Status Report MEMPHYNO darkrate measurements

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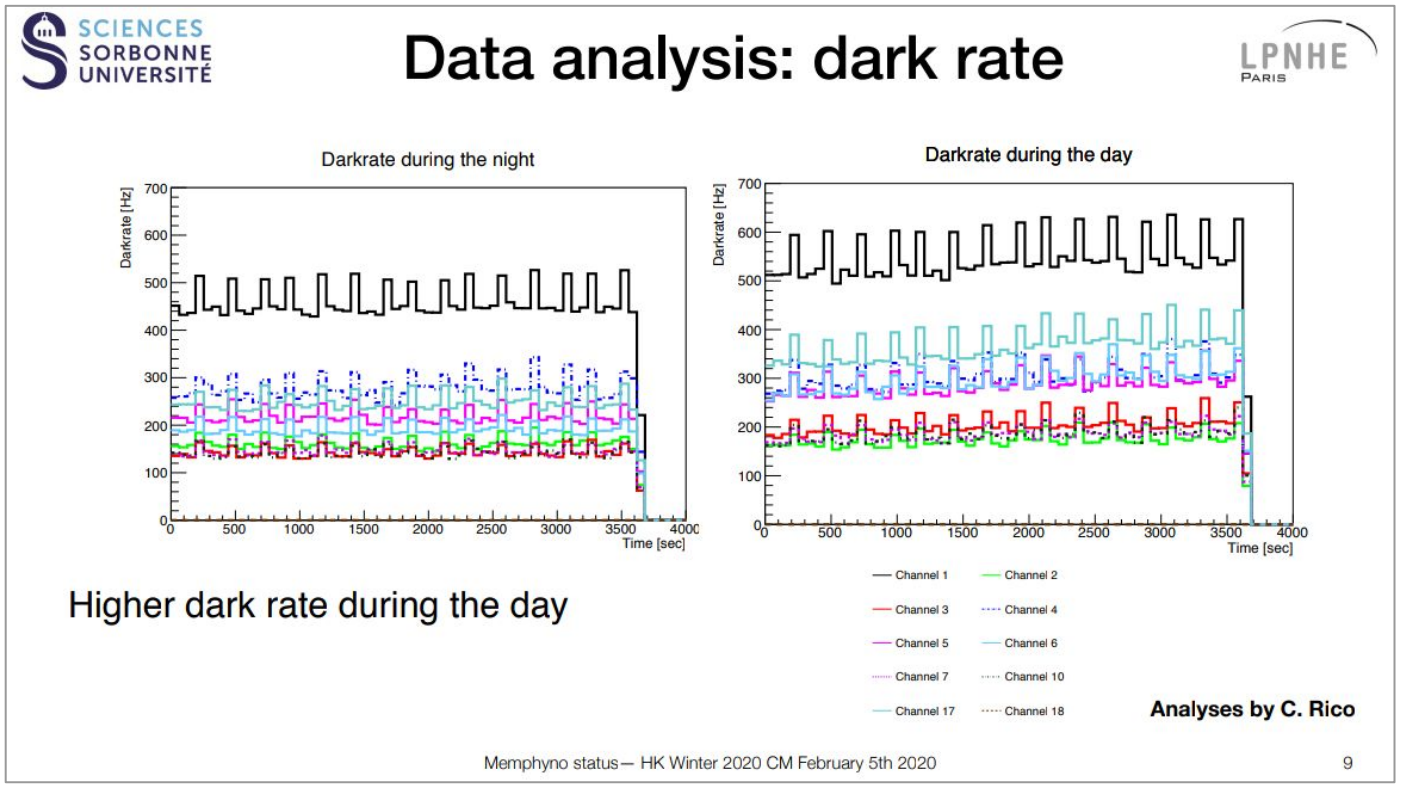
mPMT Japan meeting

Introduction

- Fixed light leak of the MEMPHYNO's water tank at APC and took the data for 2 weeks w/o any light source (only darkhits and cosmic muon)
- Analyzed the data in order to understand about the mPMT
  - Stability of the darkrate



Analysis

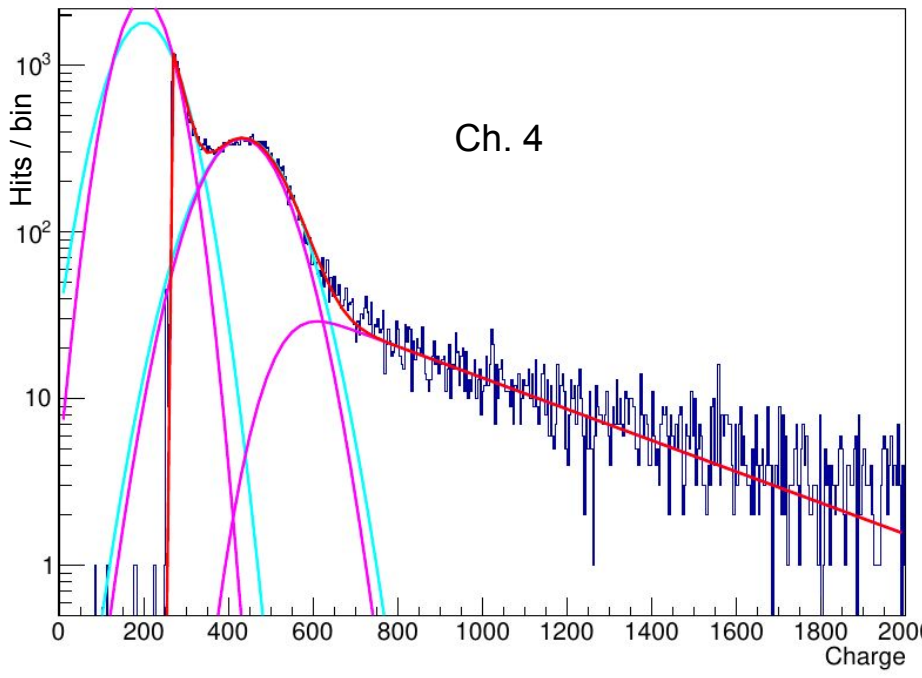
1. Divided all hits-data by the period = 100 sec
2. Made charge-distributions for the divided time-range
3. Found 1 p.e. mean with the fitting
4. Calculated the darkrate over all run-time
    - Defined the threshold as (1 p.e. mean) x 0.8

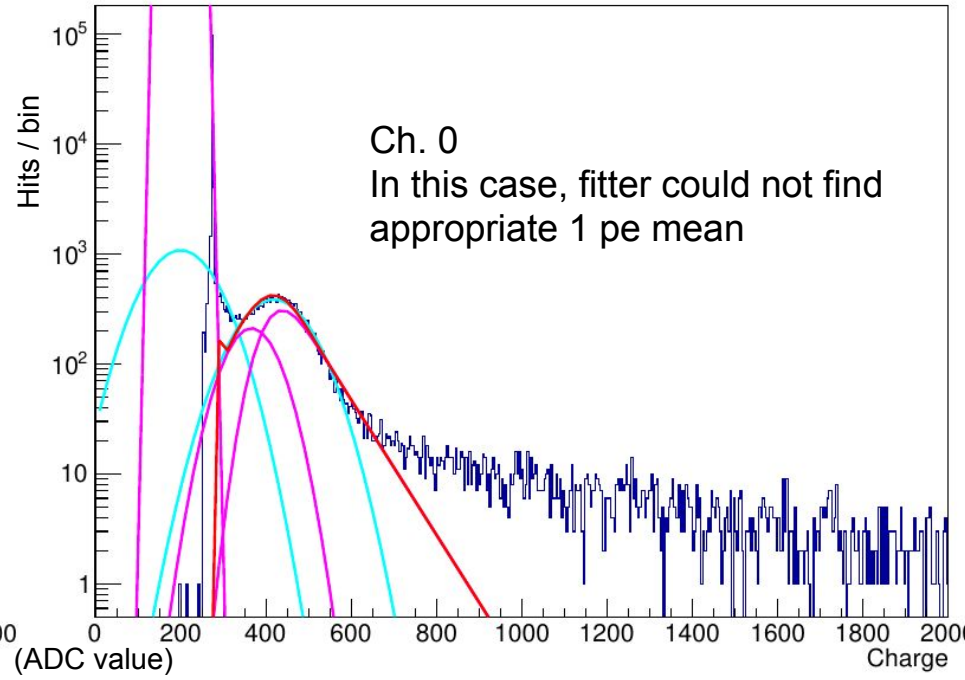
Charge-distributions

- Fit with red function: like this

$$F(q) = \left(p_0 \times \mathrm{gaus}_{\mathrm{ped.}}(q) + p_1 \times \mathrm{gaus}_{\mathrm{1pe}}(q) + \frac{1}{2}\left(\mathrm{Erf}(q/\sigma_0 - \alpha) + 1\right)\exp(q/\tau - q_0) \right) \times \frac{1}{2}\left\{\mathrm{Erf}(q/q_1 - \beta) + 1\right\}$$

