

Status of Pump Tests

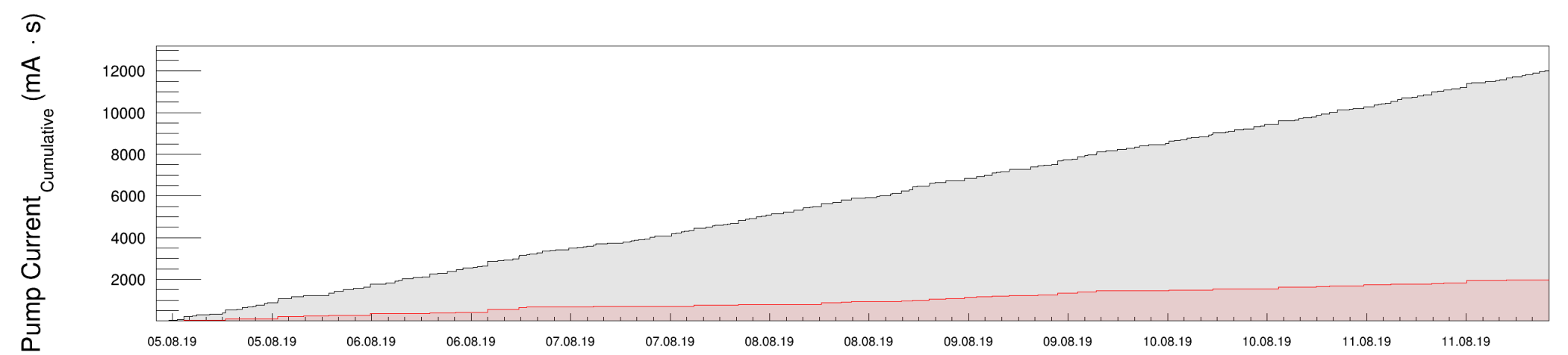
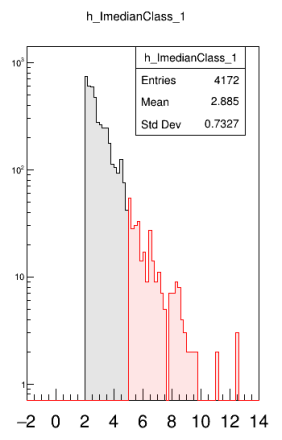
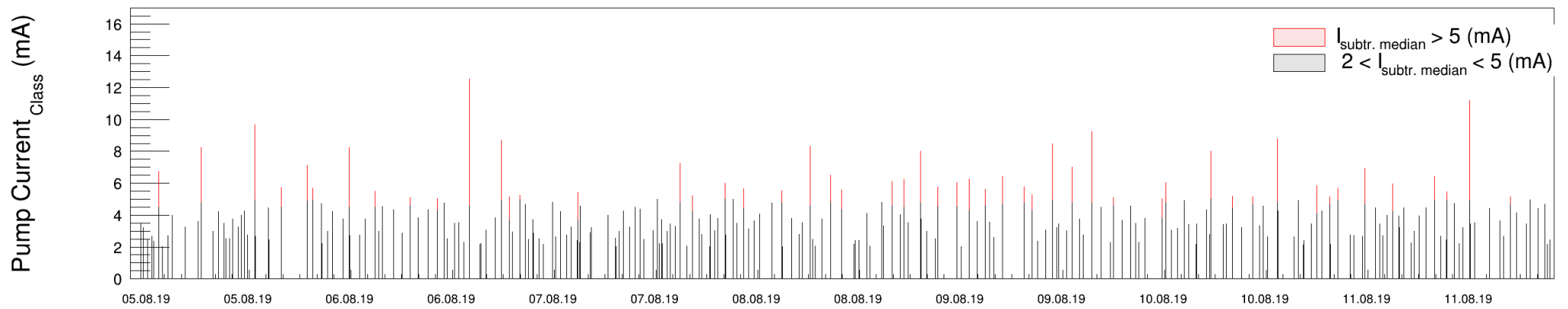
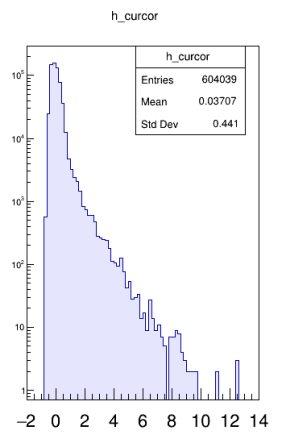
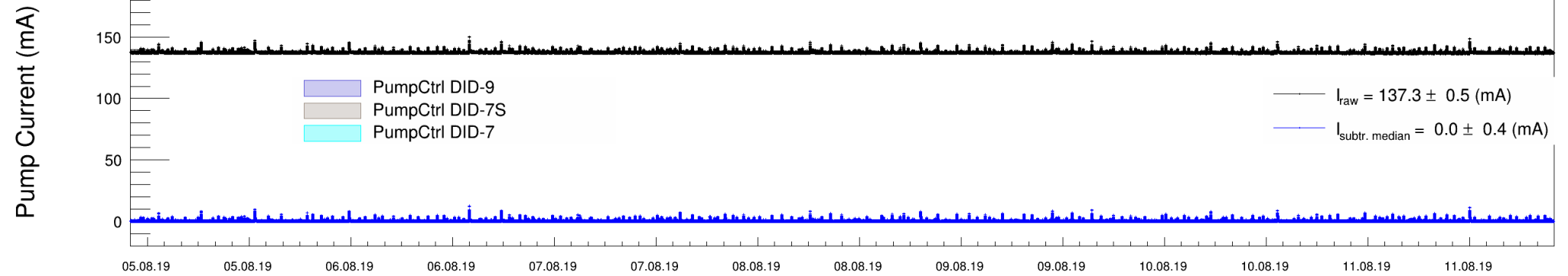
12.08.2019 UTTPS Aachen Meeting

MK #1 (LT-003)

- $T_{\text{pump}} = +15^{\circ}\text{C}$, $T_s = +20^{\circ}\text{C}$
- $T_{\text{pump}} = +10^{\circ}\text{C}$, $T_s = +20^{\circ}\text{C}$
- Pump Inspection (Feb. 13 – 14)
- $T_{\text{pump}} = +10^{\circ}\text{C}$, $T_s = +20^{\circ}\text{C}$ (Feb. 18 – 25)
- $T_{\text{pump}} = +5^{\circ}\text{C}$, $T_s = +15^{\circ}\text{C}$ (Feb. 25 – May. 23)
- Pump Inspection (May 23 – 24) & Restart (May 27)

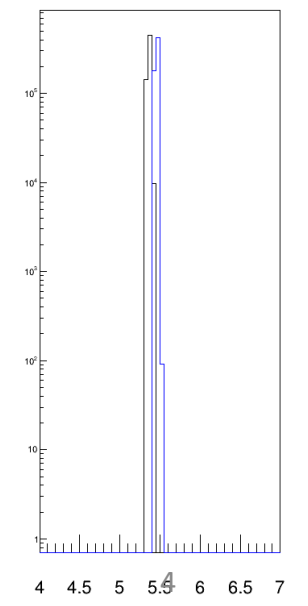
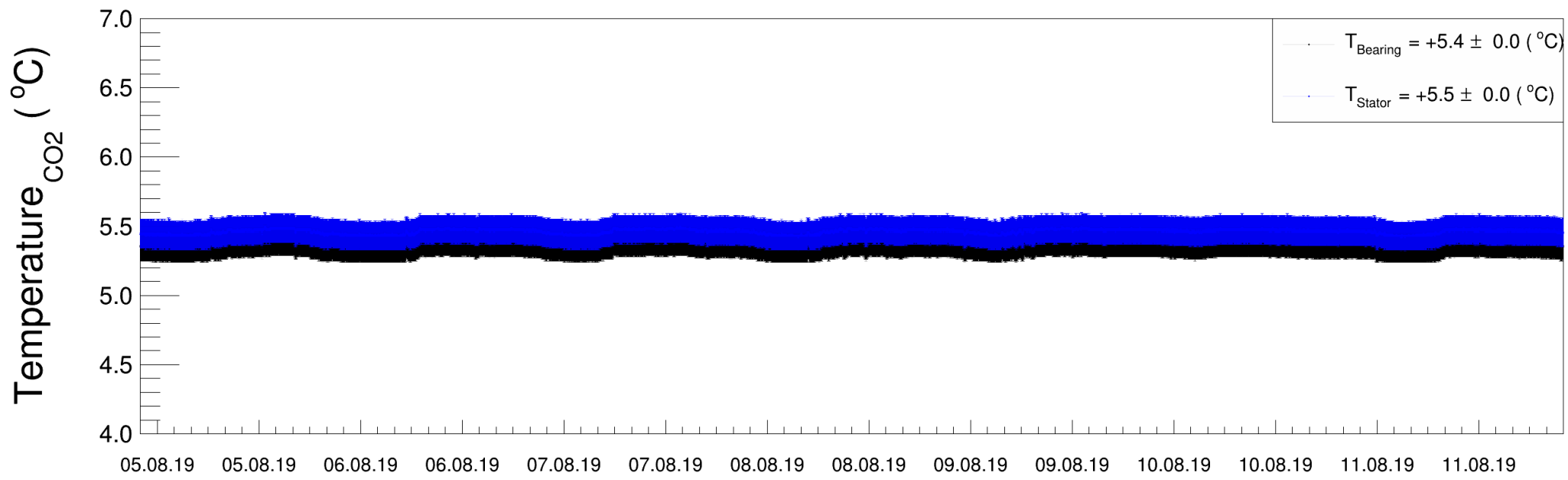
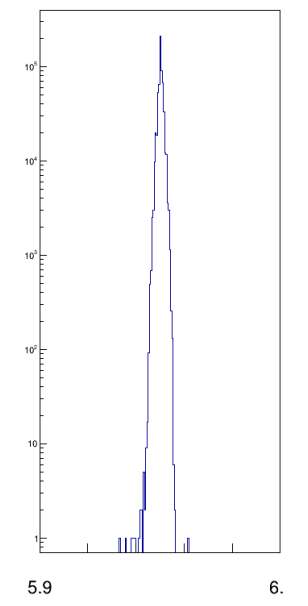
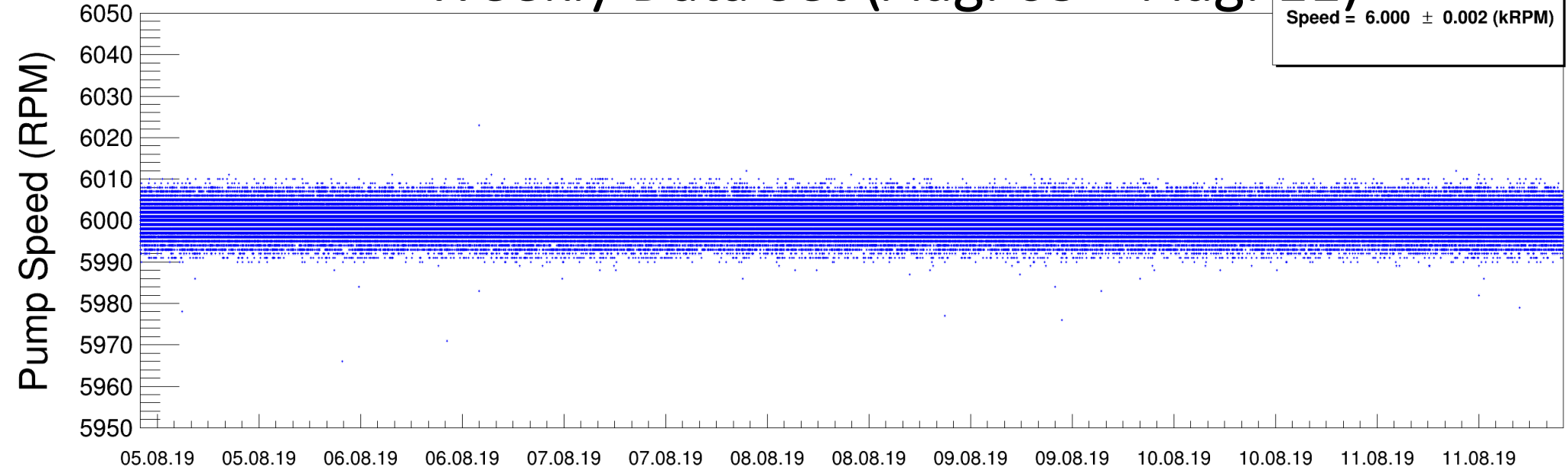
MK1 (LT003)

Weekly Data Set (Aug. 05 – Aug. 11)



MK1 (LT003)

Weekly Data Set (Aug. 05 – Aug. 11)

