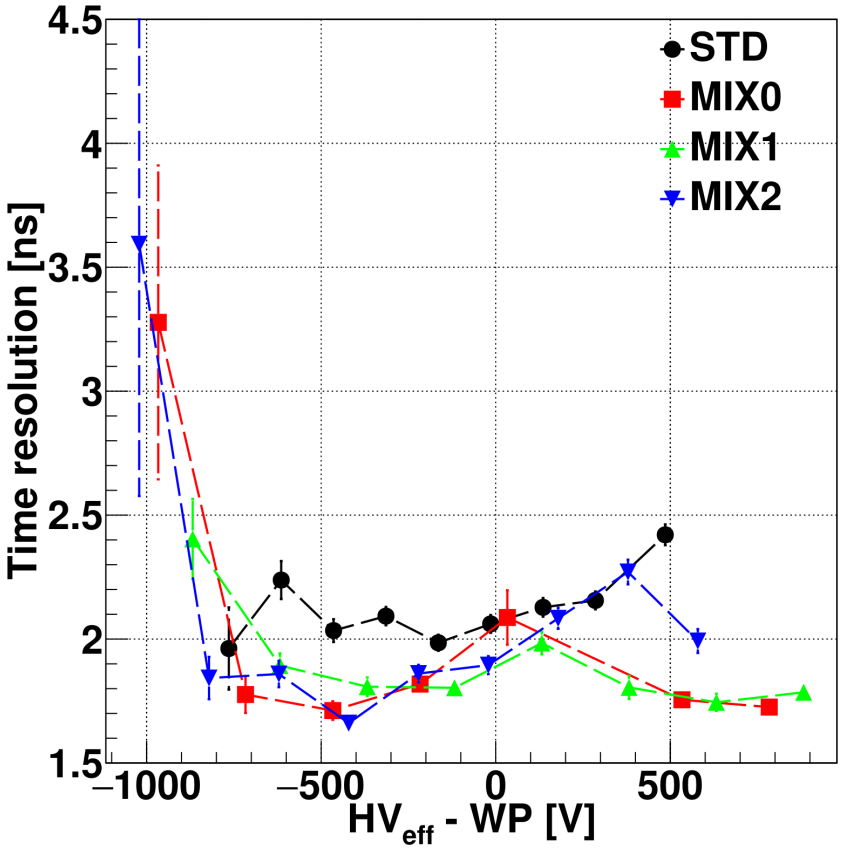
- Acquire timestamp of the signal
  → I define a threshold for the analysis (to discriminate if a strip is efficient) as 5*RMS of the signal in the noise window
  → Same interpolation technique as for the trigger for the signal
  → **For now**: time resolution calculation only if cluster size == 1

Measurement strategy - 2

- Event-by-event subtraction between signal timestamp and trigger timestamp
  → Residual distribution
- Gaussian fit to this distribution to extract the σ
  → Upper limit to the RPC time resolution
- Example with STD gas mixture at WP
- Plotted as a function of the HV in the next slide



Results - 1



- These mixtures have HFO concentration < 20%
- MIX0 has 0% HFO (95% CO2, 4% i-C4H10 and 1% SF6)
- Not worse than STD
  → Interesting result
- All values ~ 2 ns
- Upper limit since jitter of the PMTs is not considered here