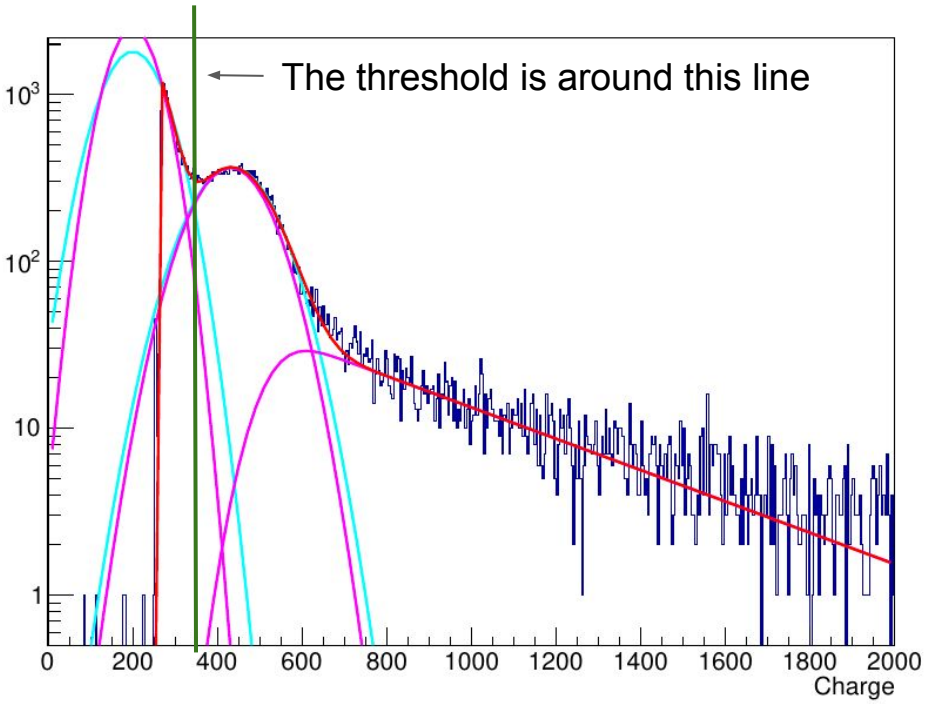
  - Magenta plots show each component: pedestal, 1 p.e., exponential noise
  - Skyblue plots show the result of fitting with only one gaussian.
    - This fitting was done with a range that I defined.
  - Here I fixed the mean value of pedestal-gaussian because the fitter could not find this parameter
- However the fittings failed with some channels like right plots





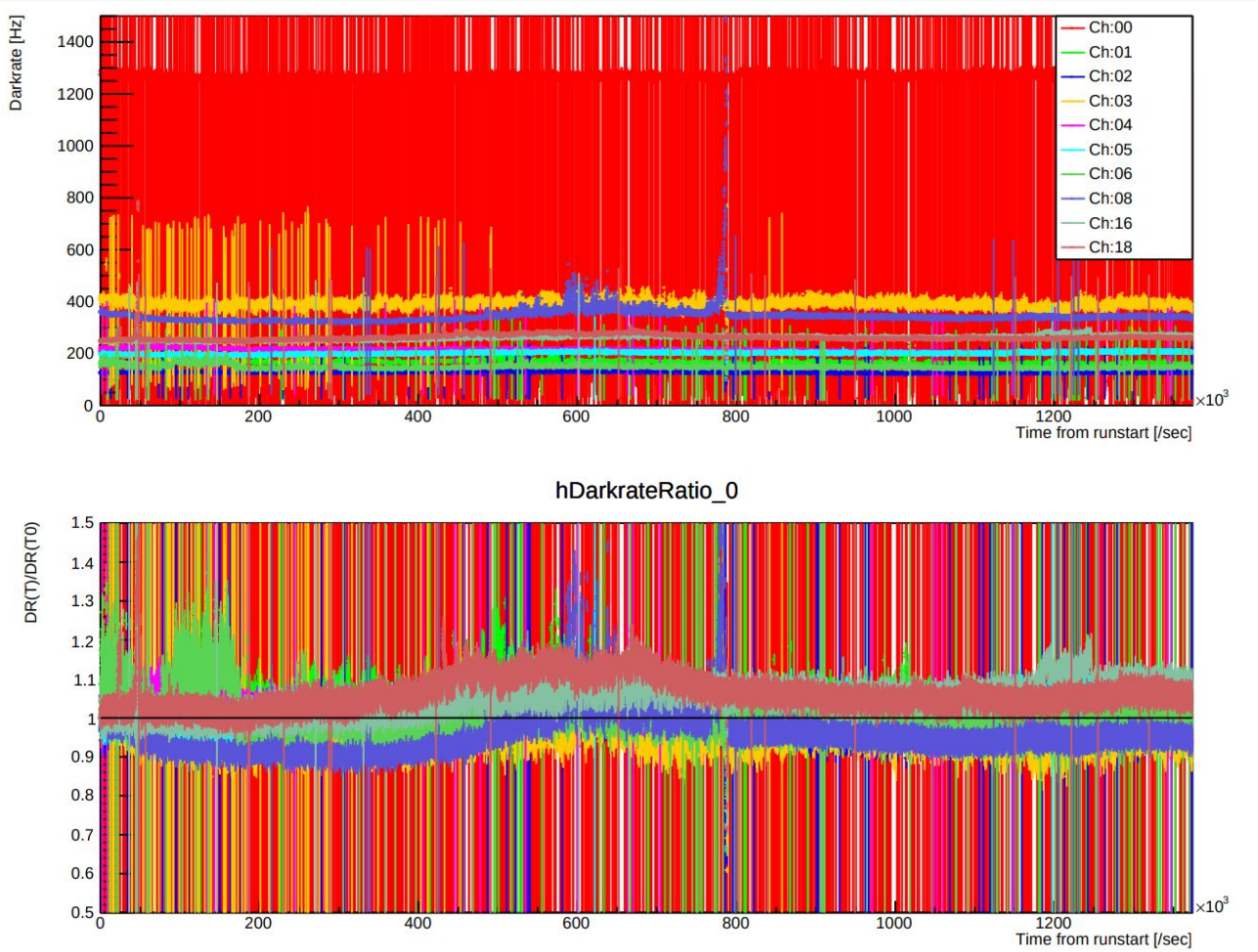
Calculation of the darkrate

- Got the 1 p.e. mean and its error from the fitting
  - I tuned the HV so that 1 p.e. is around 430
- Defined the darkrate as: $\text{darkrate} := \frac{(\text{total hits above 1pe mean} \times \alpha)}{\text{time}}$
  - In this slide, I set α=0.8 (~ 340 in ADC value)
- Added two errors
  - Stat.: Sqrt(# of hits) / time
  - Sys.: Difference when I changed 1 pe mean value by the fitting error
  - Typical contributions is O(1)% (stat.) and O(1)% (sys.)



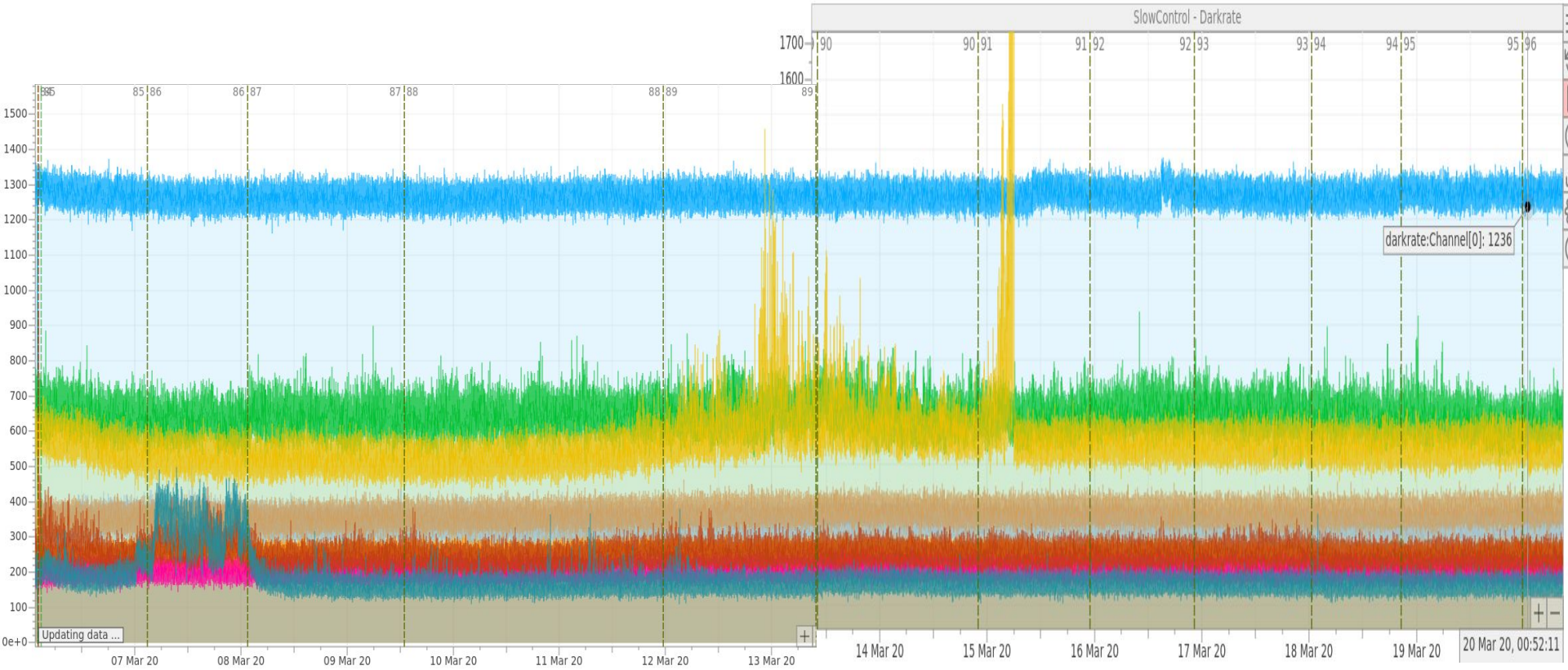
Time trend of the darkrate

- Drew the trend for 2 weeks (~ O(1e6) sec)
  - This covered large error bar (in particular red channel). I should remove these data points
  - Top plots show the absolute value [/Hz] and bottoms show the ratio of run-start