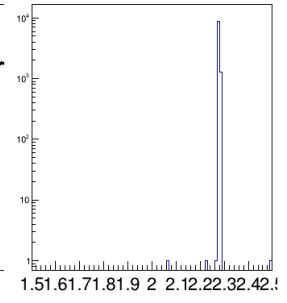
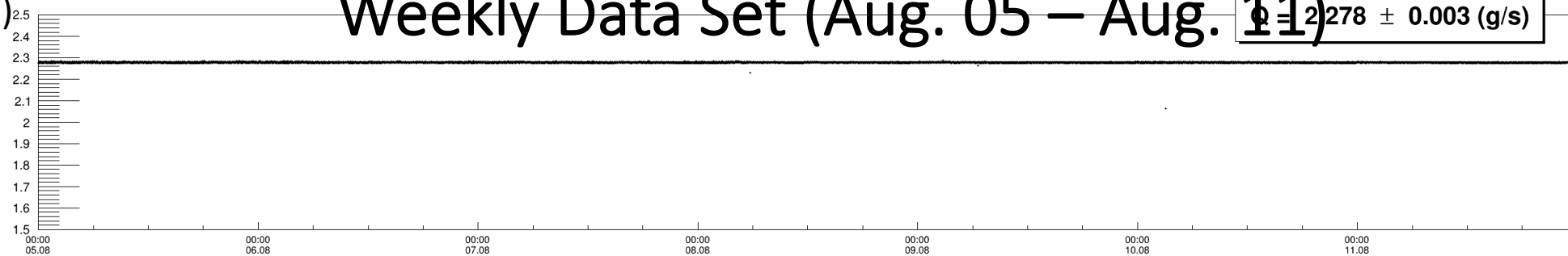


MK1 (LT003)

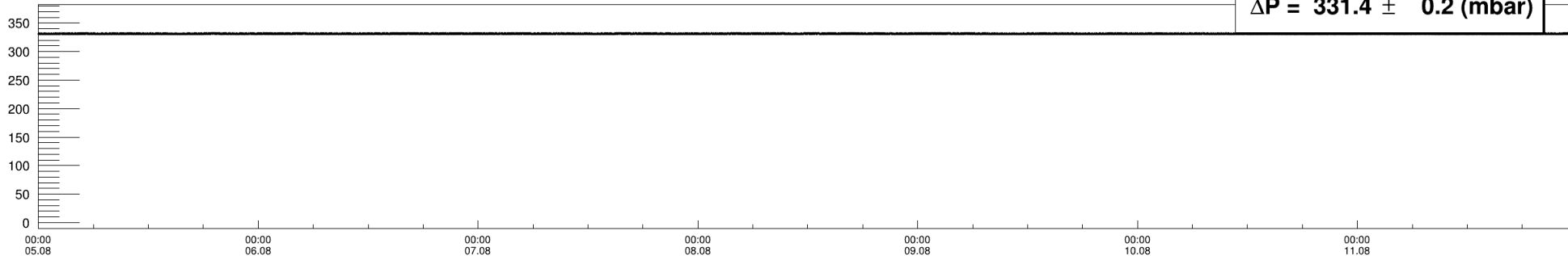
Weekly Data Set (Aug. 05 – Aug. 11)

$Q = 2278 \pm 0.003 \text{ (g/s)}$

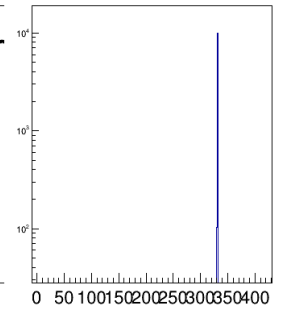
Flow Rate (g/sec)



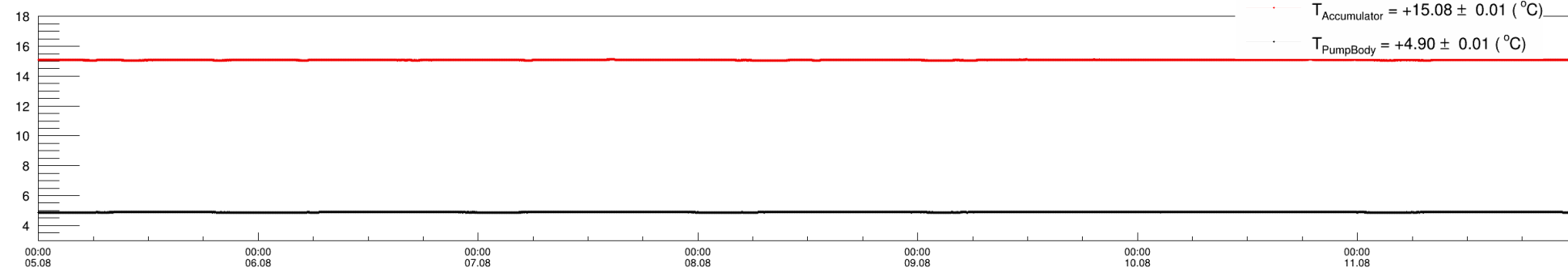
ΔP (mbar)



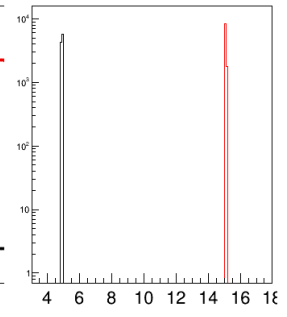
$\Delta P = 331.4 \pm 0.2 \text{ (mbar)}$



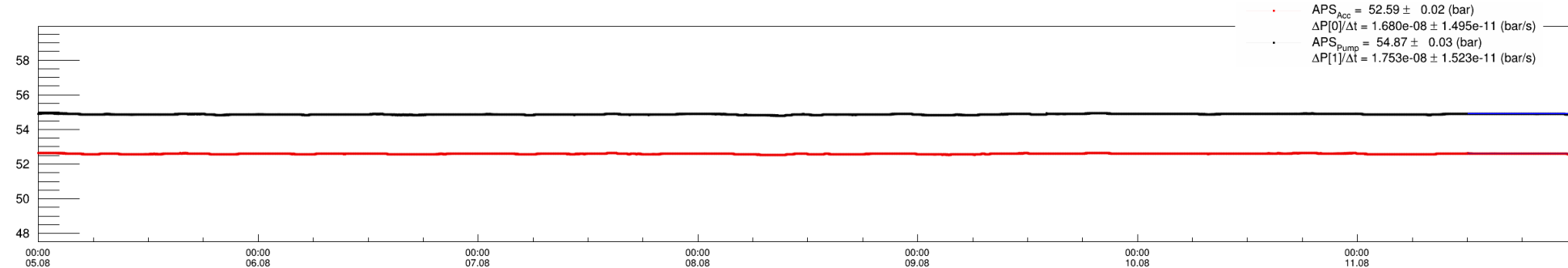
Temperature ($^{\circ}\text{C}$)



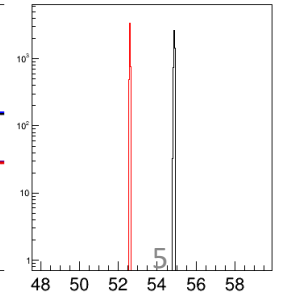
$T_{\text{Accumulator}} = 15.08 \pm 0.01 \text{ (}^{\circ}\text{C)}$
 $T_{\text{PumpBody}} = 4.90 \pm 0.01 \text{ (}^{\circ}\text{C)}$



APS (bar)

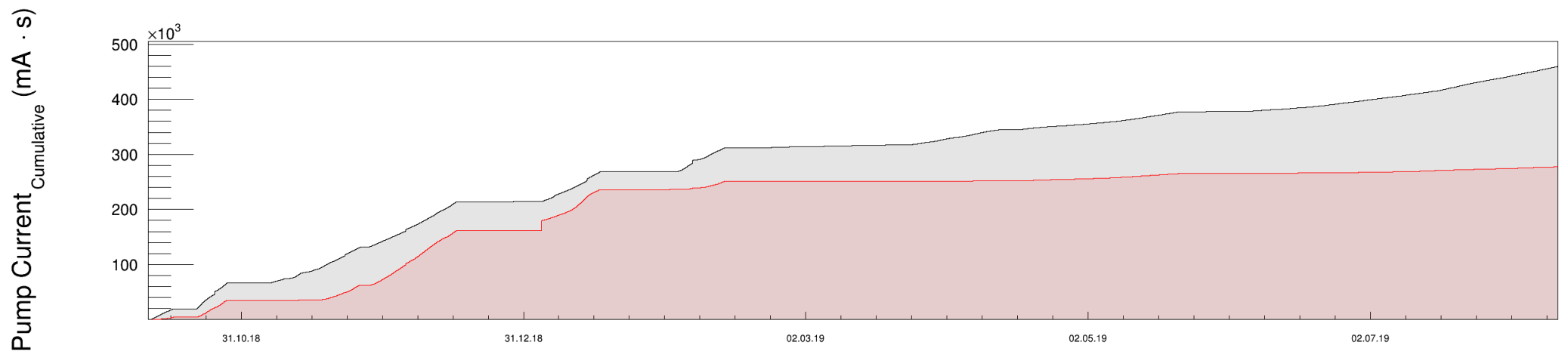
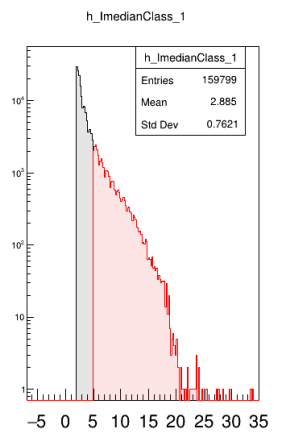
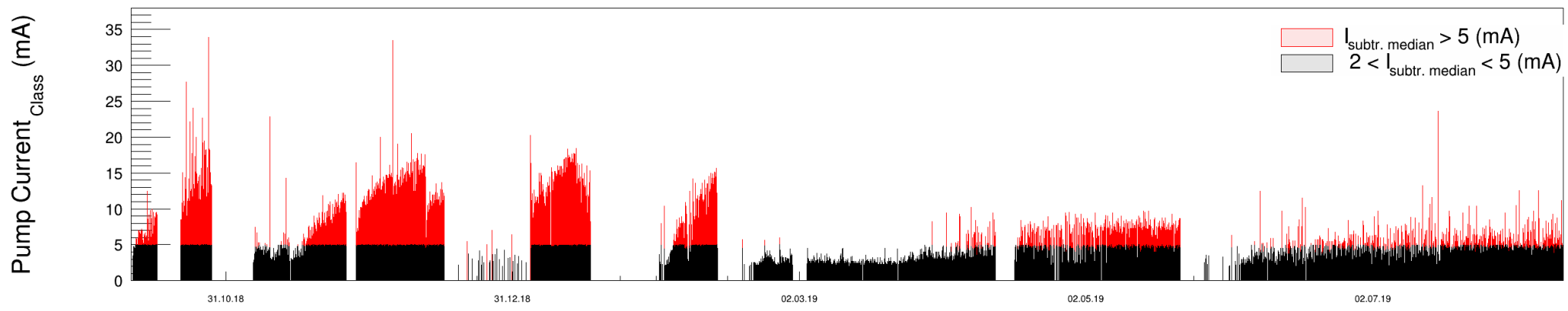
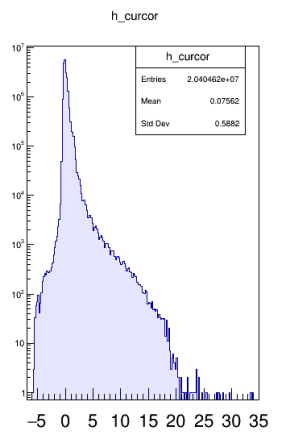
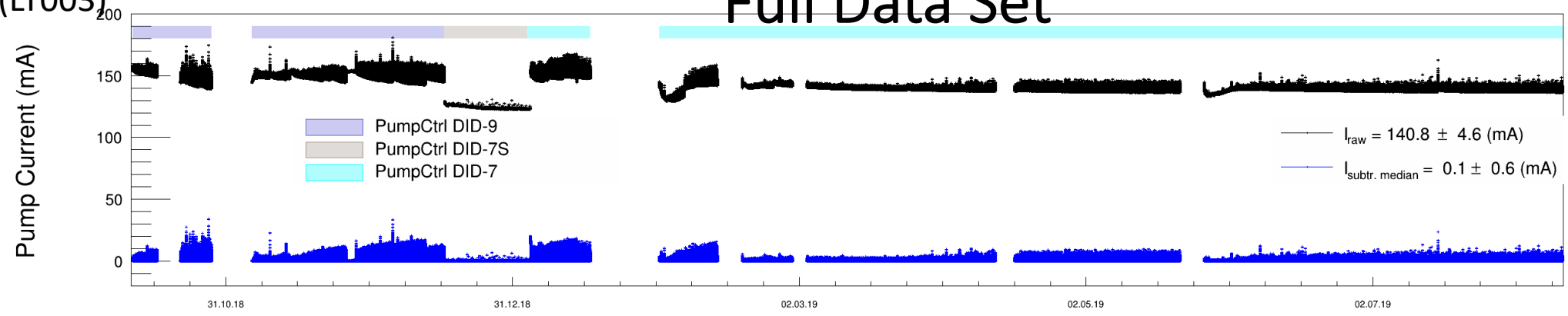