Results - 2

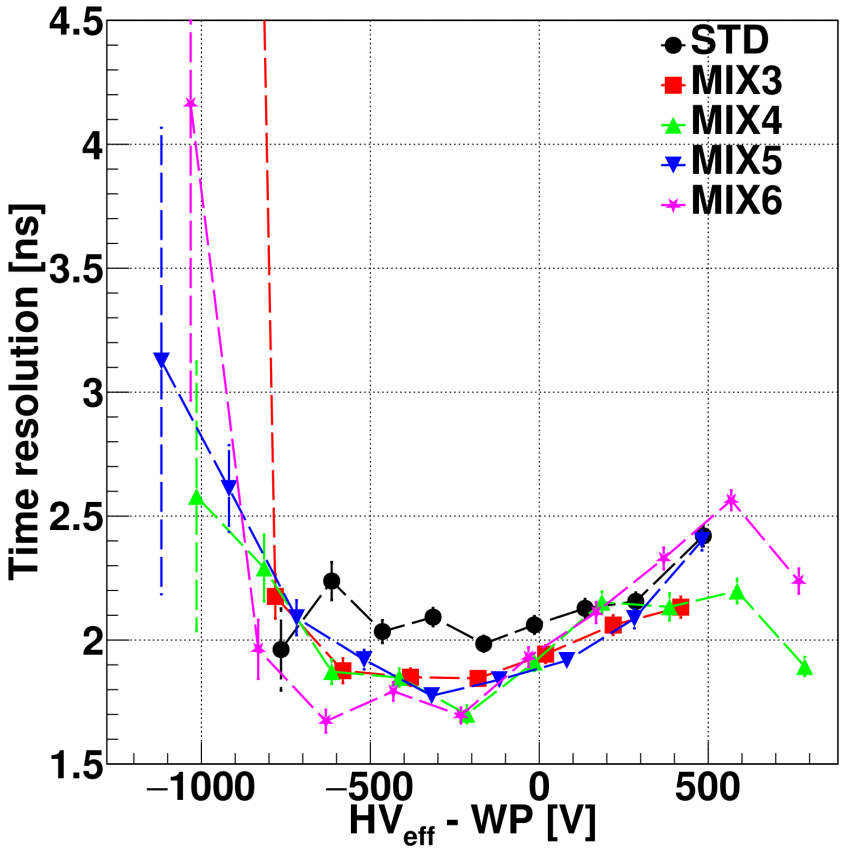
- MIX3 = ECO3
- MIX5 = ECO2

- Also values slightly lower wrt STD gas mxture

- This is an upper limit since it is not corrected for PMT jitter

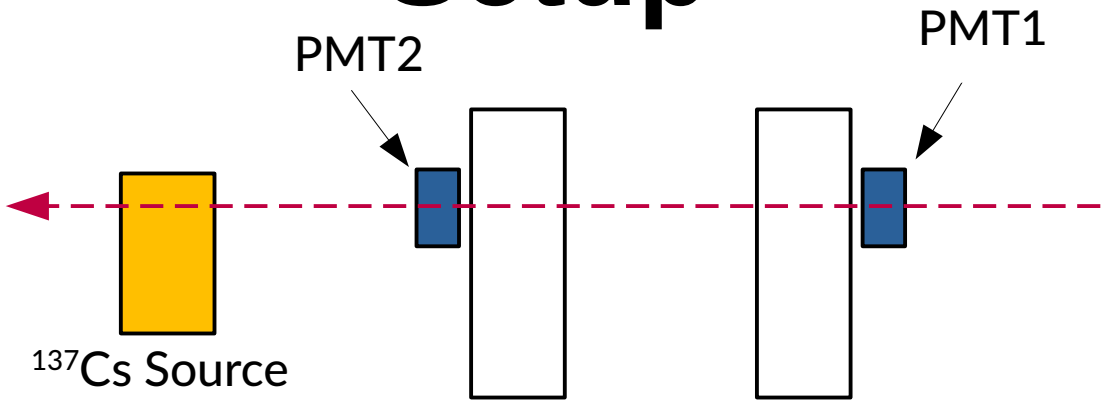
- Not worse than STD
  → Interesting result

- Interesting to see what would happen if events with CS > 1 were included in the measurement