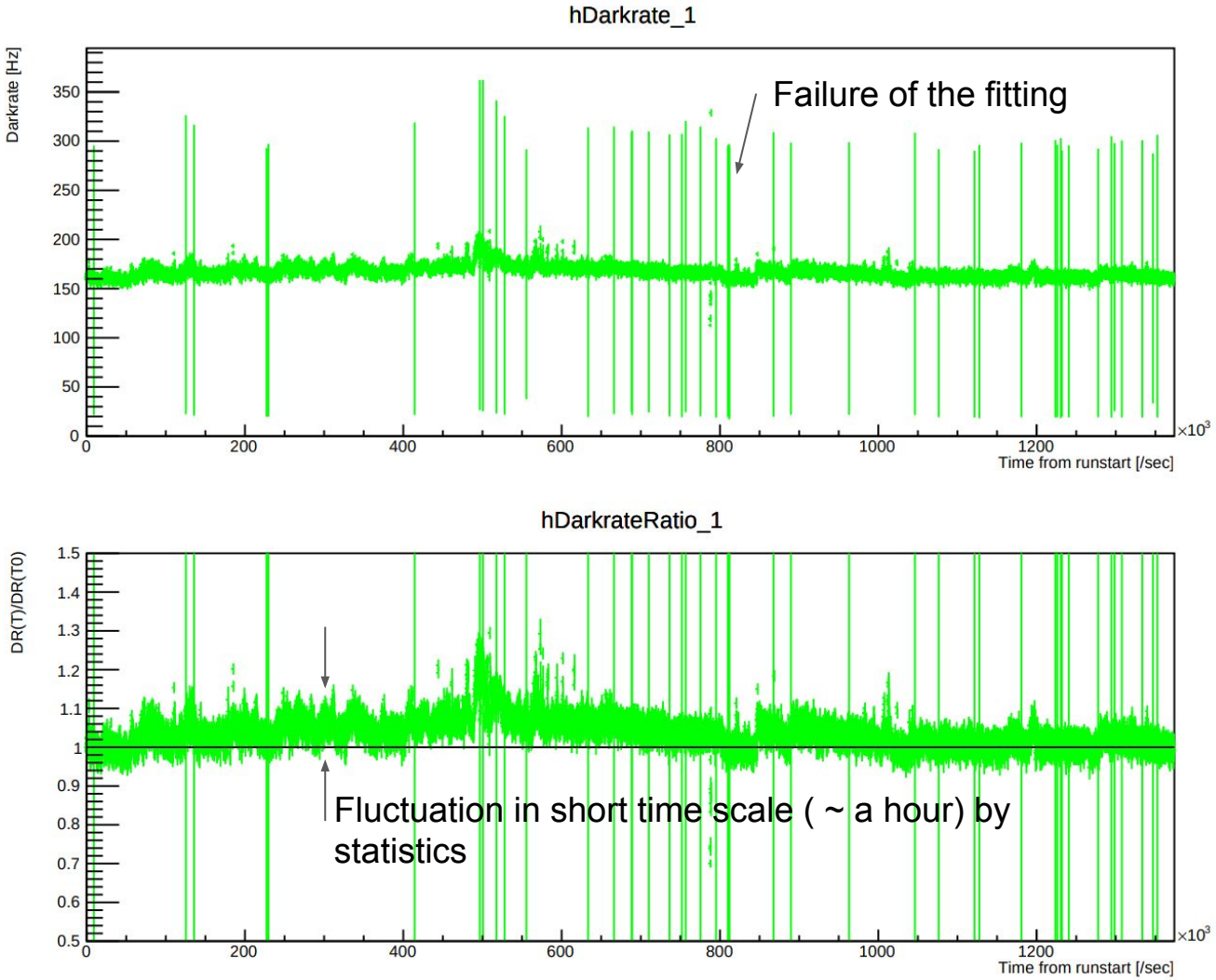
Comparison with slow control monitor

- Main structures are consistent (the color annotation is not same with my plots)



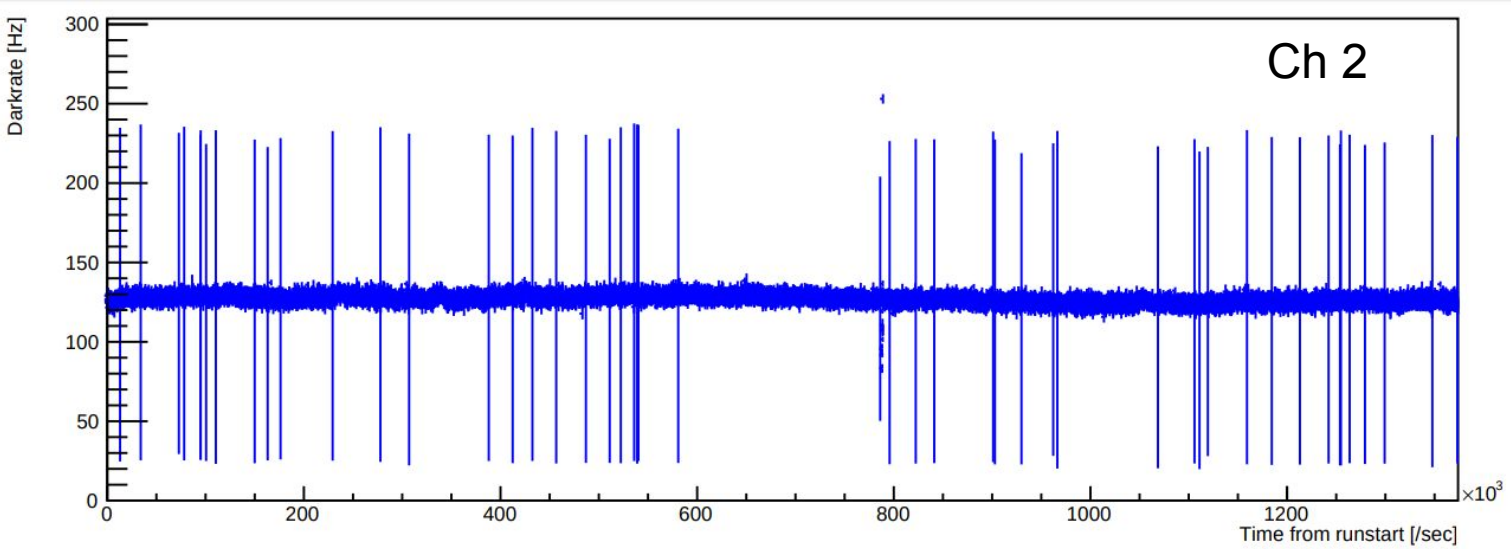
Time trend of the darkrate (ch 1)

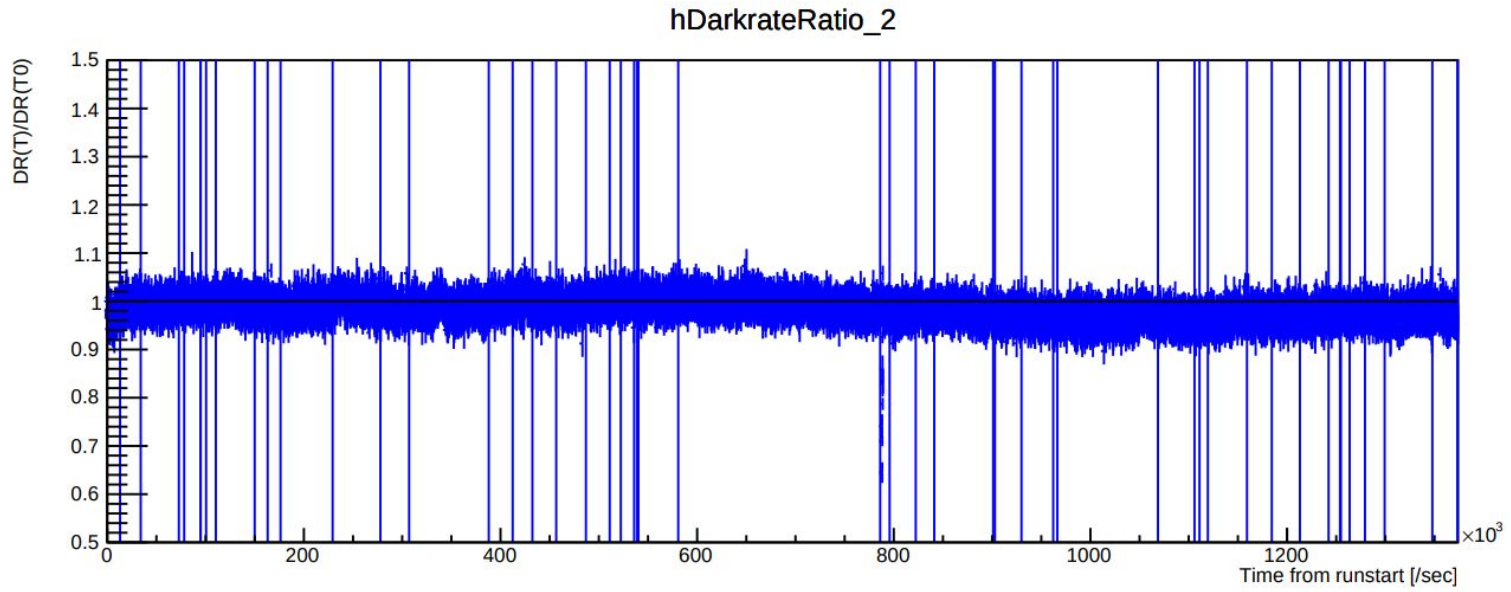
- Vertical lines, which appear sometimes: large error due to failure the fitting
-