$\text{APS}_{\text{Acc}} = 52.59 \pm 0.02 \text{ (bar)}$
 $\Delta P[0]/\Delta t = 1.680\text{e-}08 \pm 1.495\text{e-}11 \text{ (bar/s)}$
 $\text{APS}_{\text{Pump}} = 54.87 \pm 0.03 \text{ (bar)}$
 $\Delta P[1]/\Delta t = 1.753\text{e-}08 \pm 1.523\text{e-}11 \text{ (bar/s)}$



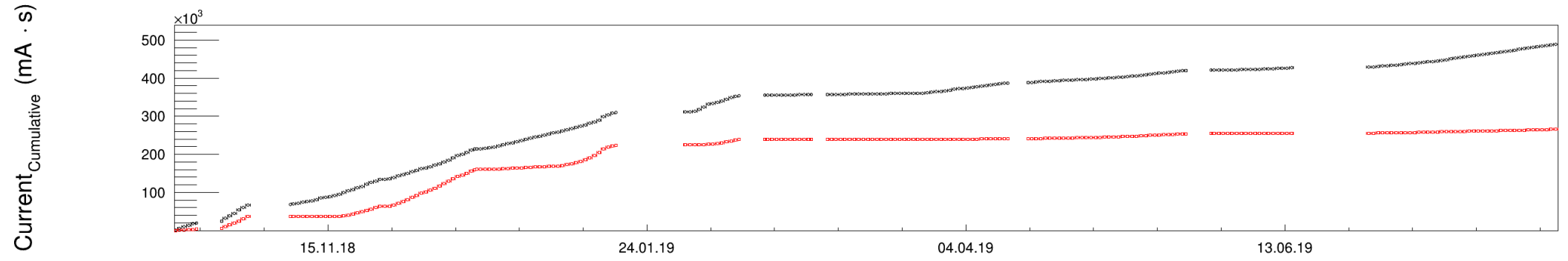
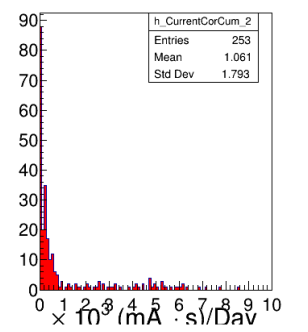
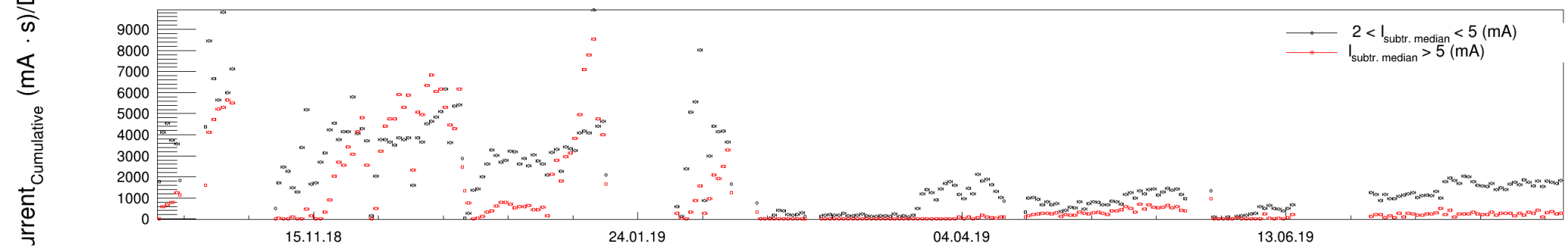
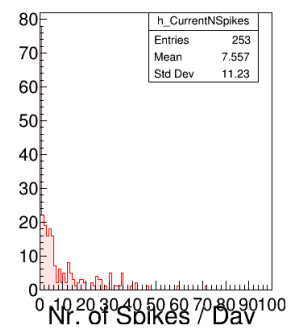
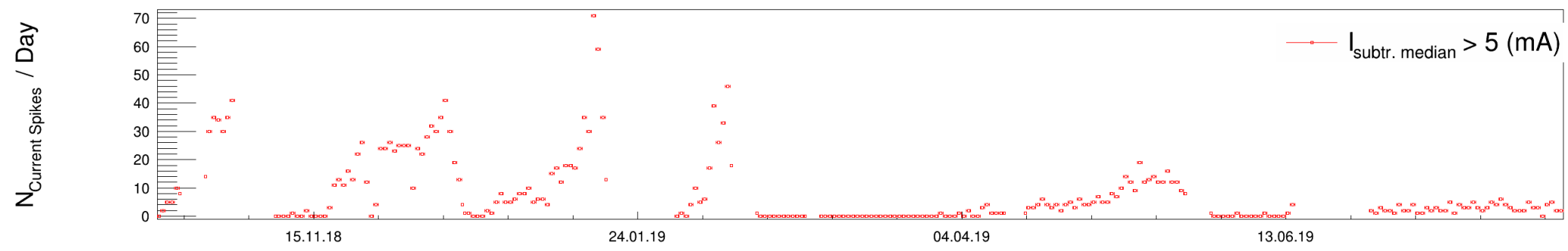
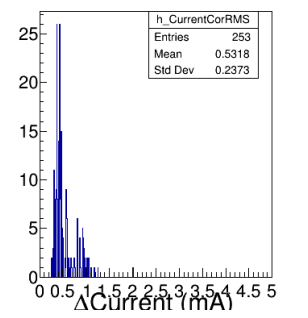
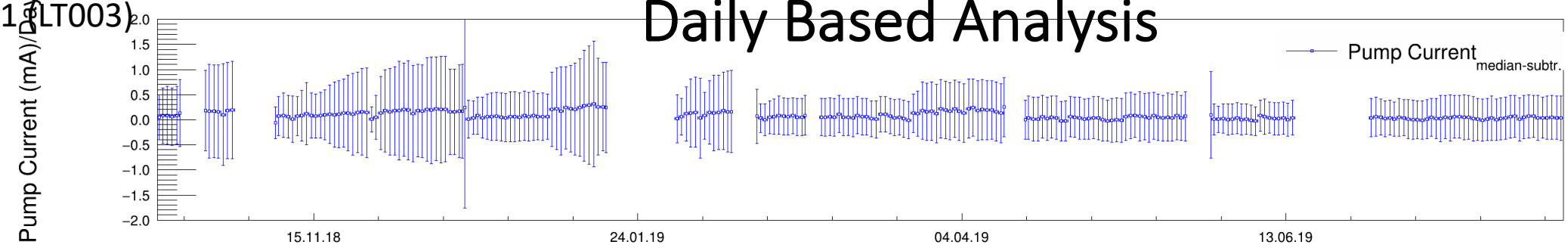
MK1 (LT003)

Full Data Set



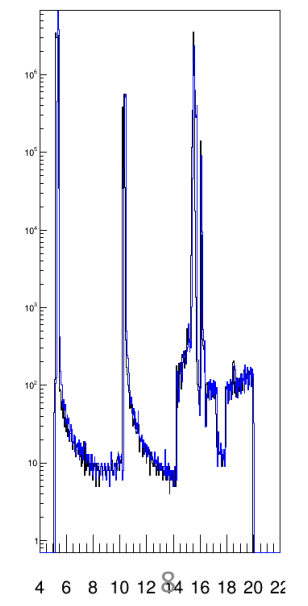
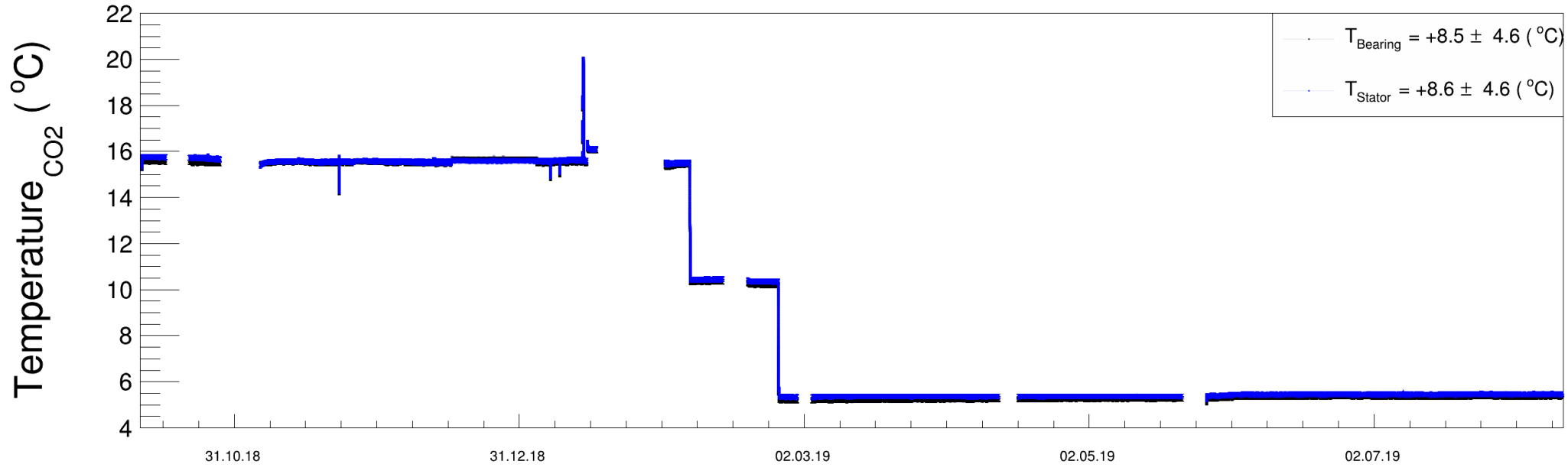
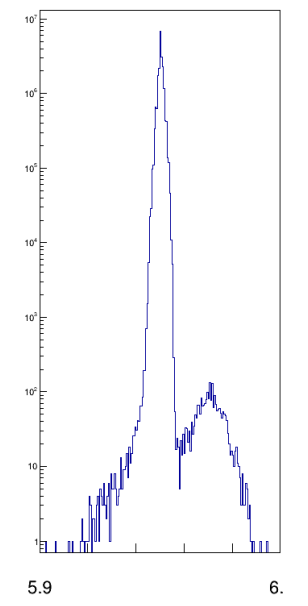
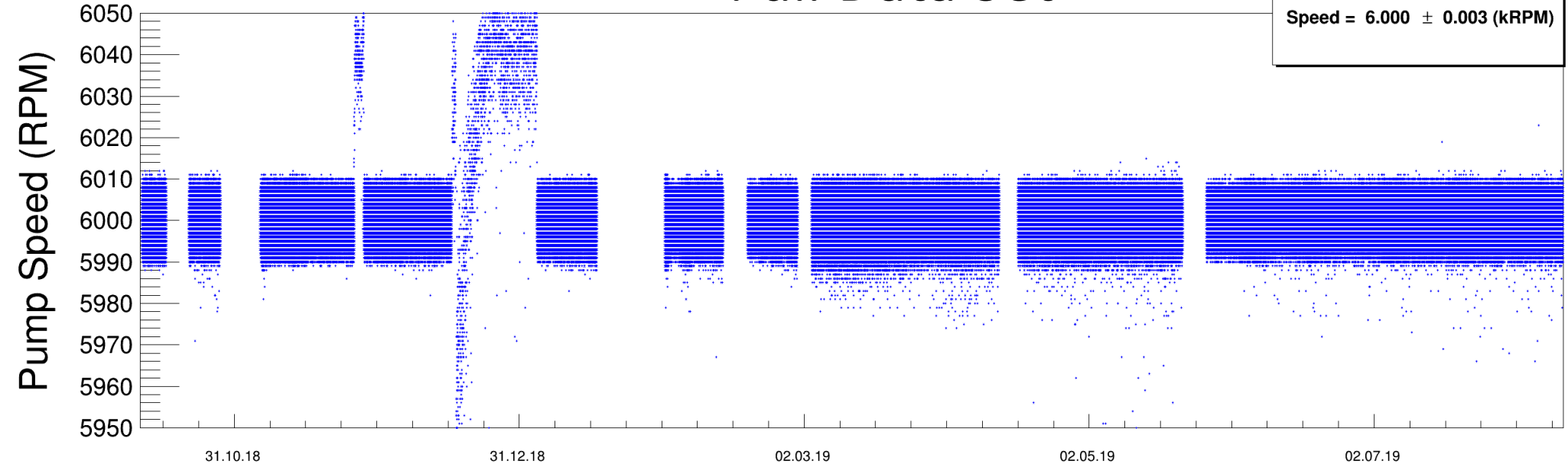
MK1 (TLT003)

Daily Based Analysis



MK1 (LT003)