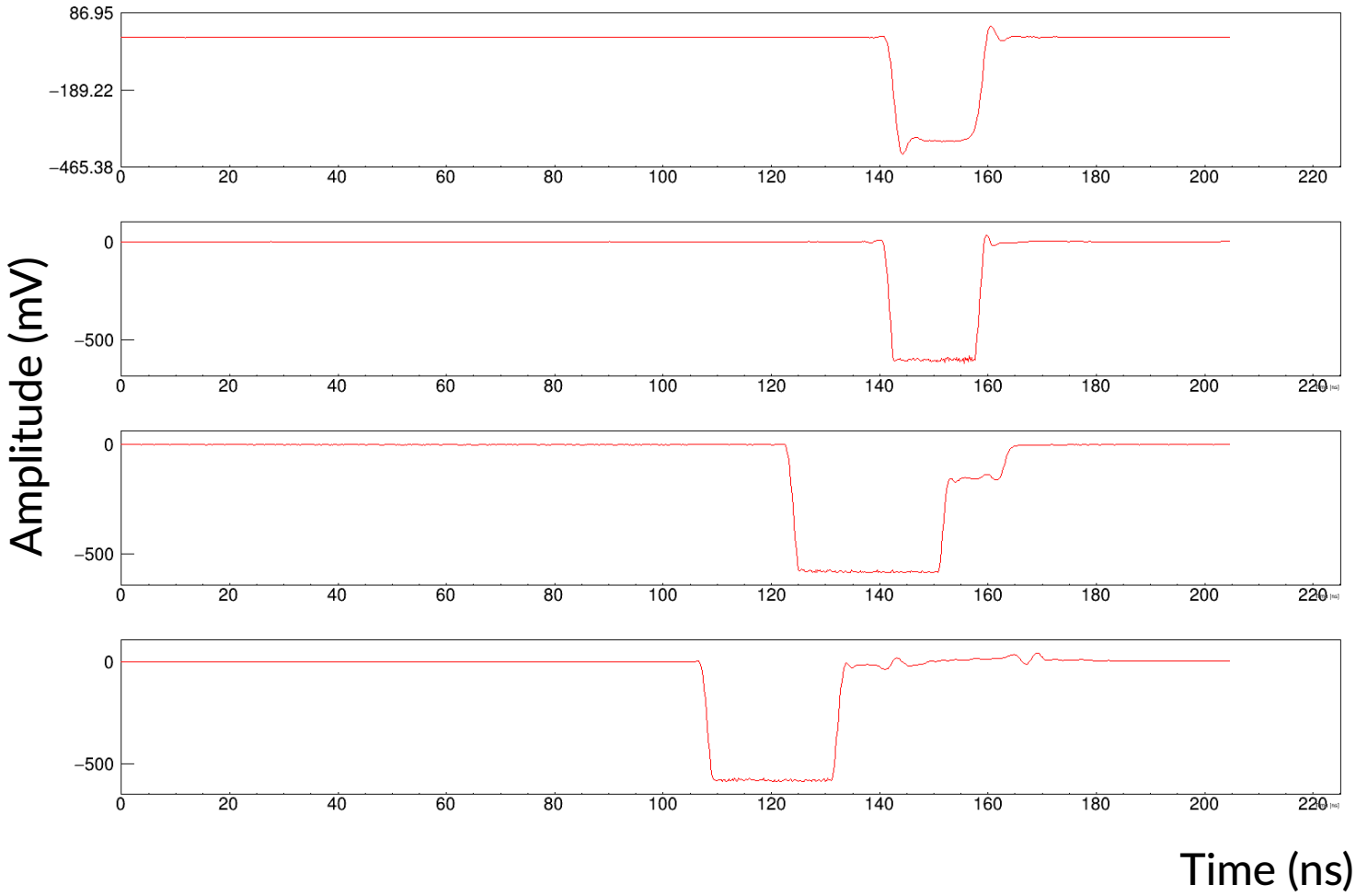
Possible study of PMT jitter

Setup



- Internal scintillators coincidence used as trigger
- Internal coincidence to input channel 0
- PMT1 to input channel 1
- PMT2 to input channel 2
- 20k triggers for the measurement