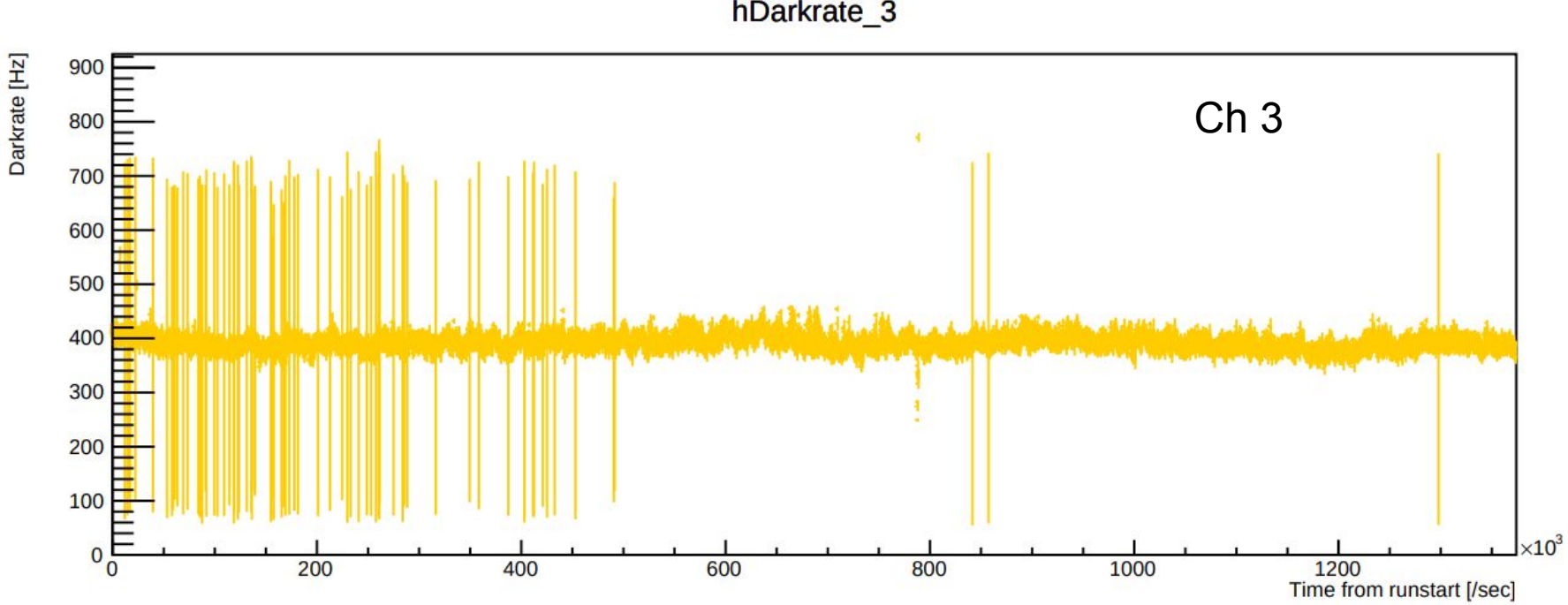


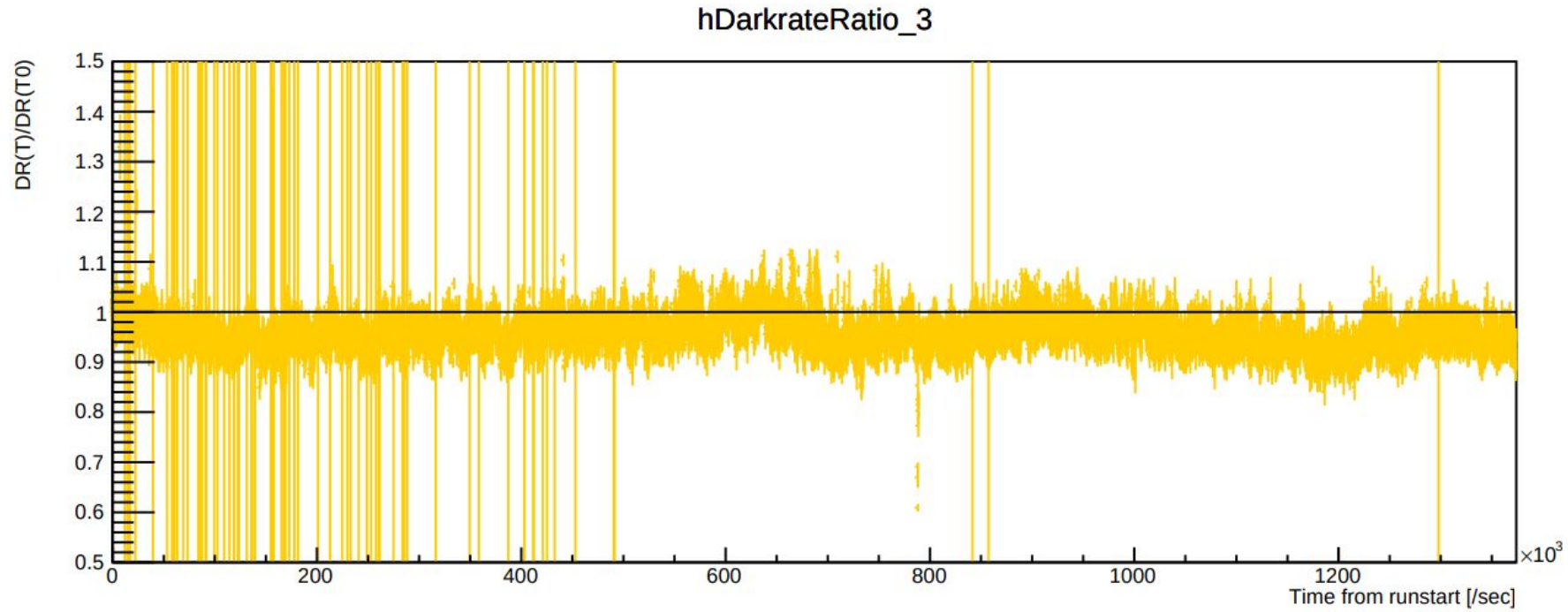
Time trend of the darkrate (ch 2)