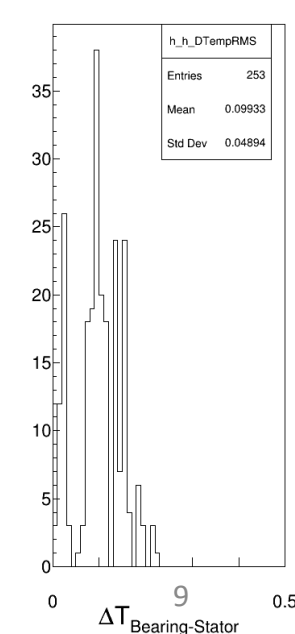
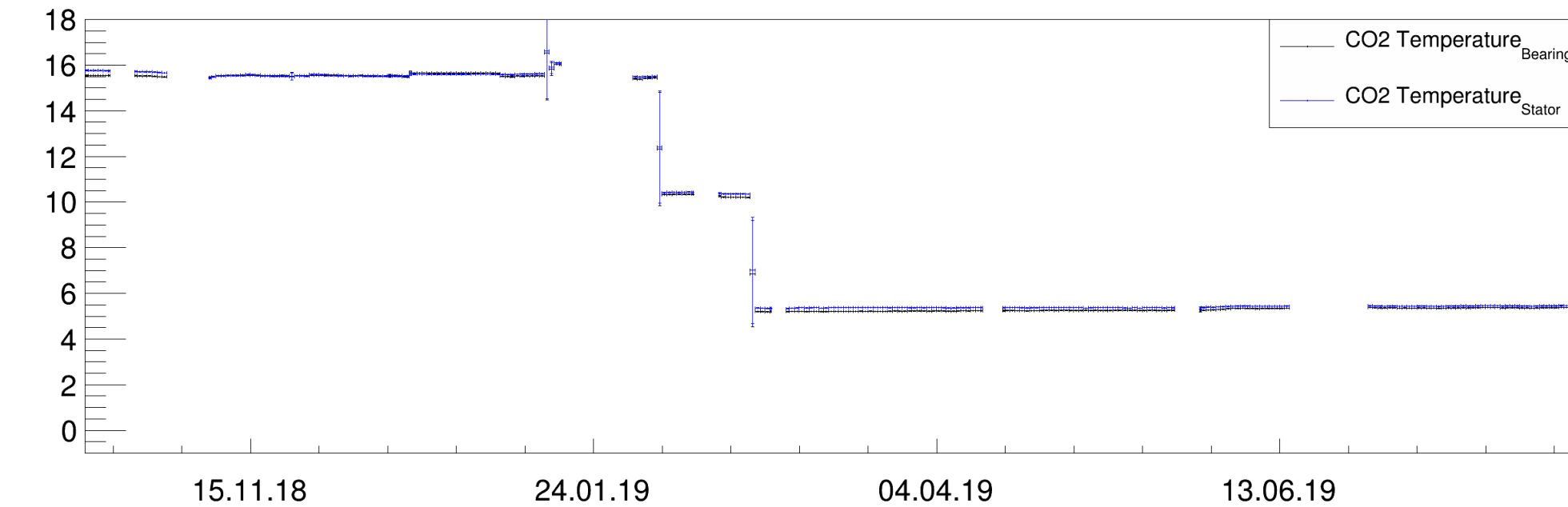
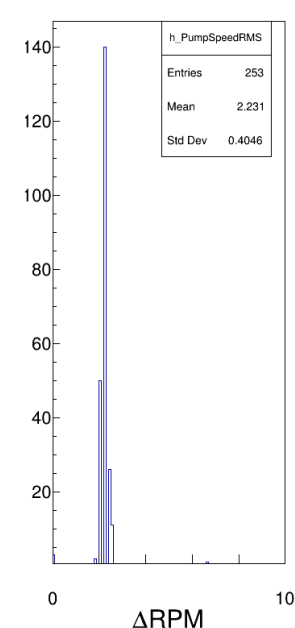
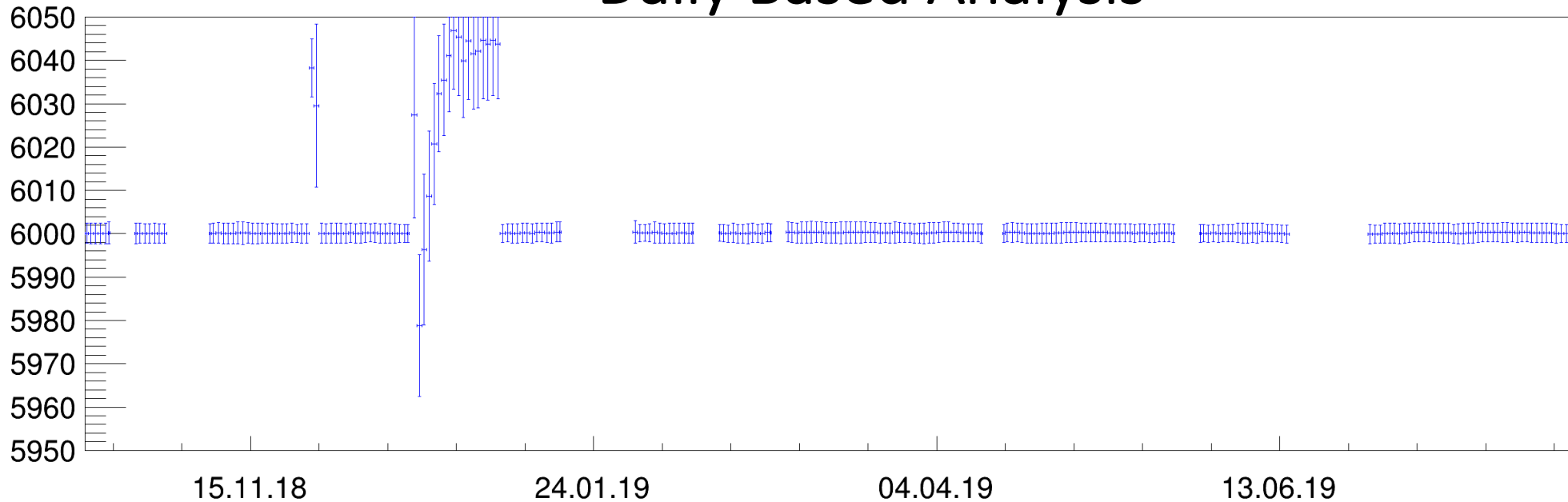
Full Data Set



MK1 (T003)

Daily Based Analysis

Pump Speed (RPM)/Day
Temperature_{CO2} (°C)/Day



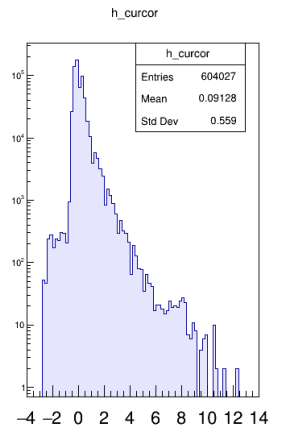
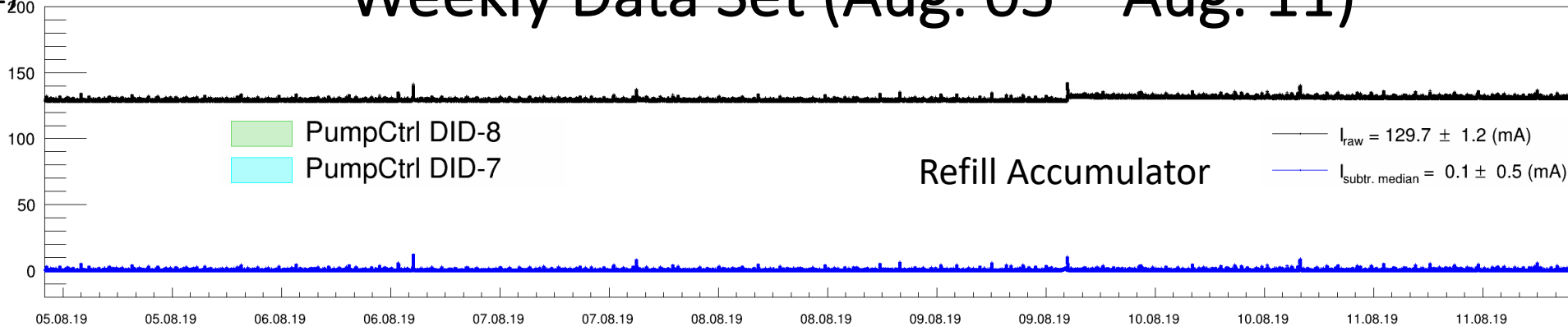
MK #2
(LT-002)

- $T_{\text{pump}} = +0^{\circ}\text{C}$, $T_s = +5^{\circ}\text{C}$ (constant condition)

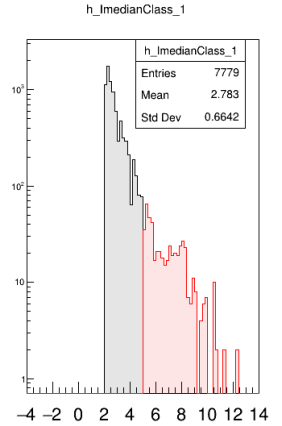
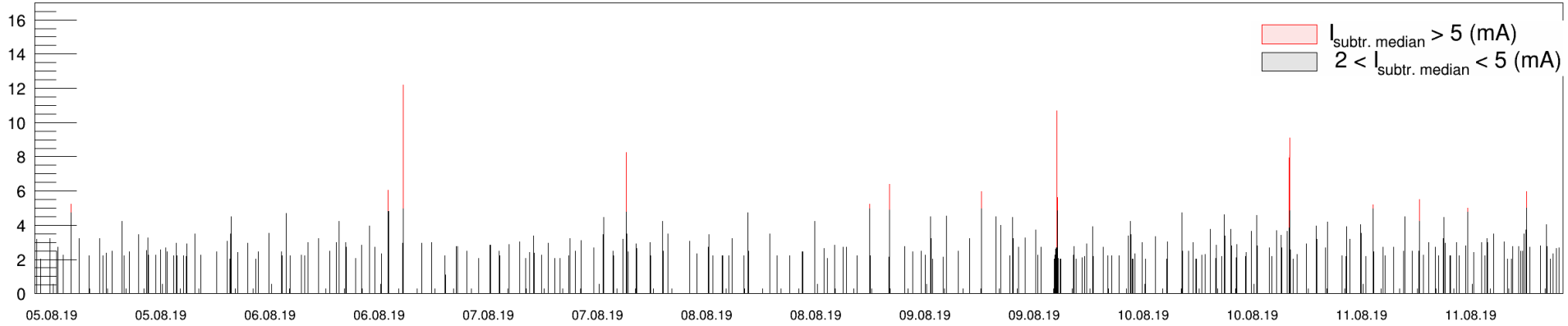
Weekly Data Set (Aug. 05 – Aug. 11)

MK2 (LT002)

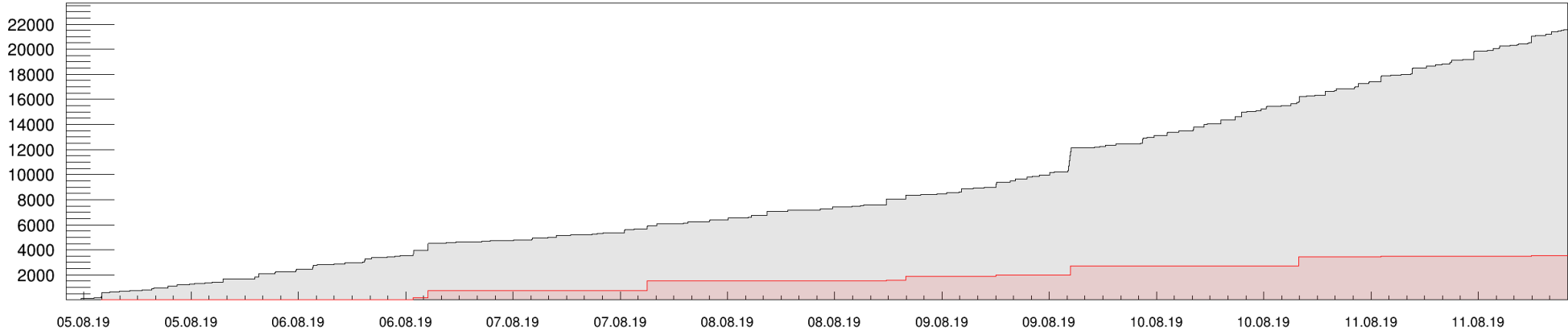
Pump Current (mA)



Pump Current_{Class} (mA)