Results - 1



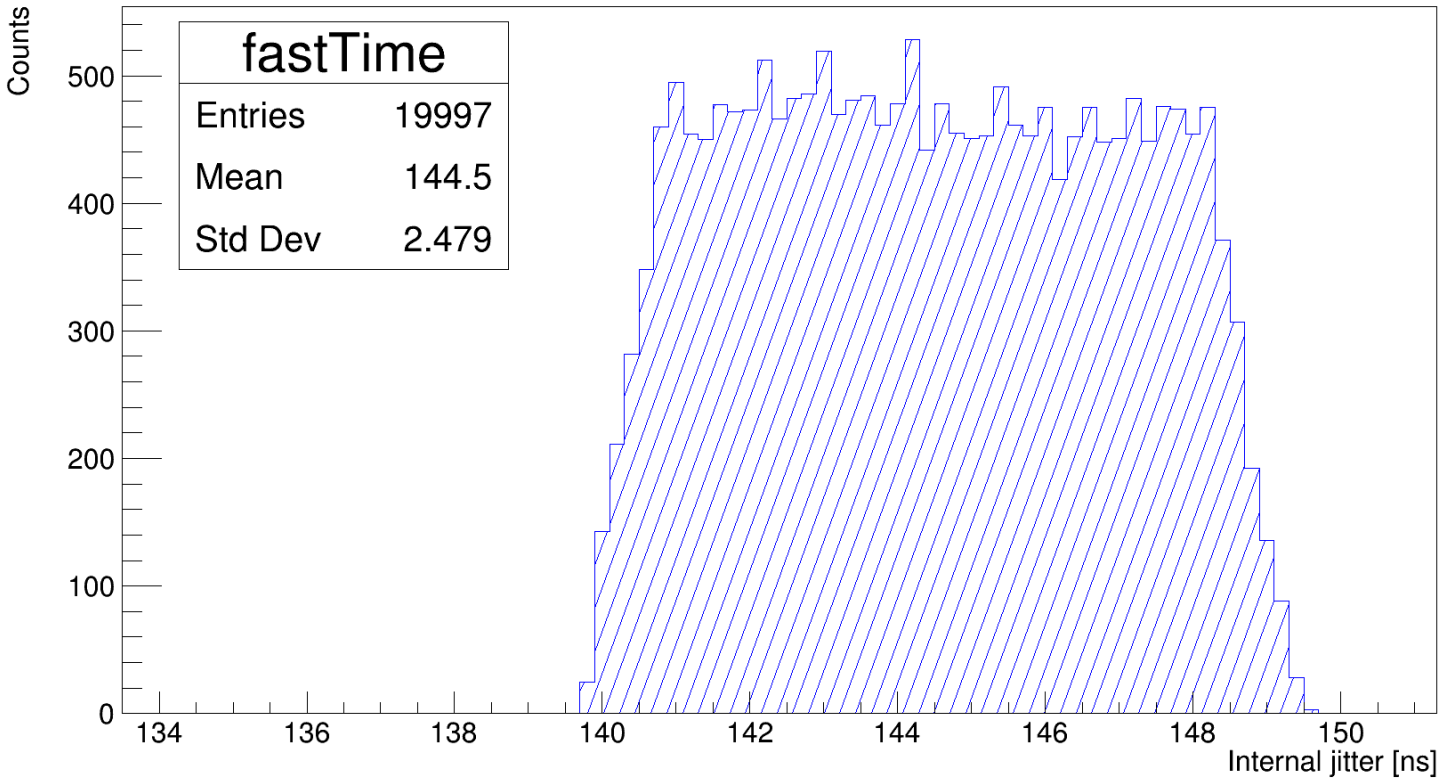
Fast trigger

Ch0: PMT1 and PMT2

Ch1: PMT1

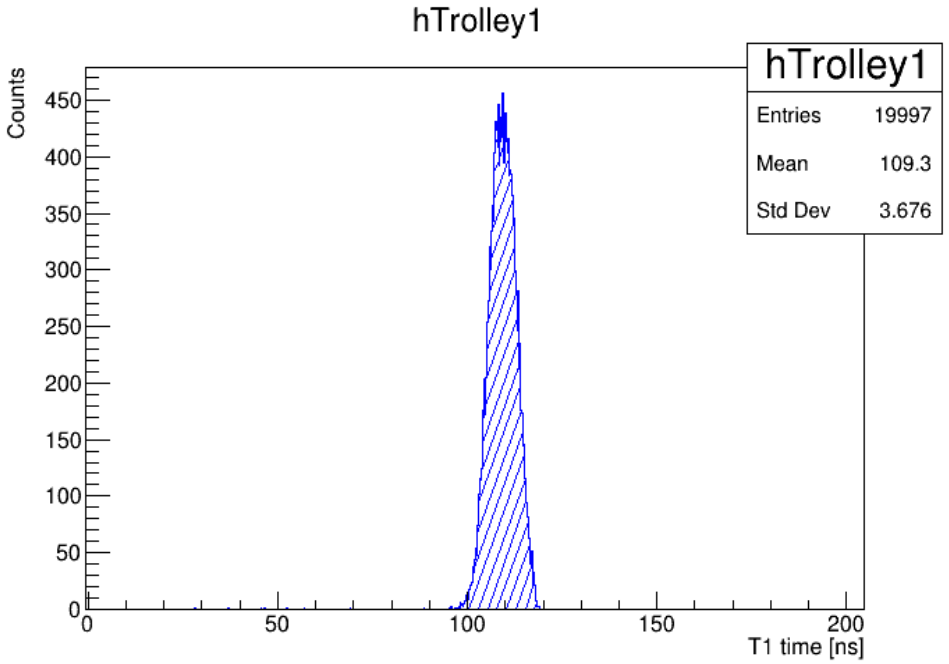
Ch2: PMT2

Results - 2