- No day/night difference, relatively stable channel

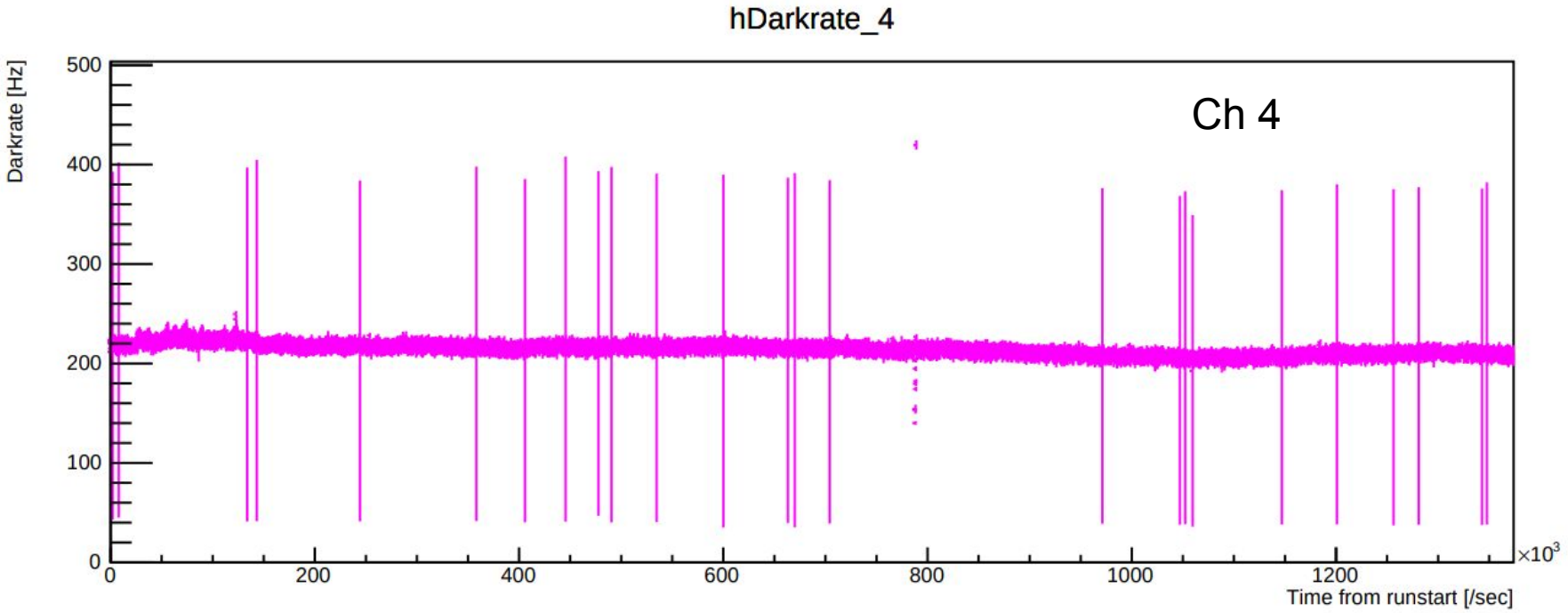


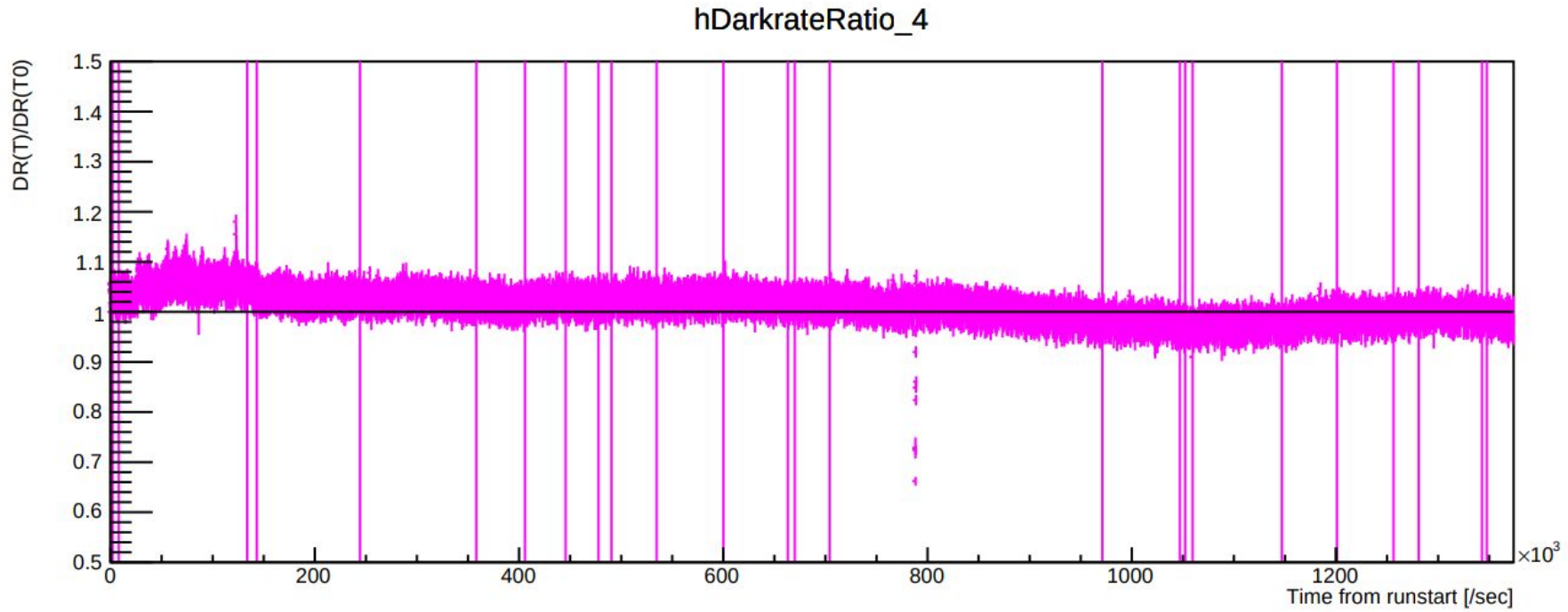


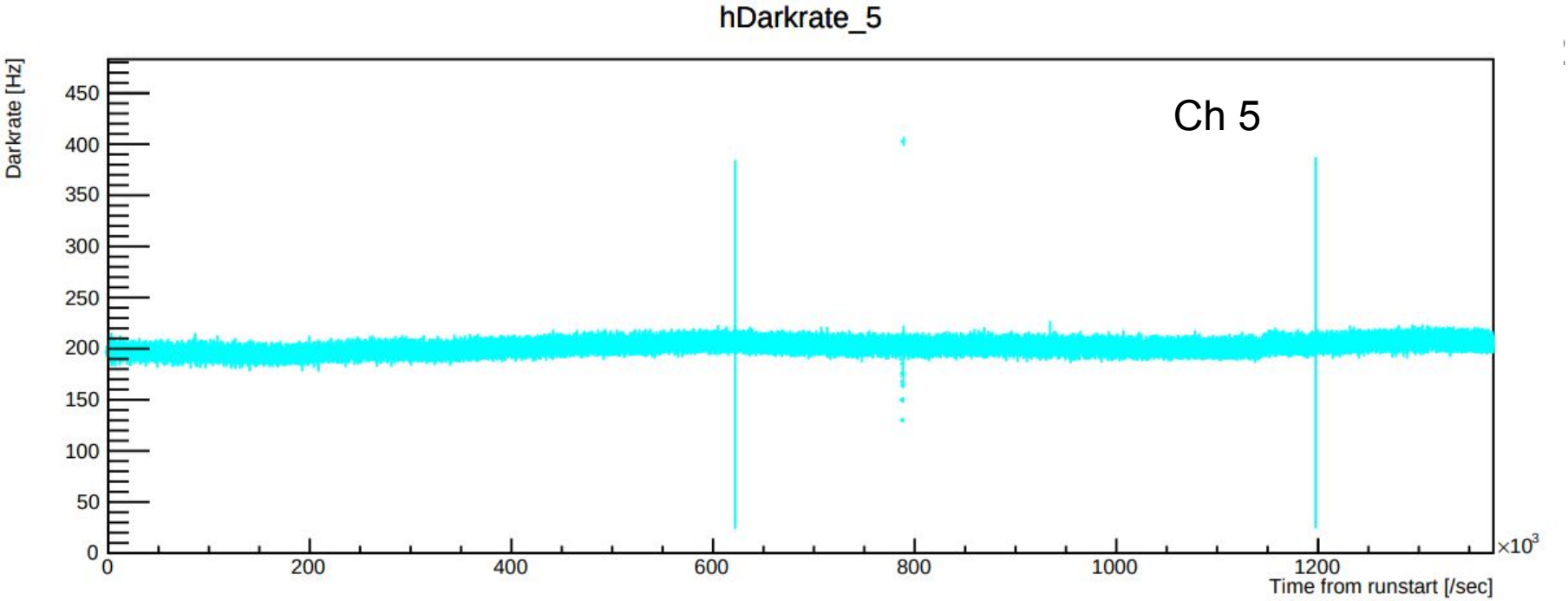

hDarkrate_3
Darkrate [Hz]
Ch 3
Time from runstart [/sec]
×10^3

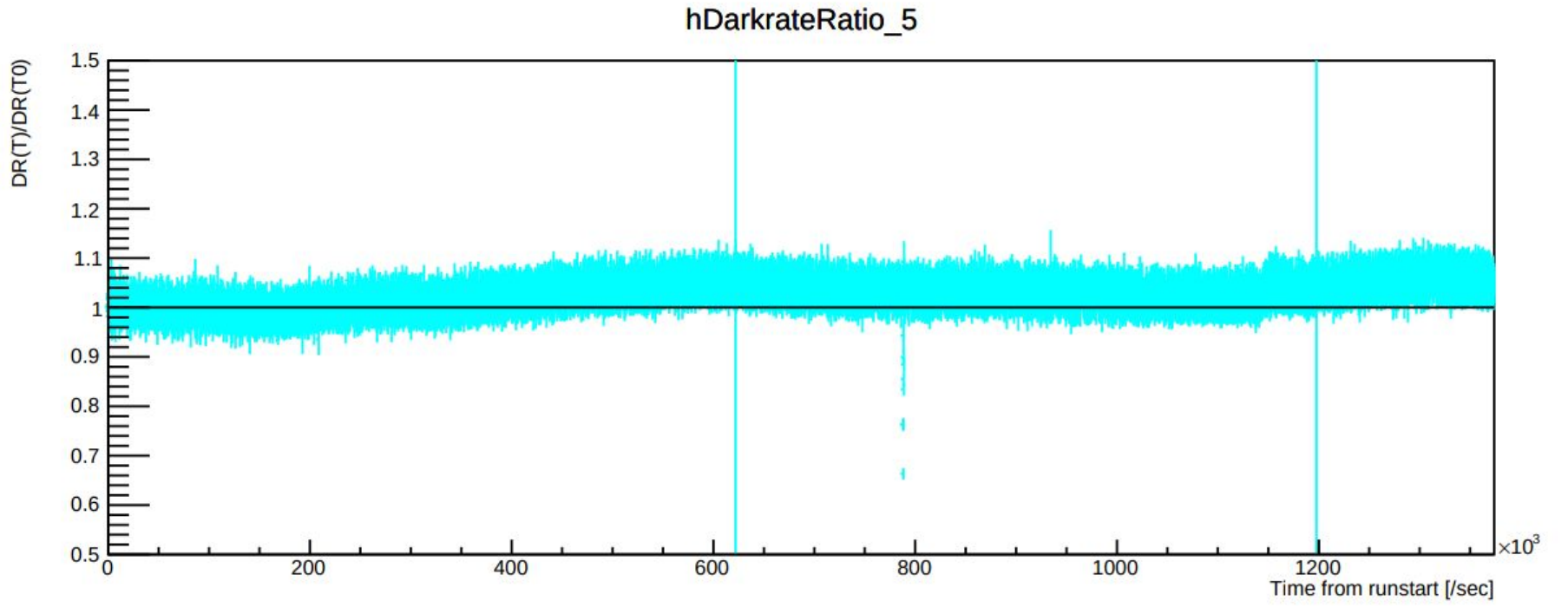

hDarkrateRatio_3
DR(T)/DR(T0)
Time from runstart [/sec]
×10^3

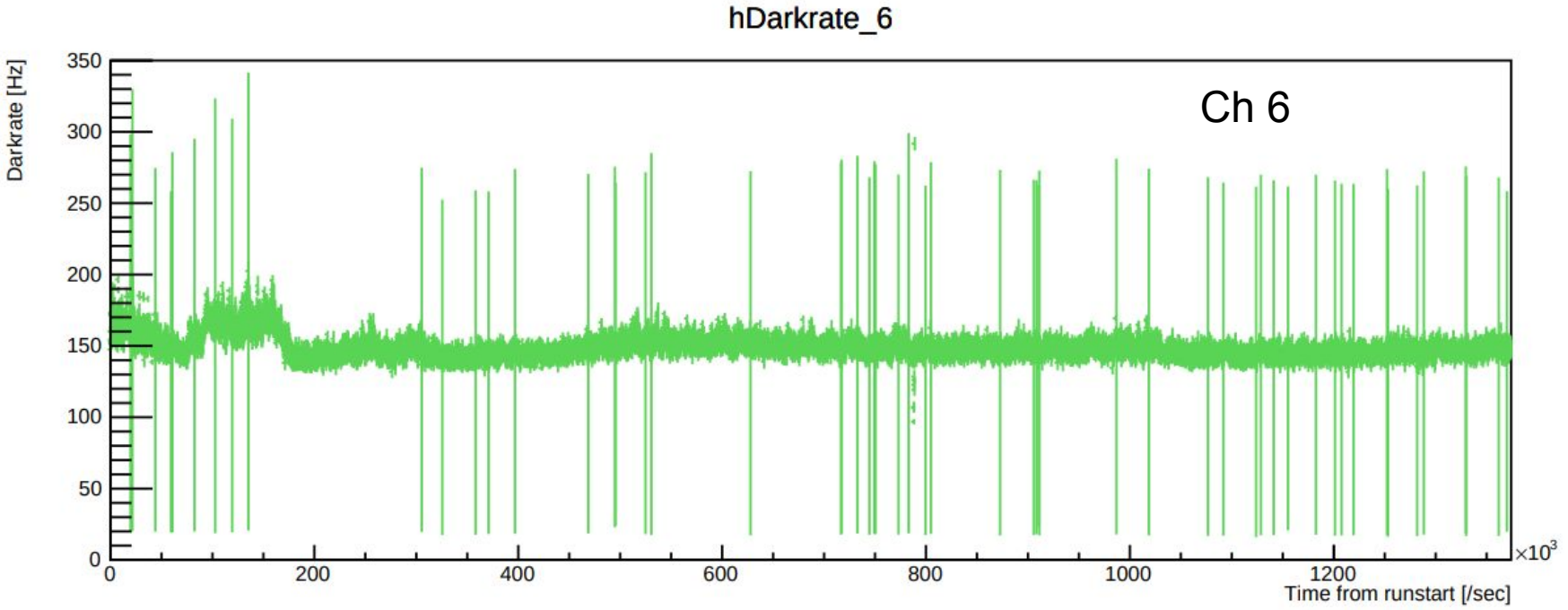
T

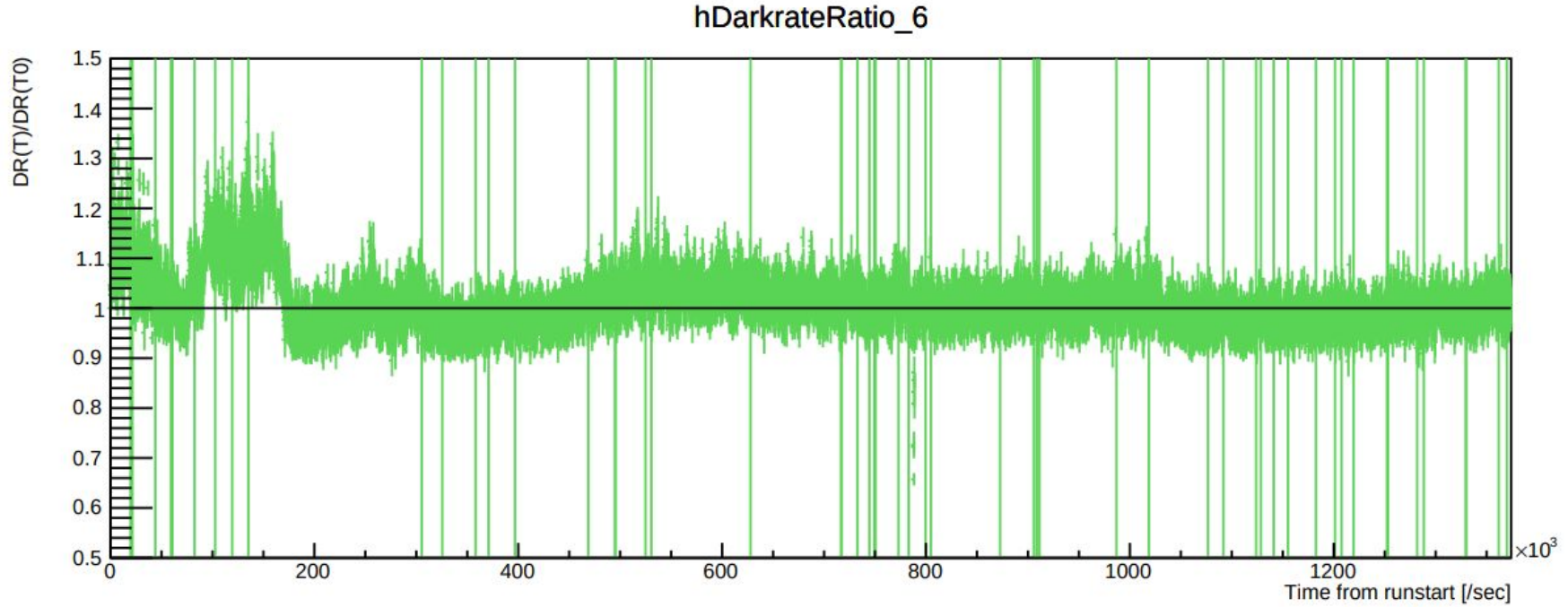

hDarkrate_4