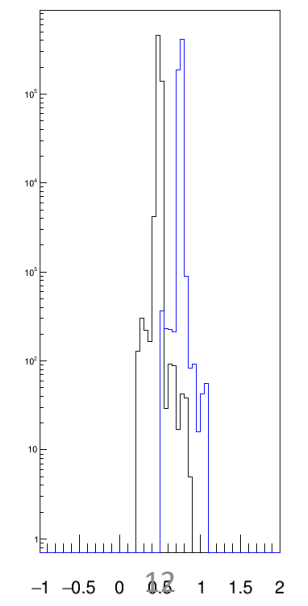
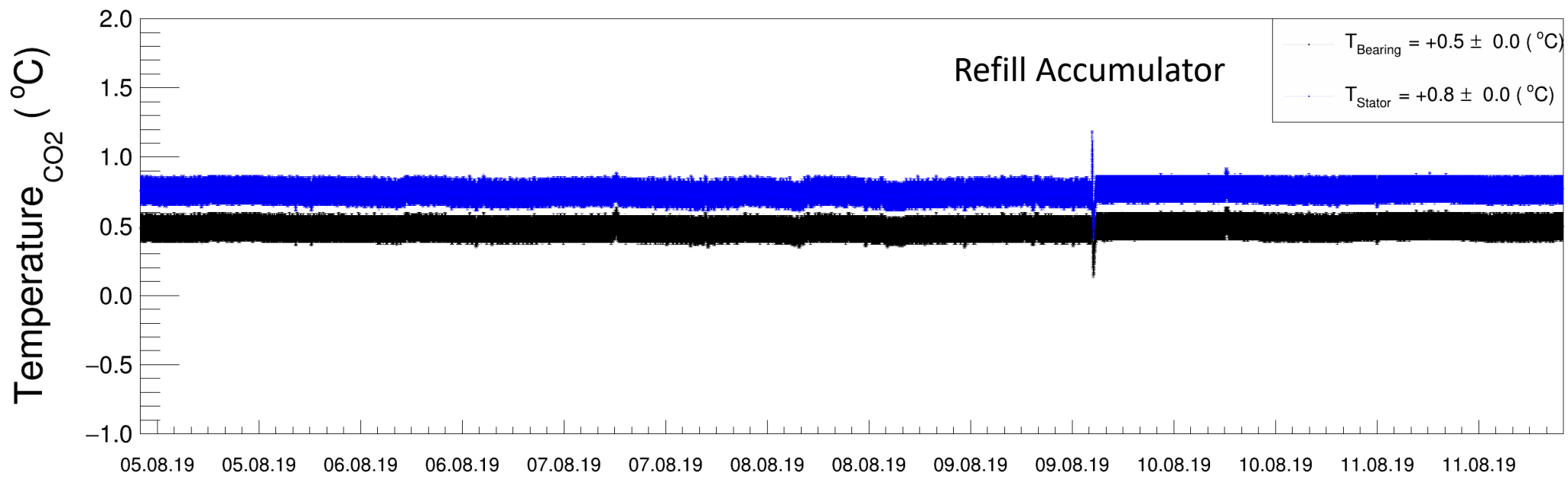
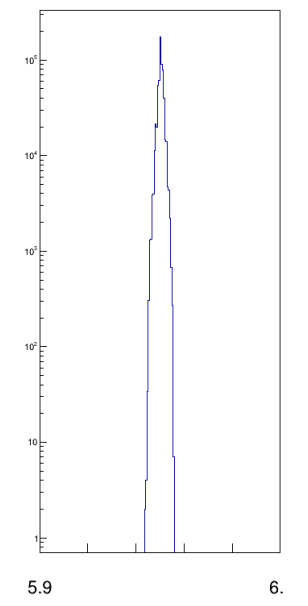
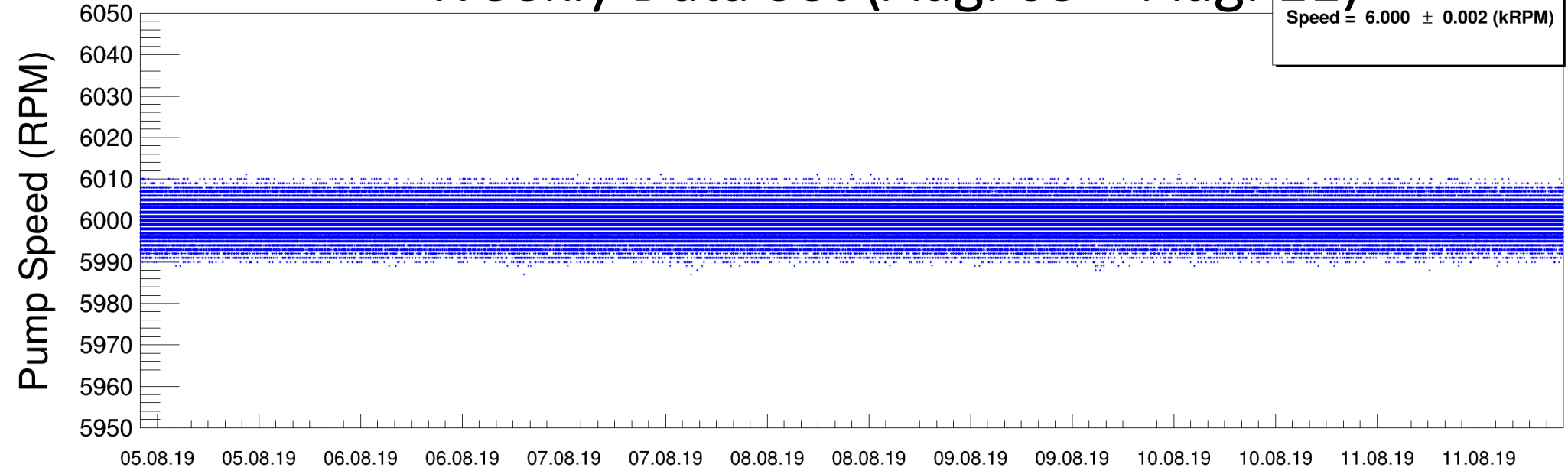


Pump Current_{Cumulative} (mA · s)



MK2 (LT002)

Weekly Data Set (Aug. 05 – Aug. 11)

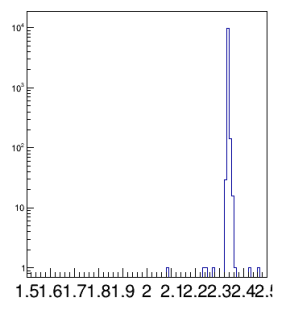
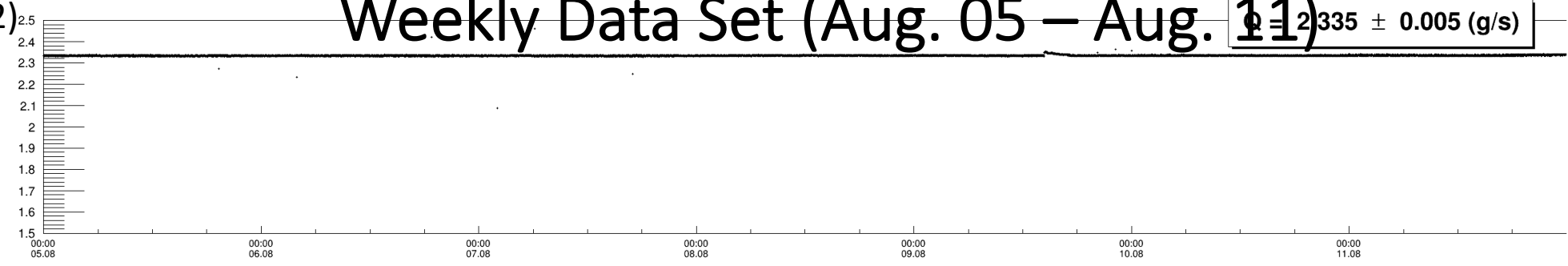


MK2 (LT002)

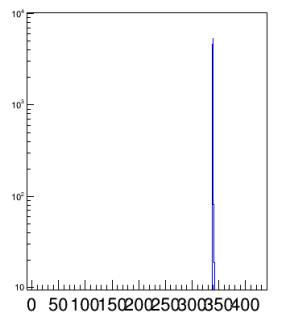
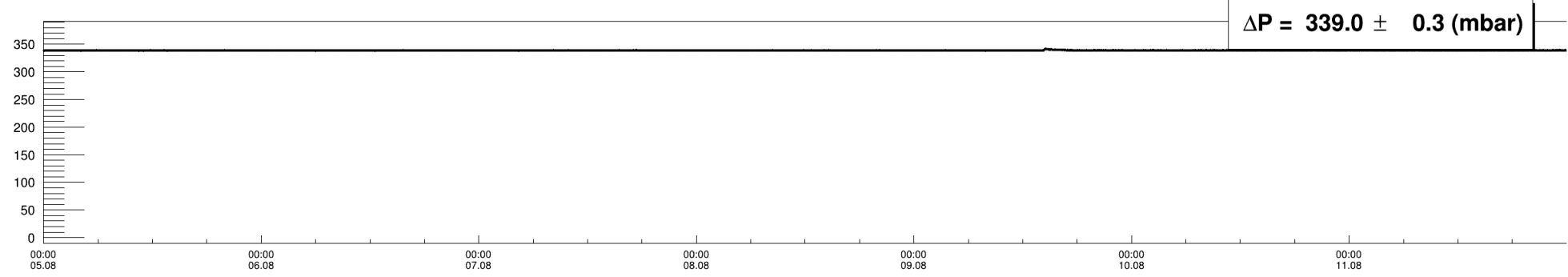
Weekly Data Set (Aug. 05 – Aug. 11)

$Q = 2335 \pm 0.005 \text{ (g/s)}$

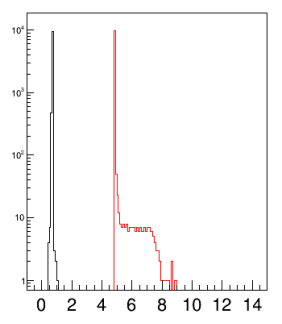
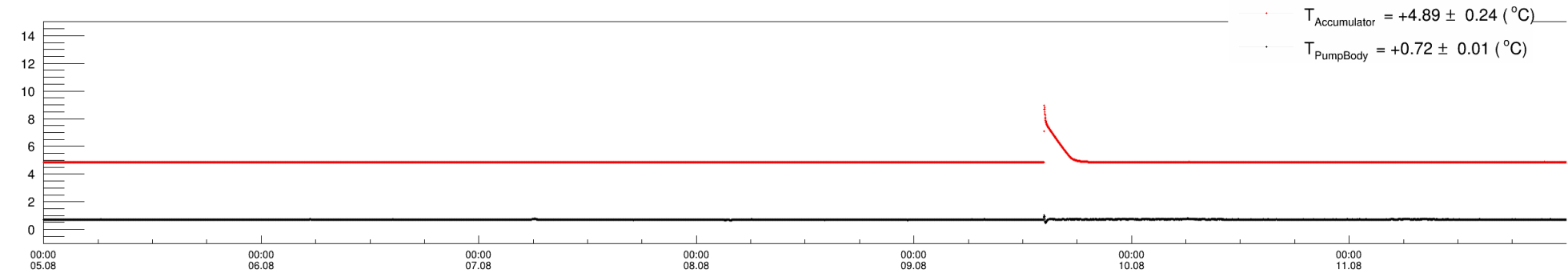
Flow Rate (g/sec)



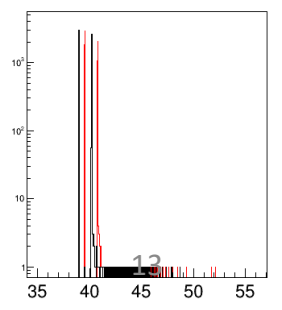
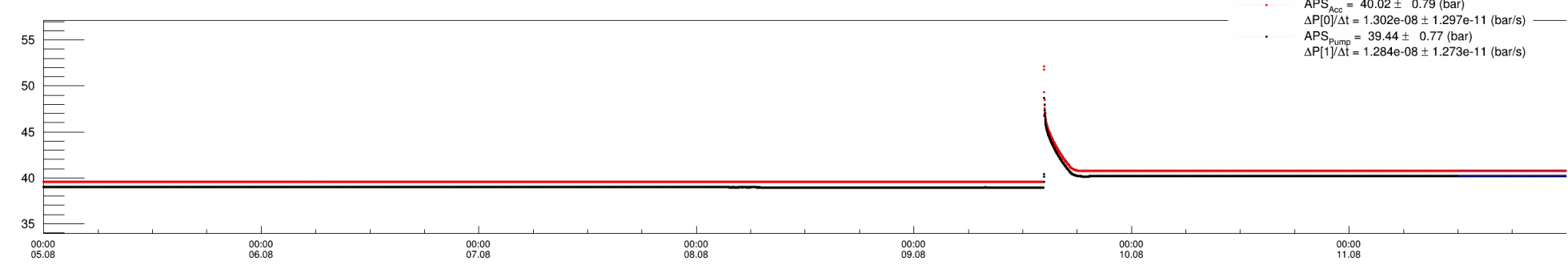
ΔP (mbar)



Temperature (°C)