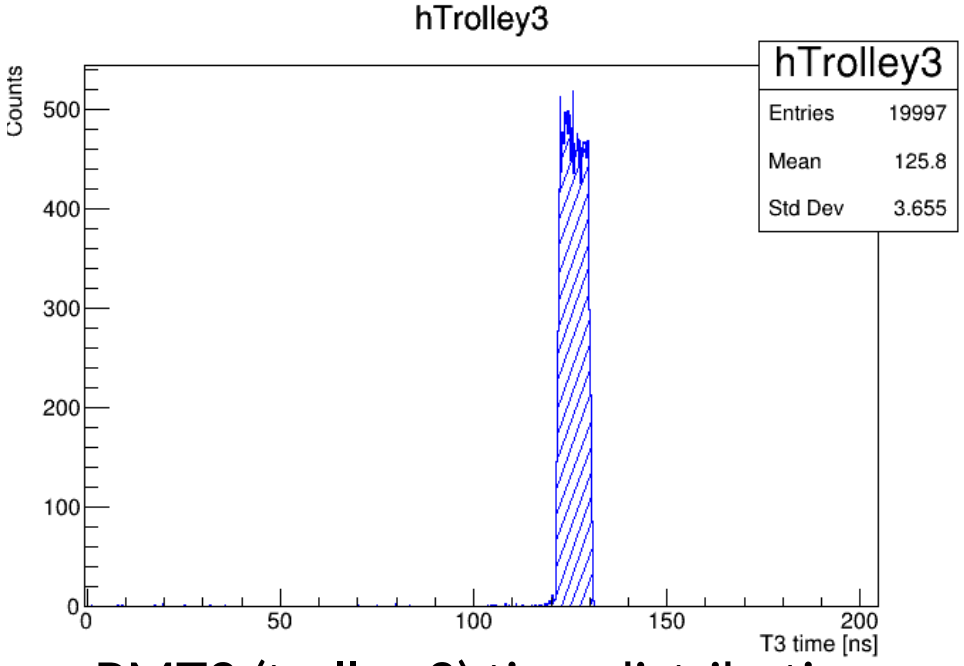


- Fast trigger time distribution
- Jitter of 8.5 ns as explained earlier
- This jitter is removed when these times are used in subtractions