Darkrate [Hz]
Ch 4
500
400
300
200
100
0
0
200
400
600
800
1000
1200
×10^3
Time from runstart [/sec]

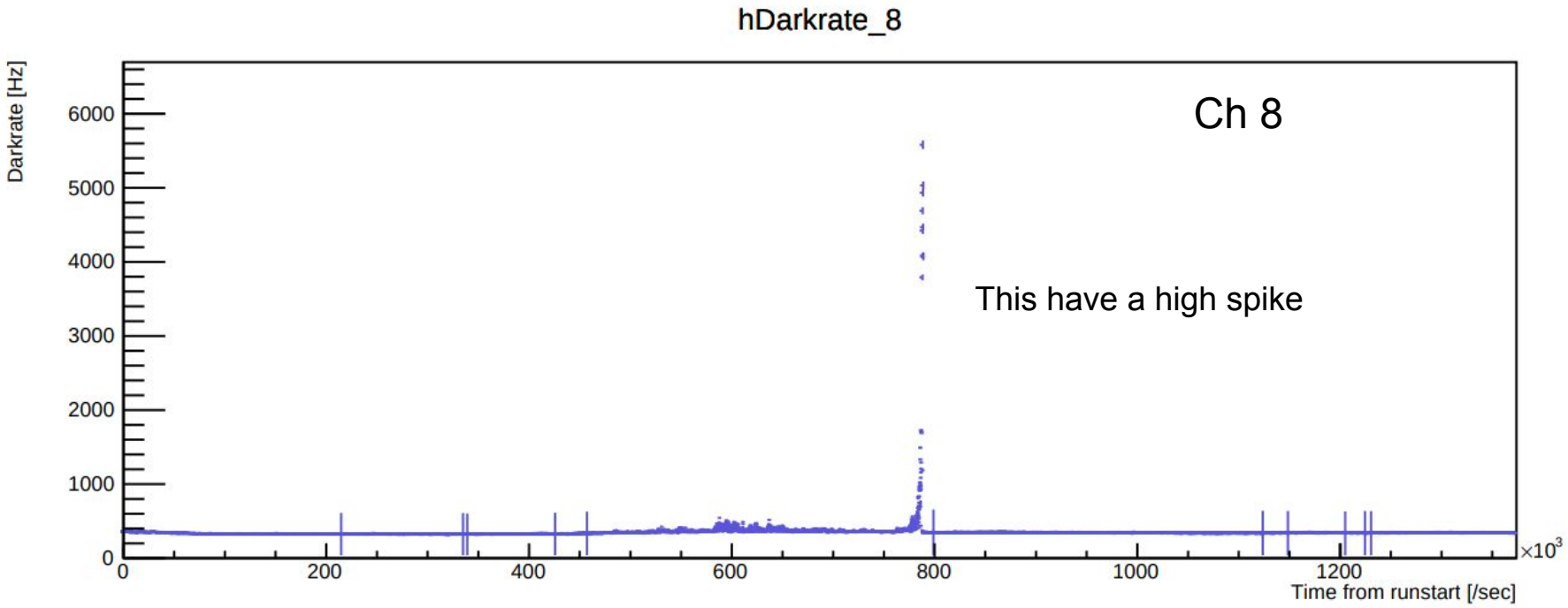

hDarkrateRatio_4
DR(T)/DR(T0)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0
200
400
600
800
1000
1200
×10^3
Time from runstart [/sec]

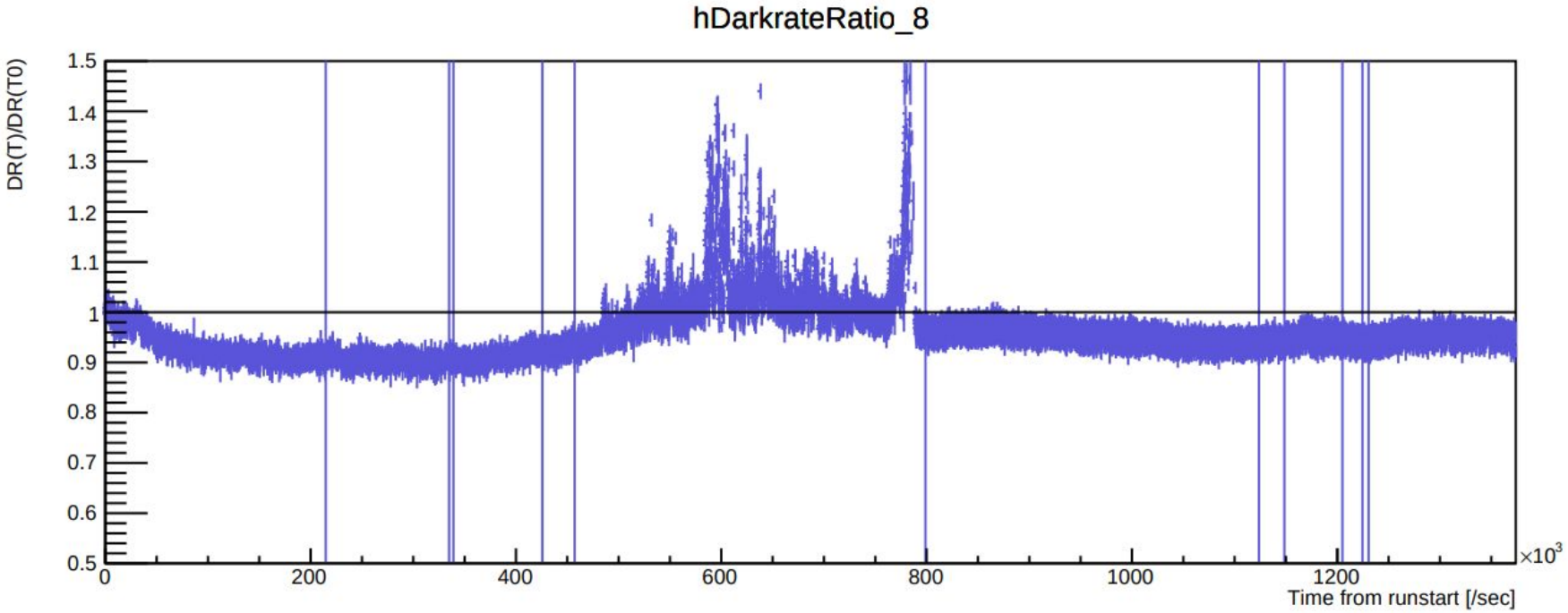

hDarkrate_5
Darkrate [Hz]
Ch 5
0
50
100
150
200
250
300
350
400
450
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