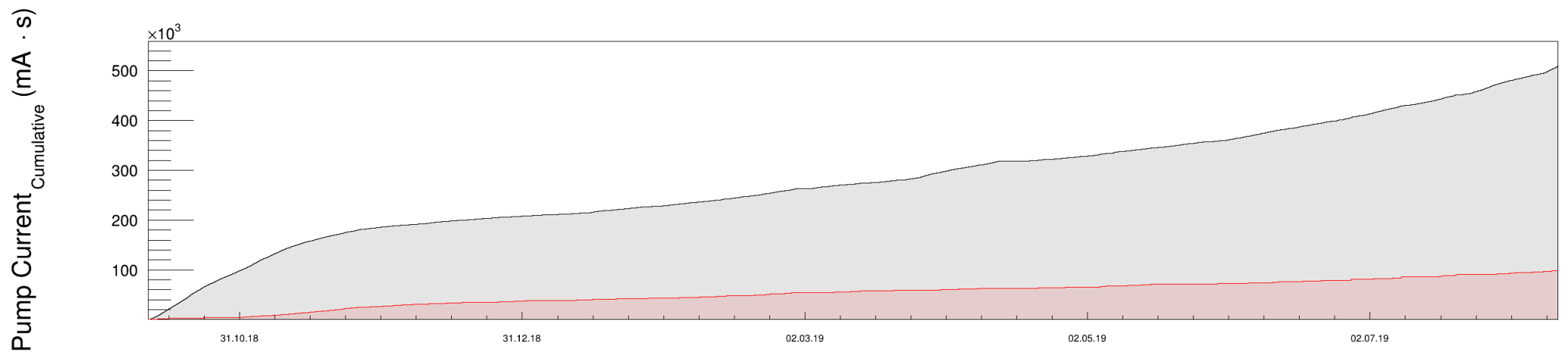
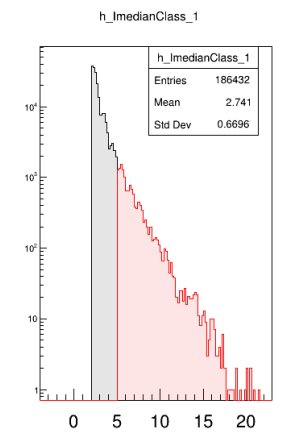
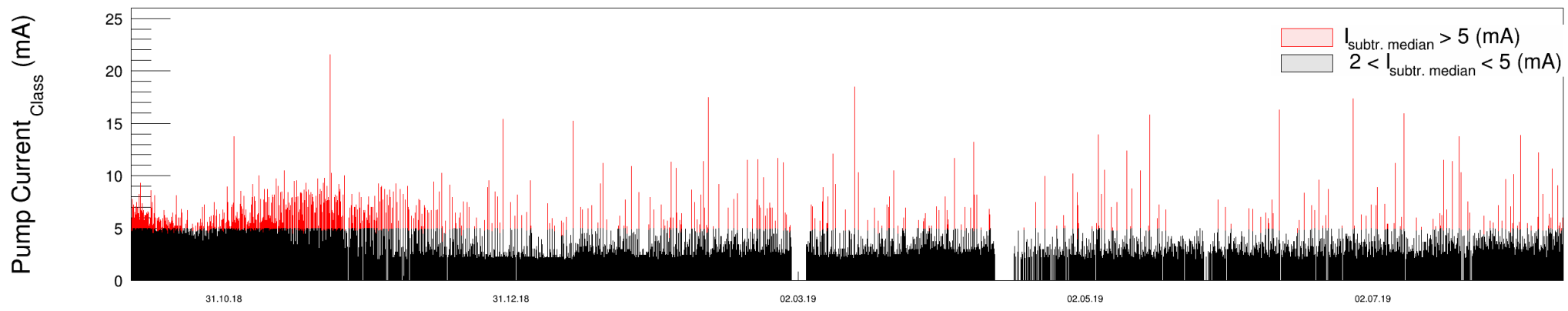
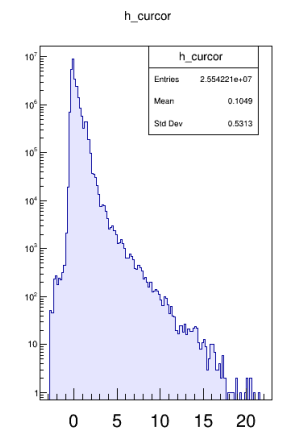
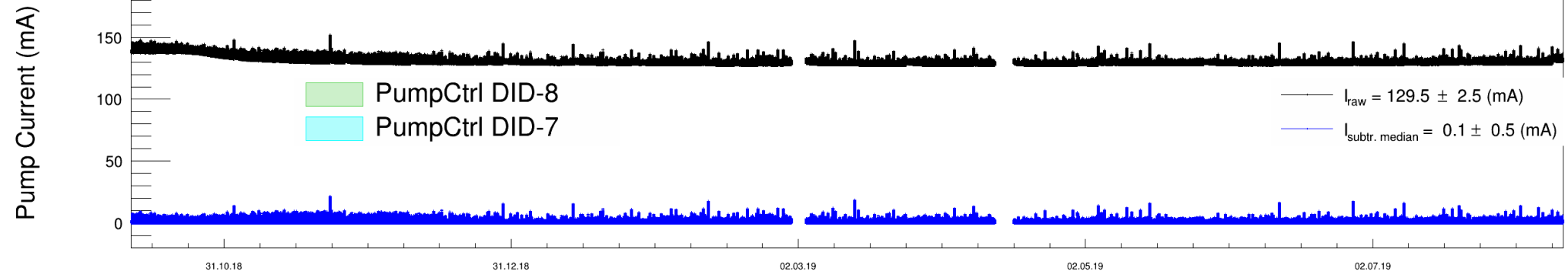


APS (bar)



$APS_{\text{Acc}} = 40.02 \pm 0.79 \text{ (bar)}$
 $\Delta P[0]/\Delta t = 1.302\text{e-}08 \pm 1.297\text{e-}11 \text{ (bar/s)}$
 $APS_{\text{Pump}} = 39.44 \pm 0.77 \text{ (bar)}$
 $\Delta P[1]/\Delta t = 1.284\text{e-}08 \pm 1.273\text{e-}11 \text{ (bar/s)}$

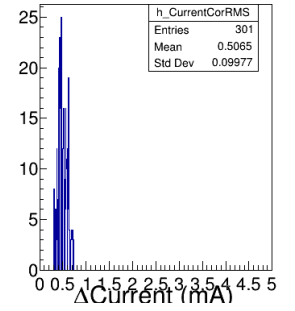
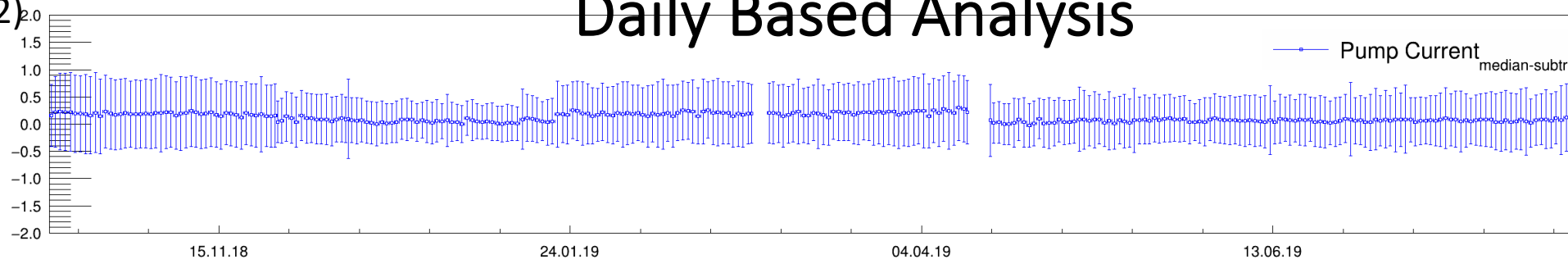
Full Data Set



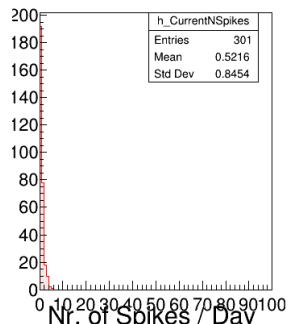
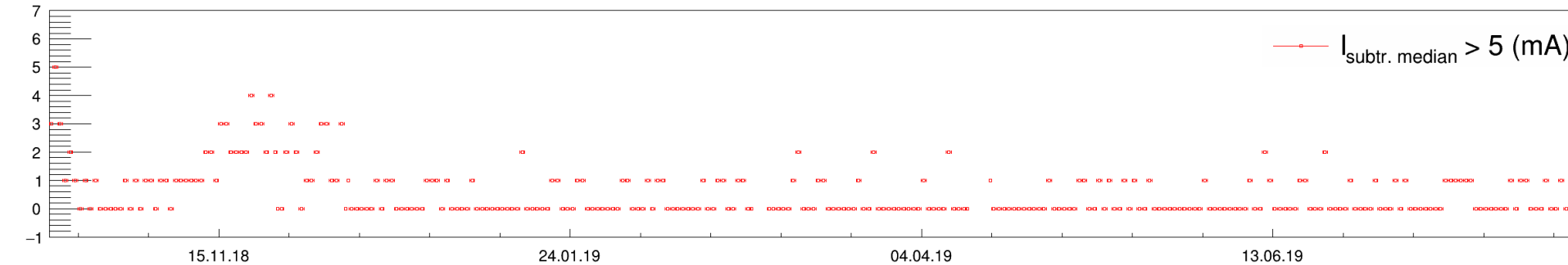
Daily Based Analysis

MK2 (TLT002)

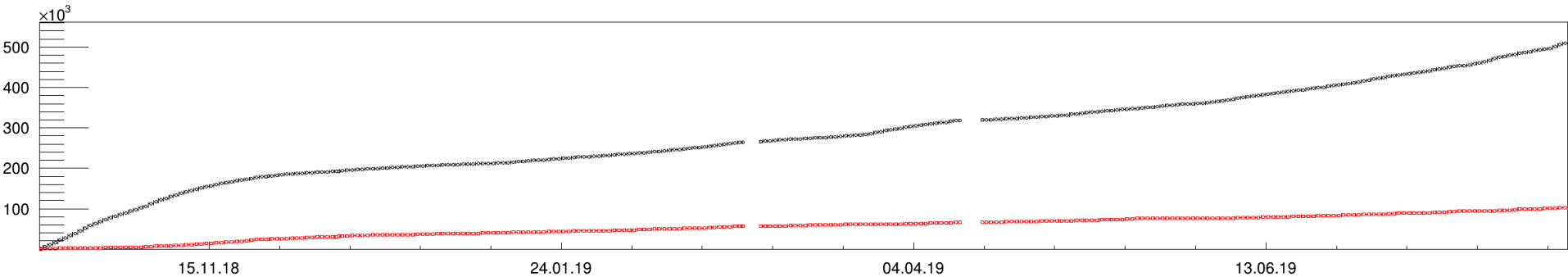
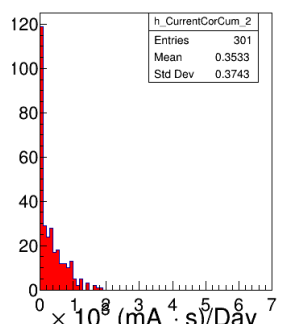
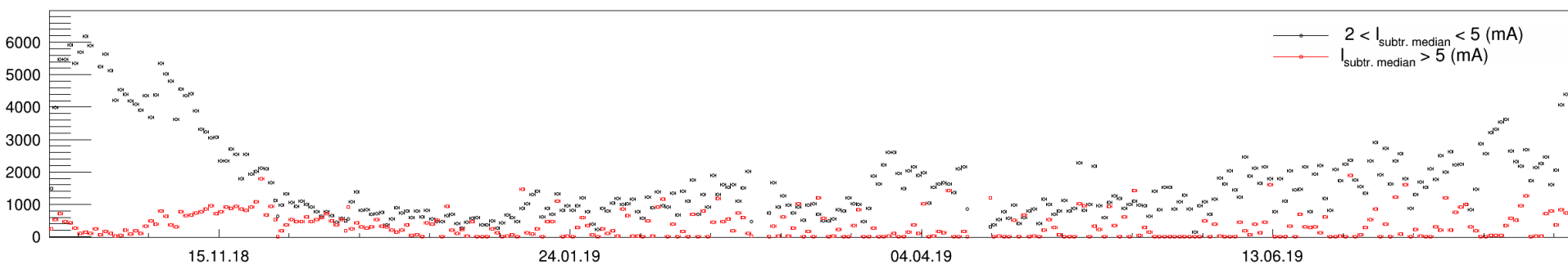
Pump Current (mA)/Day