Results - 3

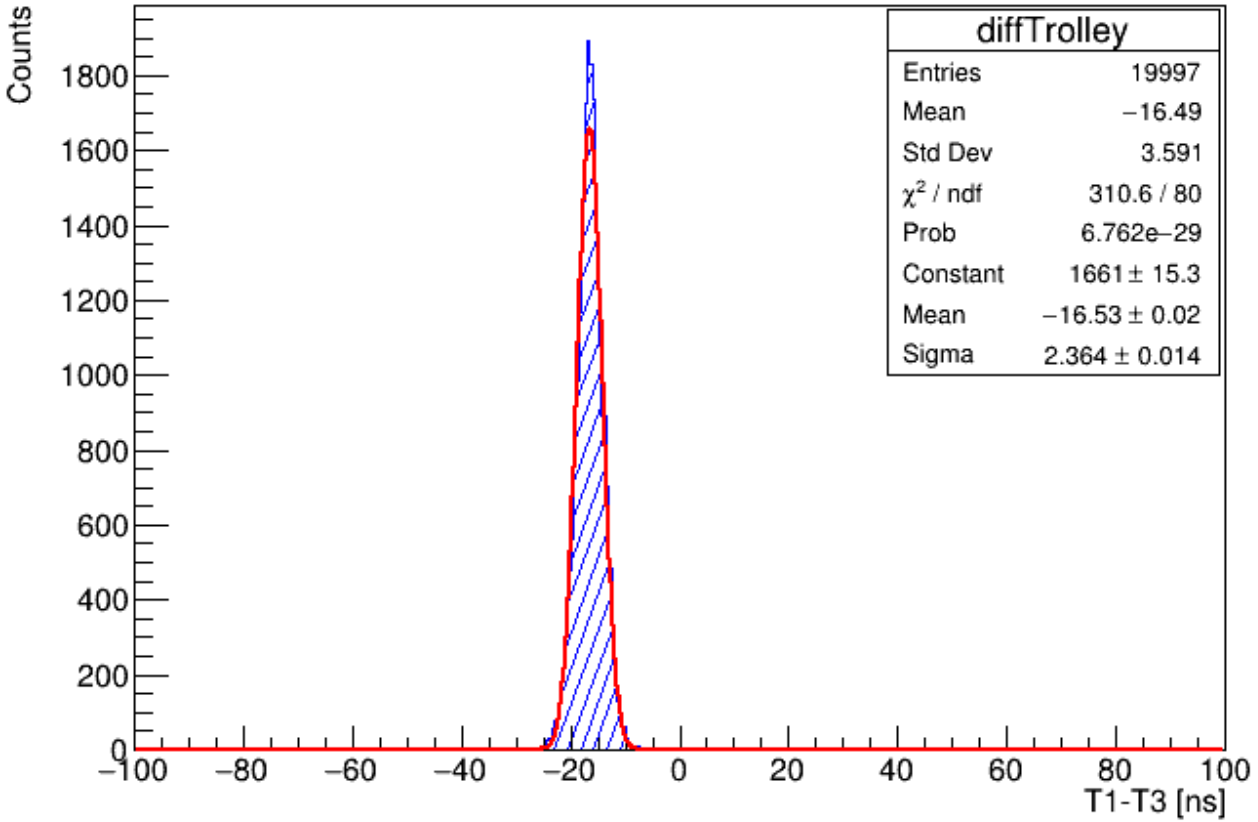


PMT1 (trolley 1) time distribution



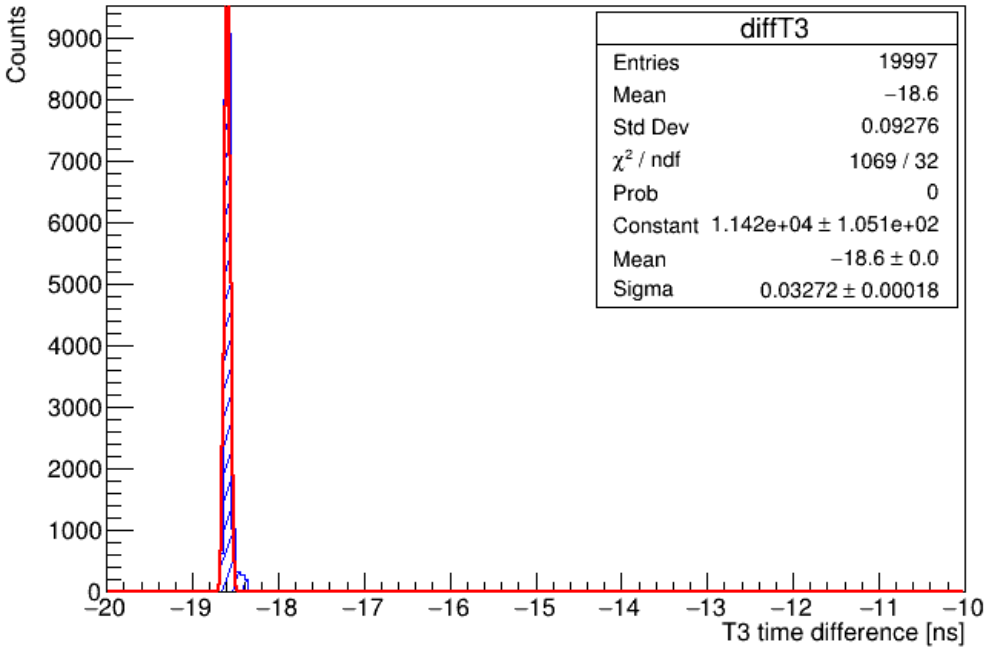
PMT2 (trolley 3) time distribution

Results - 4

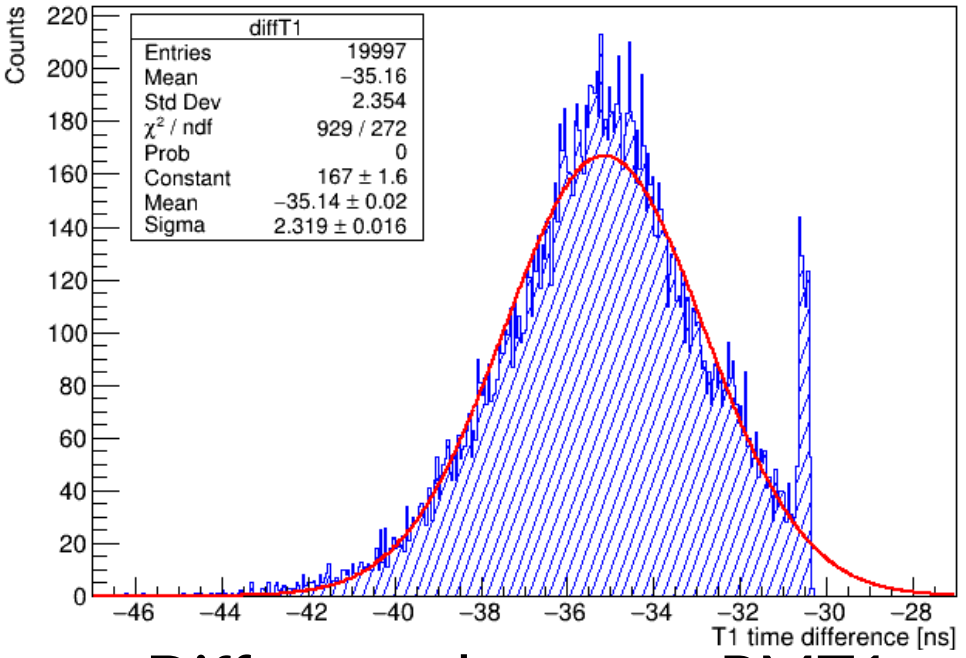


- Difference between PMT1 (trolley1) and PMT2 (trolley3)
- Is this the jitter we are looking for?
- Doesn't make a lot of sense to me since it is greater than the time resolution of the RPCs….
- Up for discussion

Results - 5



Difference between PMT2 (trolley3) and coincidence



Difference between PMT1 (trolley1) and coincidence