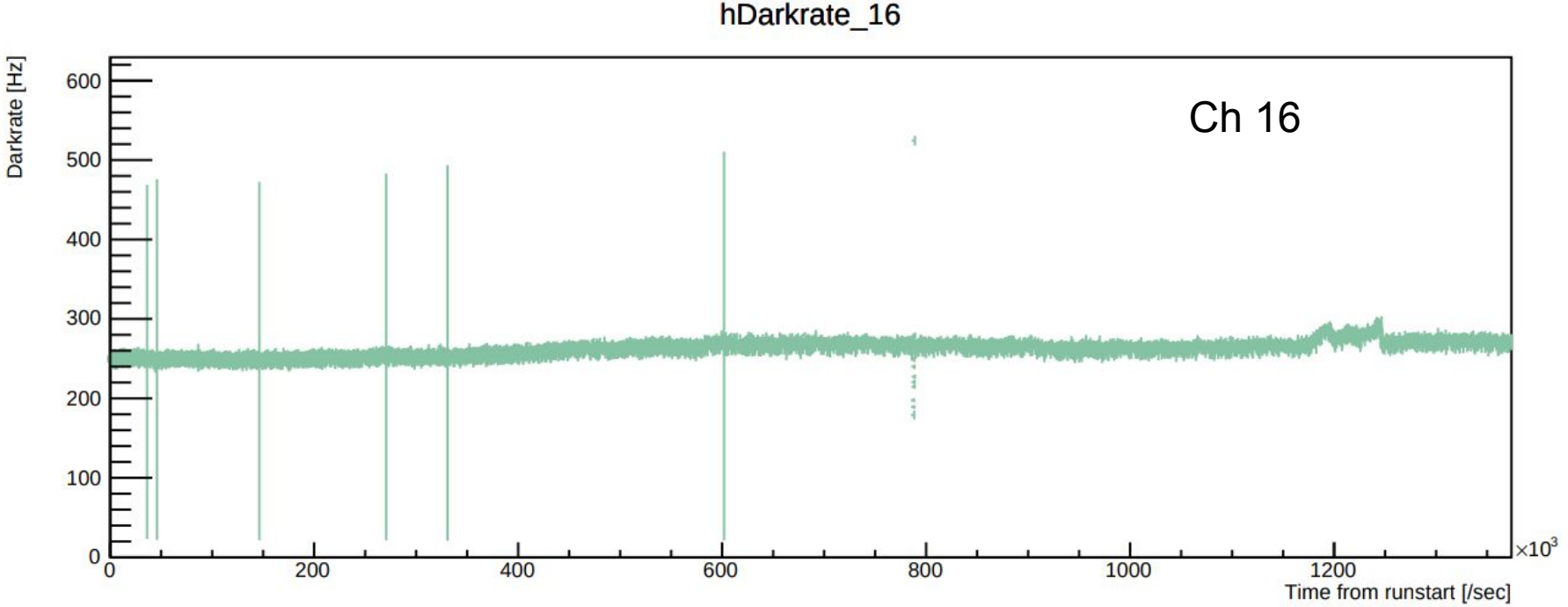

hDarkrateRatio_5
DR(T)/DR(T0)
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

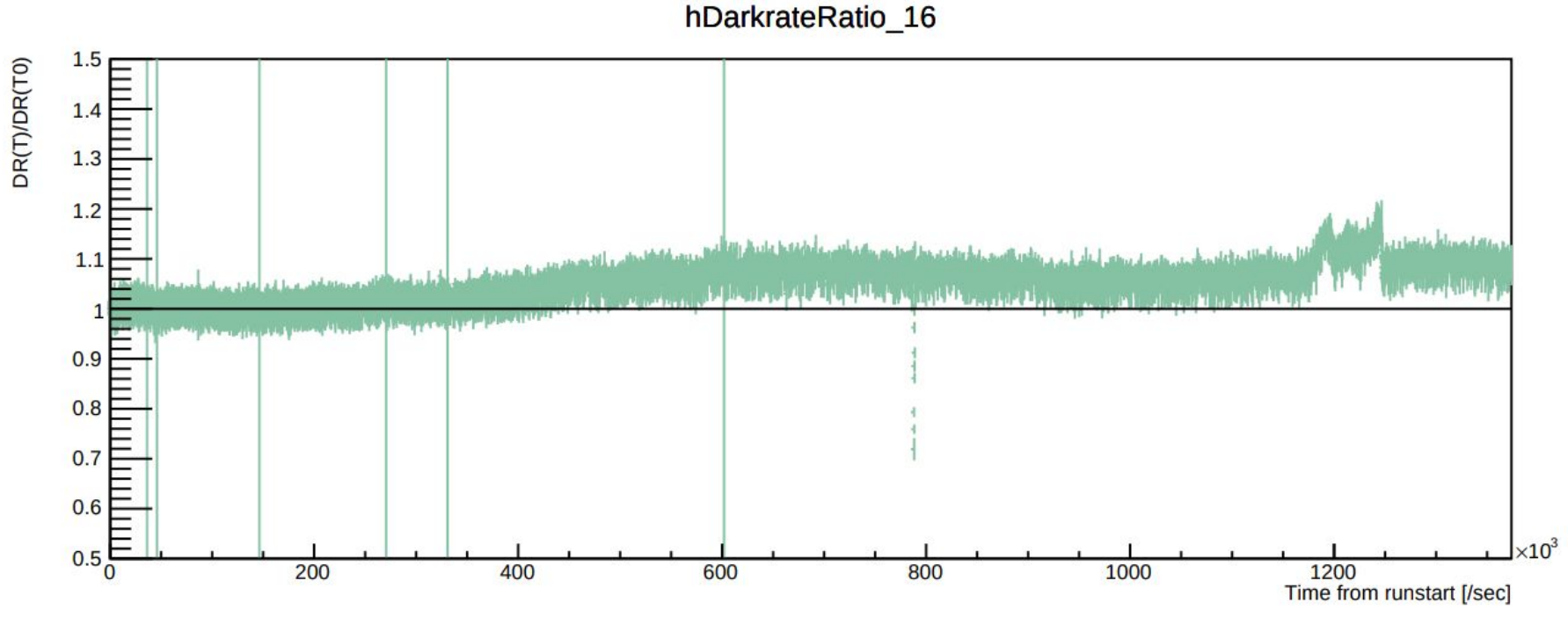

hDarkrate_6
Darkrate [Hz]
Ch 6
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

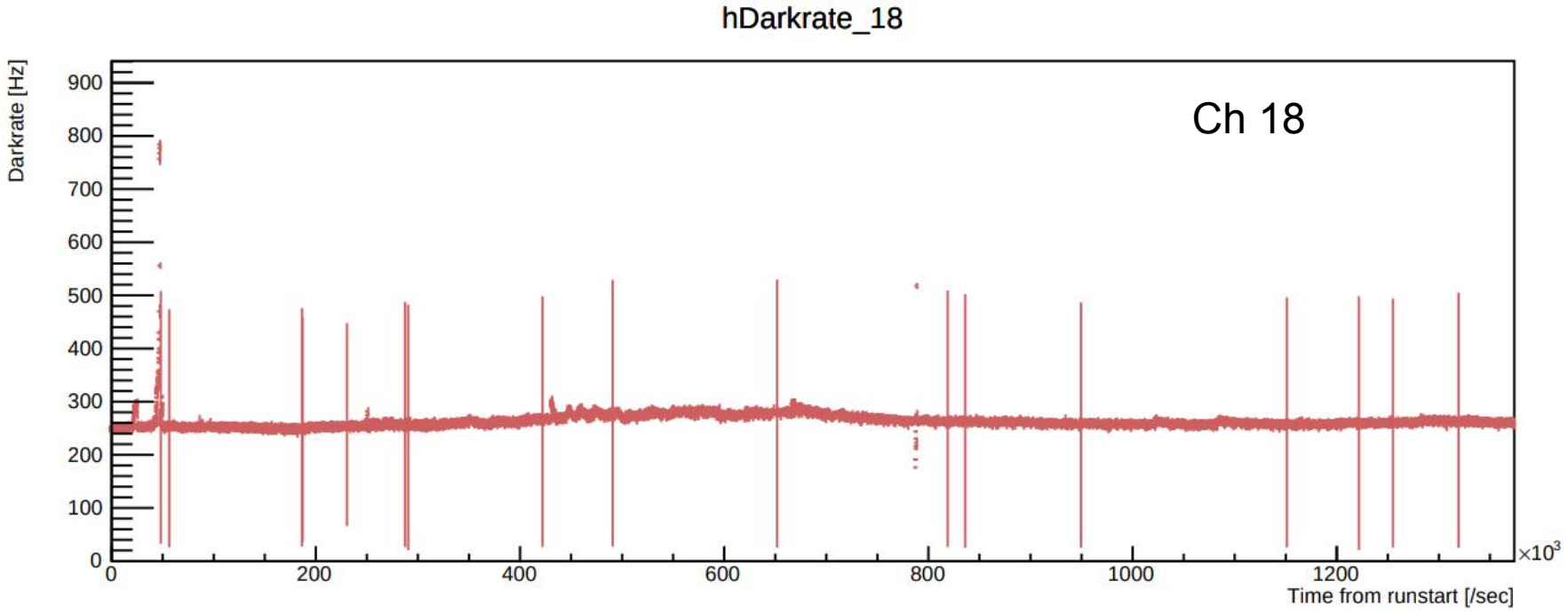

hDarkrateRatio_6
DR(T)/DR(T0)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