$N_{\text{Current Spikes}} / \text{Day}$

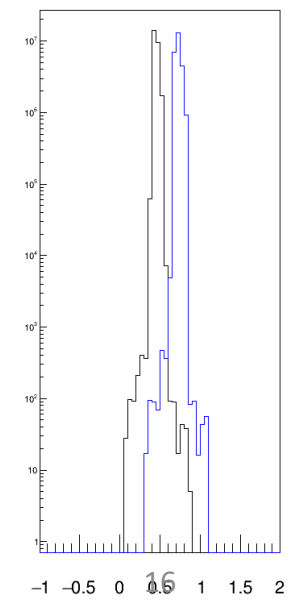
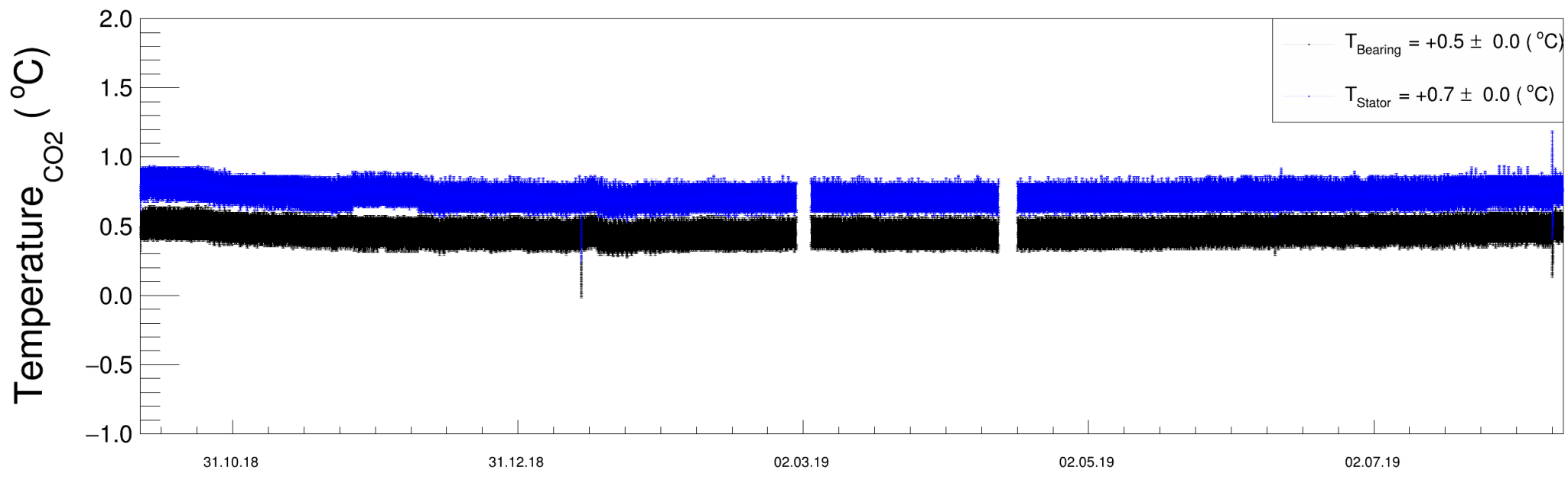
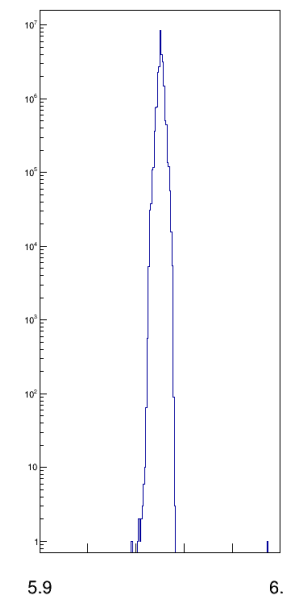
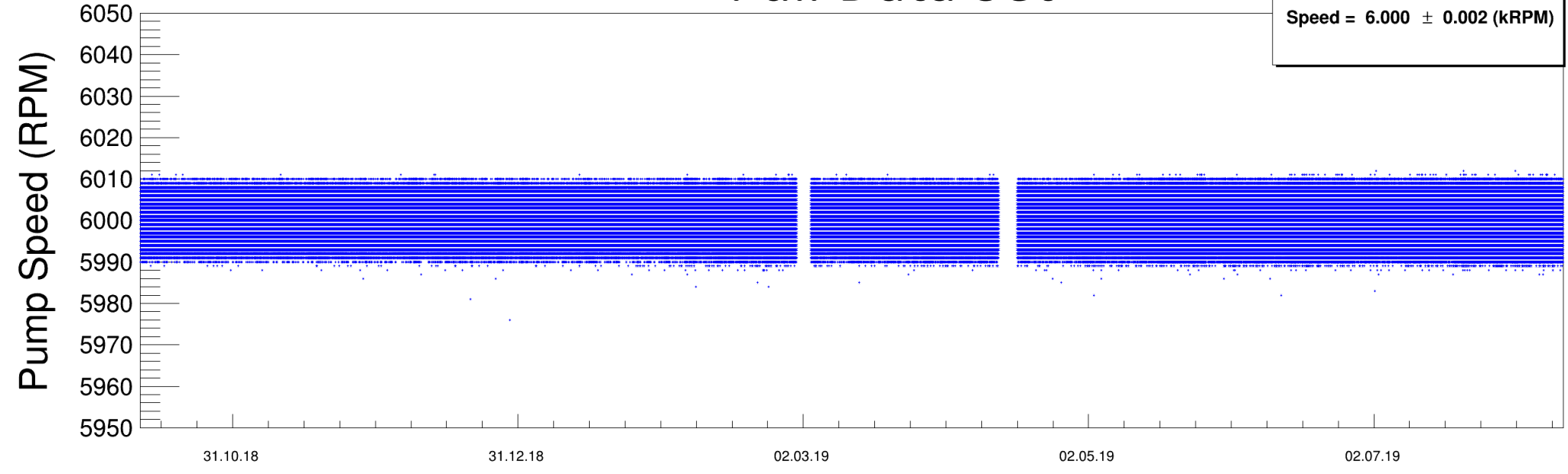


Current_Cumulative (mA · s)



MK2 (LT002)

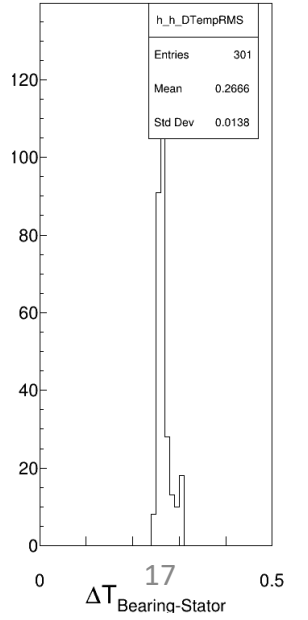
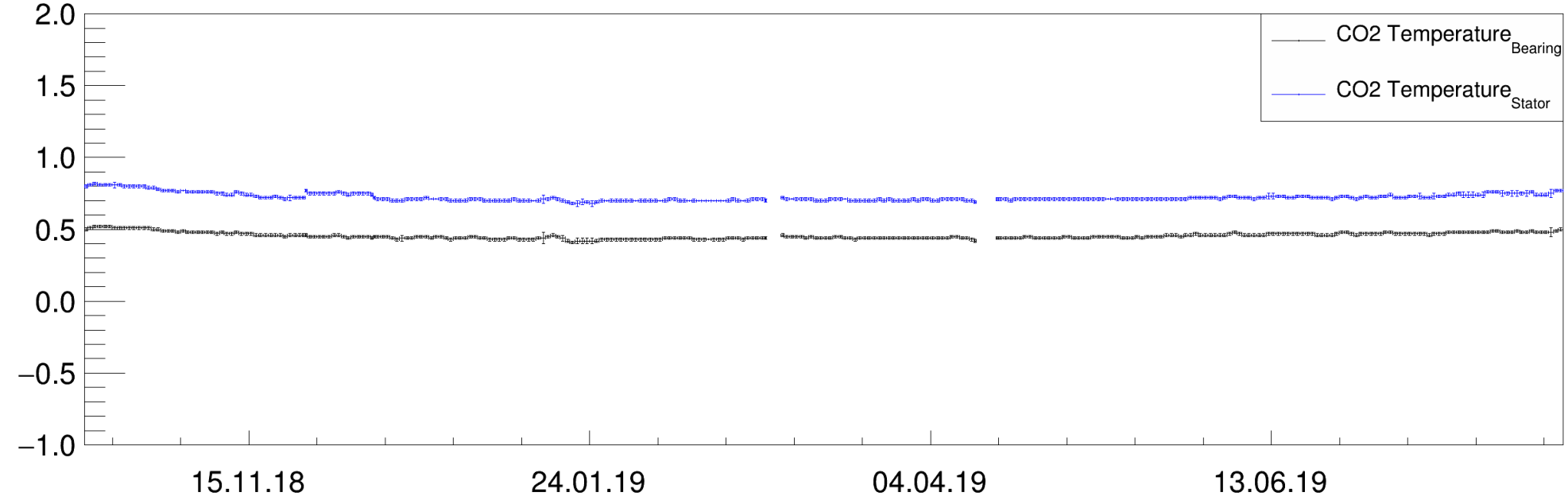
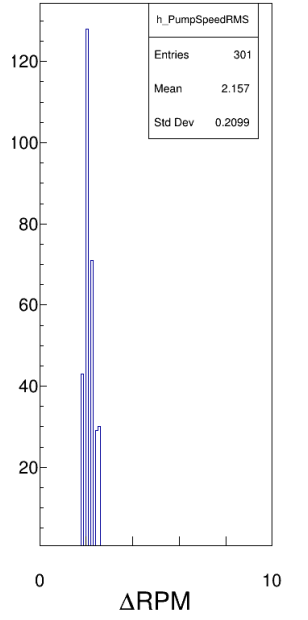
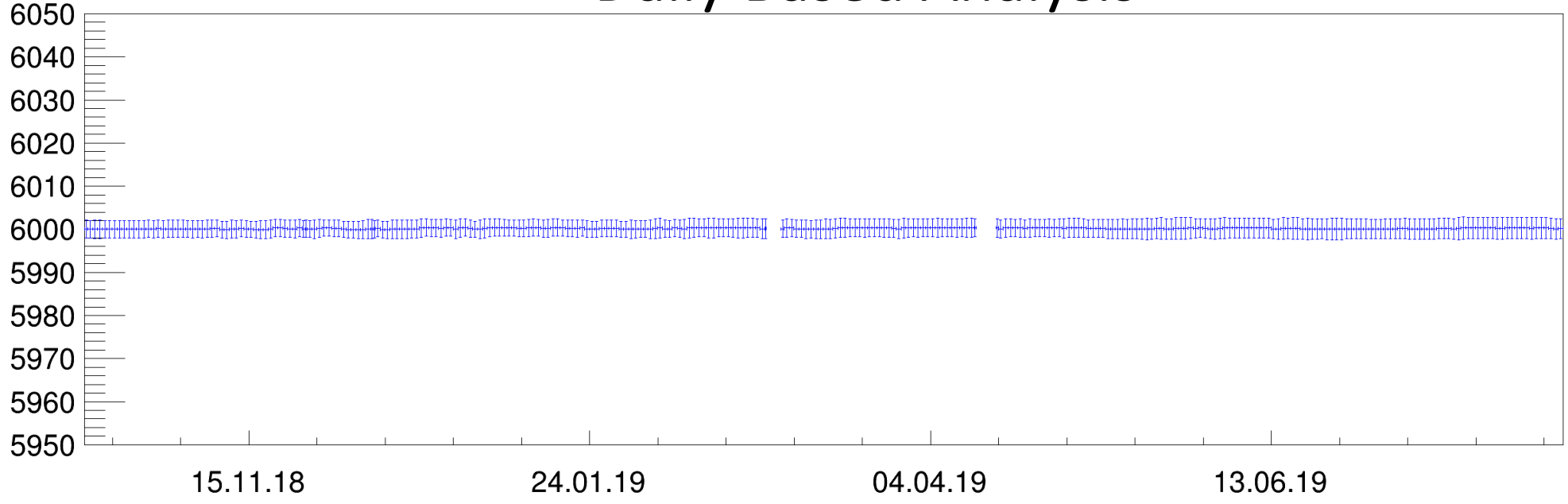
Full Data Set



Daily Based Analysis

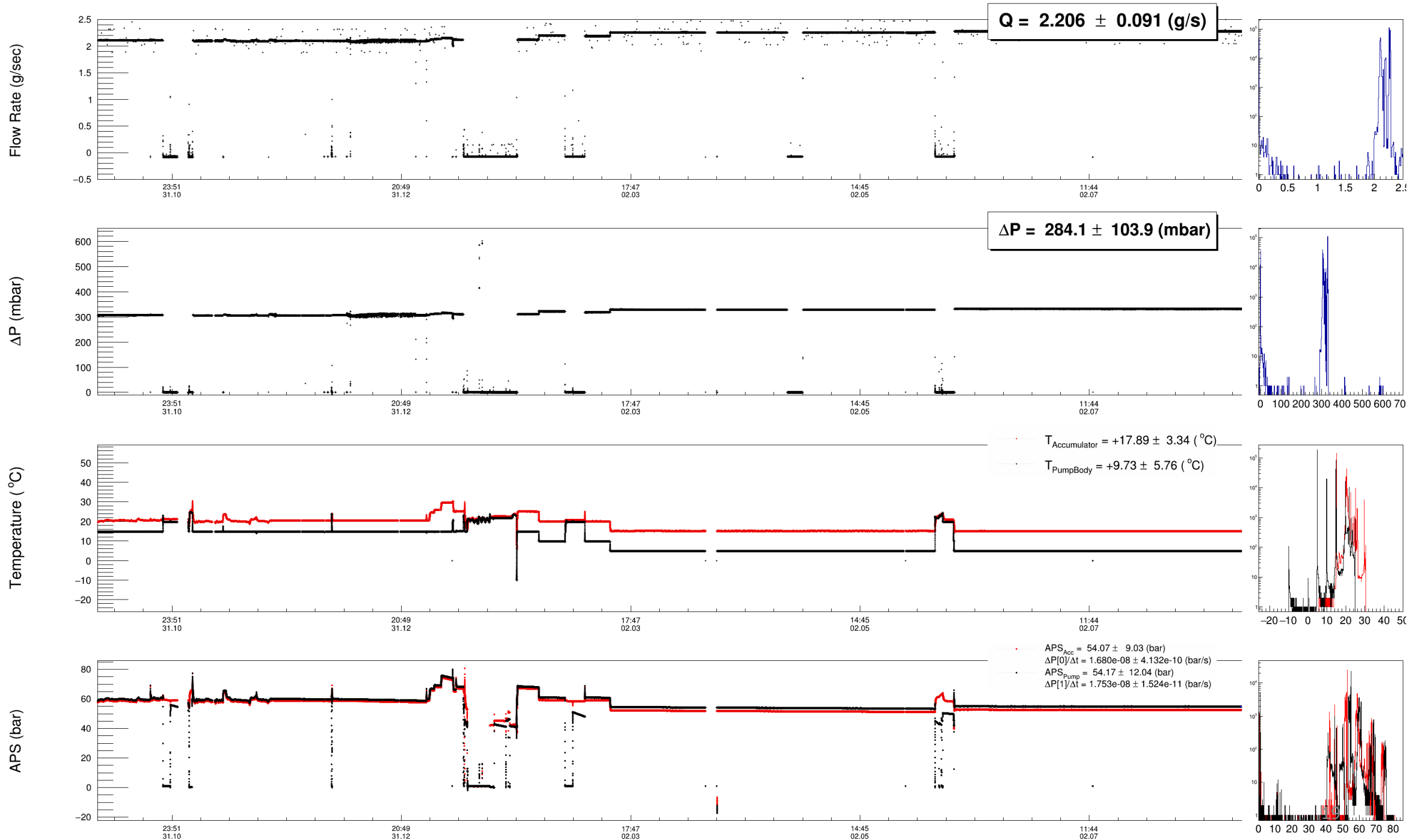
MK2 (T002)