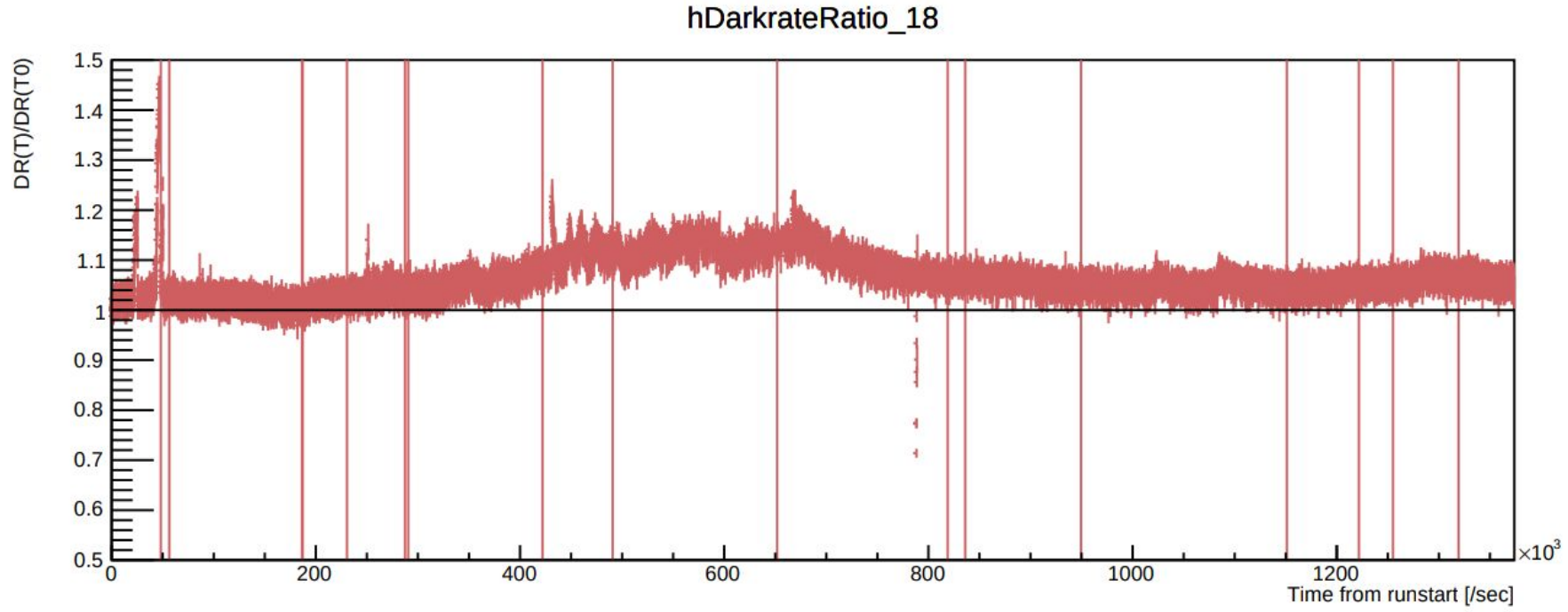

hDarkrate_8
Darkrate [Hz]
Ch 8
This have a high spike
Time from runstart [/sec]
×10^3


hDarkrateRatio_8
DR(T)/DR(T0)
Time from runstart [/sec]
×10^3


hDarkrate_16
Darkrate [Hz]
Ch 16
600
500
400
300
200
100
0
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

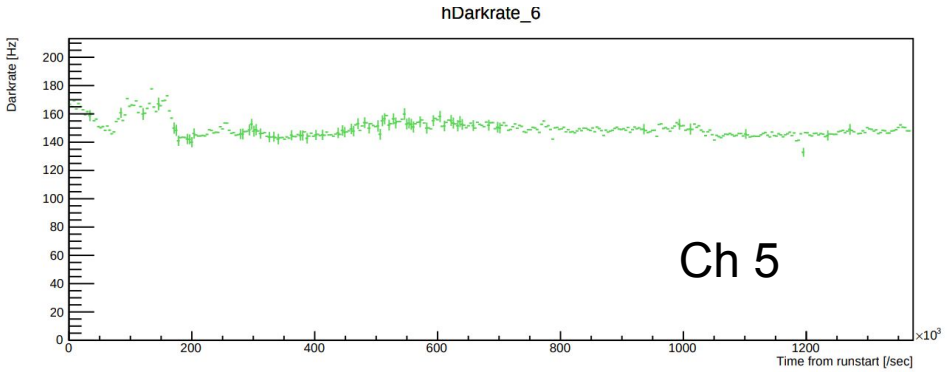

hDarkrateRatio_16
DR(T)/DR(T0)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0
200
400
600
800
1000
1200
×10³
Time from runstart [/sec]

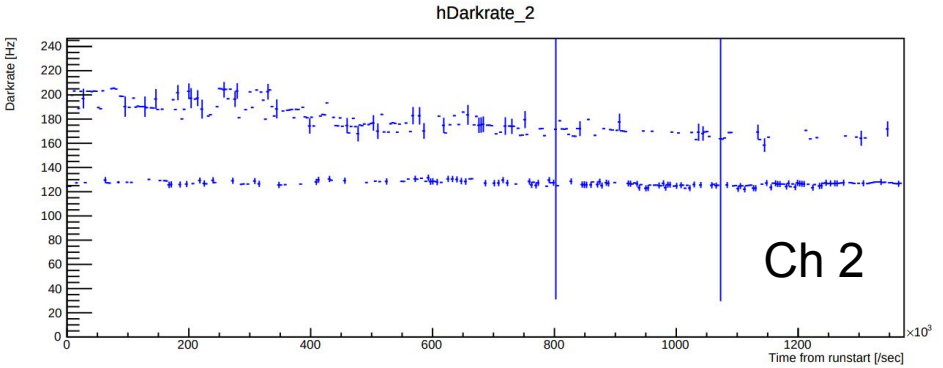

hDarkrate_18
Darkrate [Hz]
Ch 18
Time from runstart [/sec]
×10^3

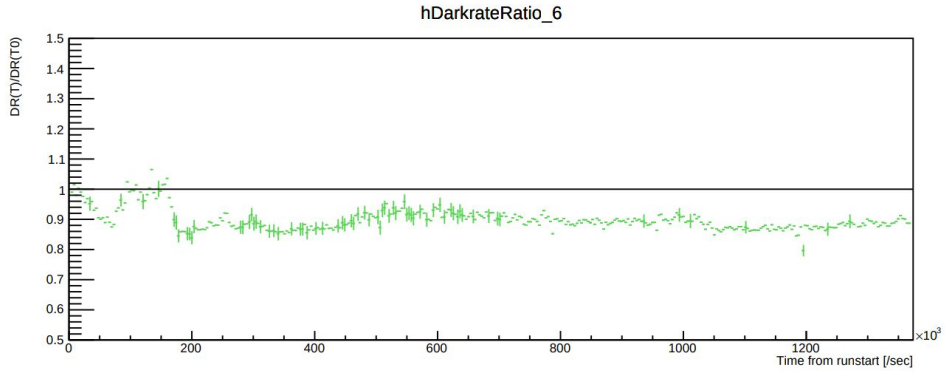

hDarkrateRatio_18
DR(T)/DR(T0)
Time from runstart [/sec]
×10^3

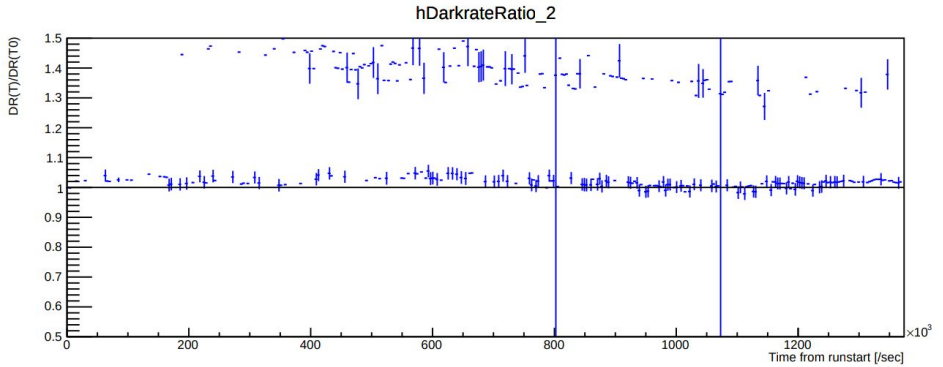
Changed time-period

- Changed the time period of the first step <u>from 100 s to 1 h</u>
- Some channels still had higher errors (like right plot)
  - I am now investigating and I have to be sure the fitter result









Summary

- Plotted the time trends of the darkrate
- They are not so stable
  - We have many unknown structures (spikes, step etc.)

Plan

- Make sure the fitter result
  - Now I checked only fitting error of the parameter (1 pe mean)
- Check the HV (I recorded the HV when changing the run)
-