Pump Speed (RPM)/Day
Temperature_{CO2} (°C)/Day



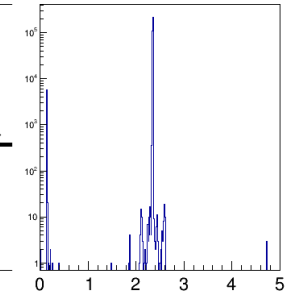
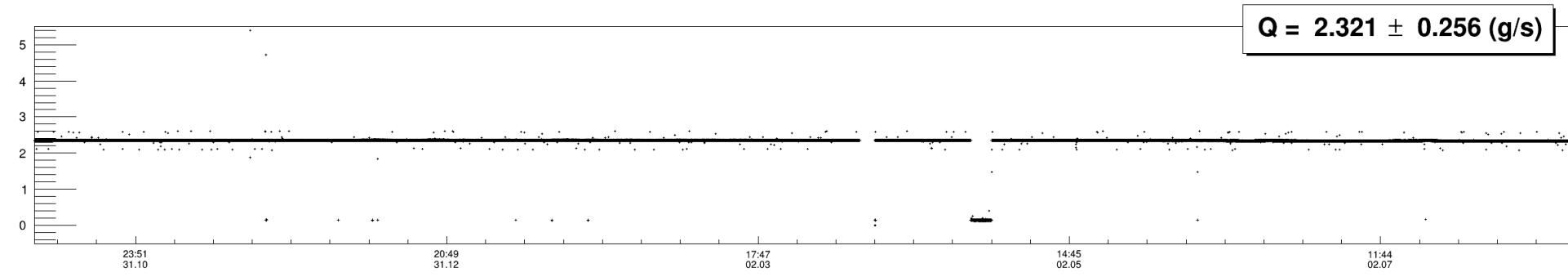
Appendix

MK1

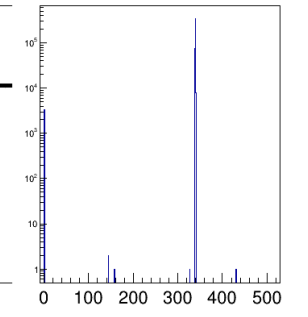
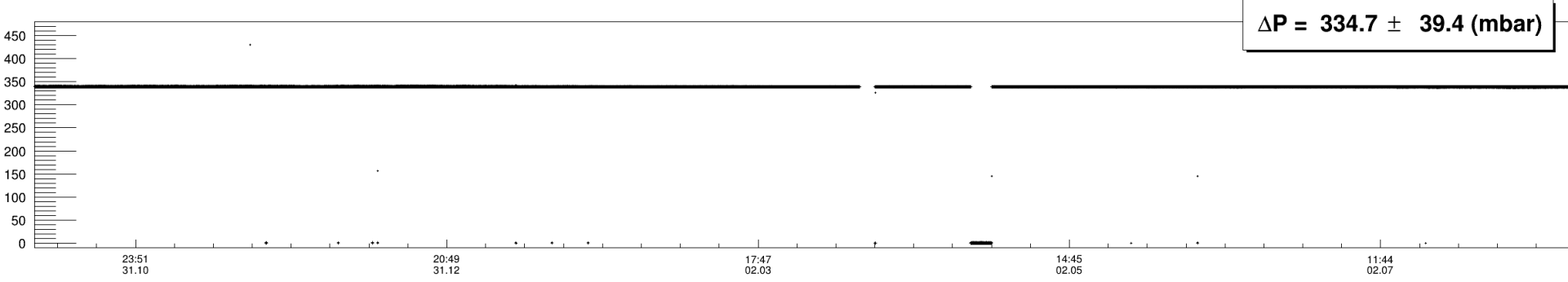


MK2

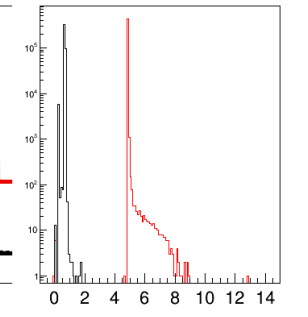
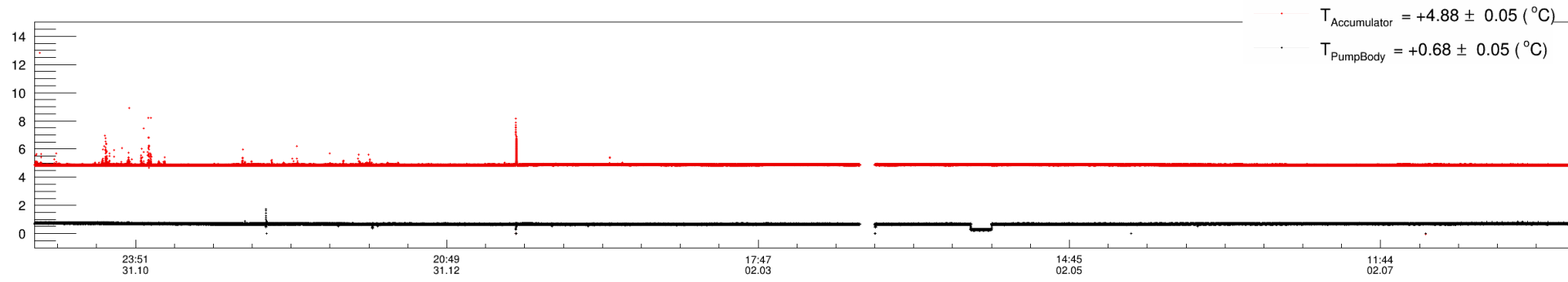
Flow Rate (g/sec)



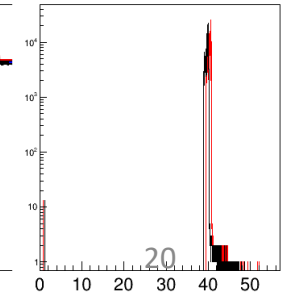
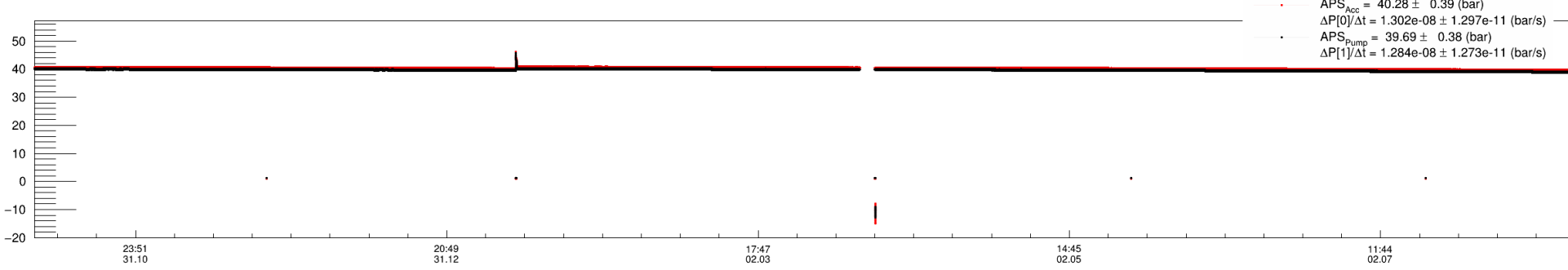
ΔP (mbar)



Temperature (°C)



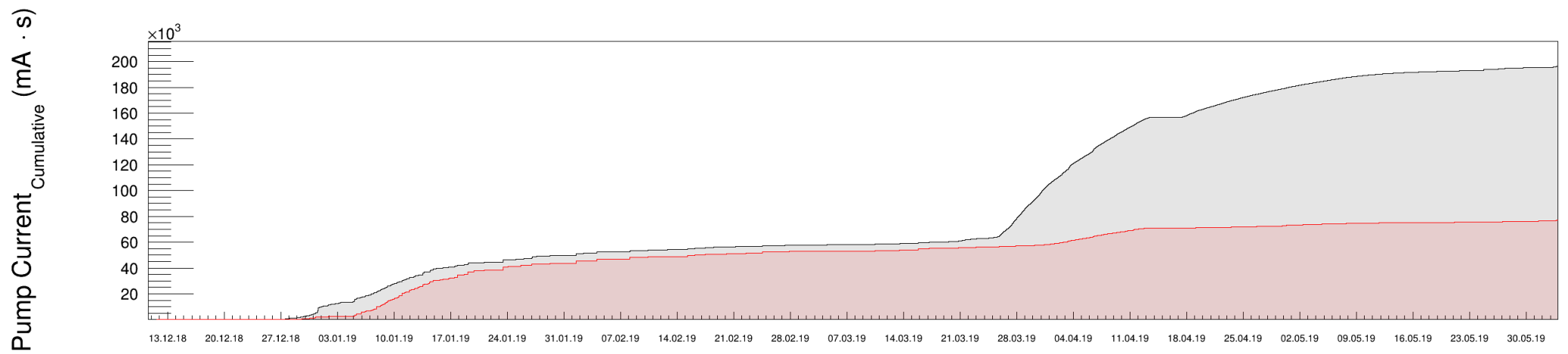
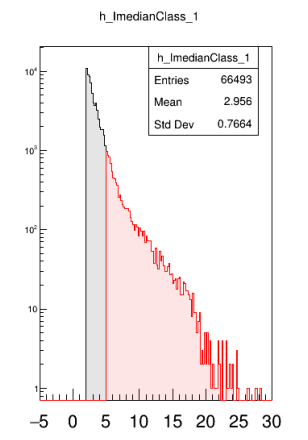
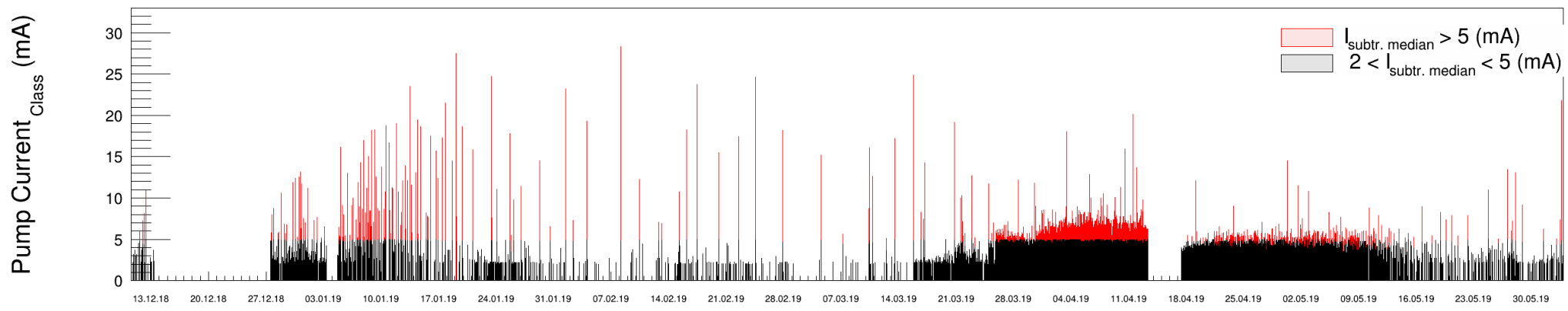
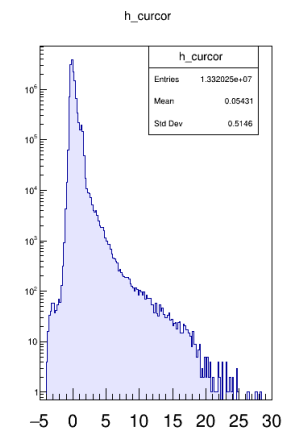
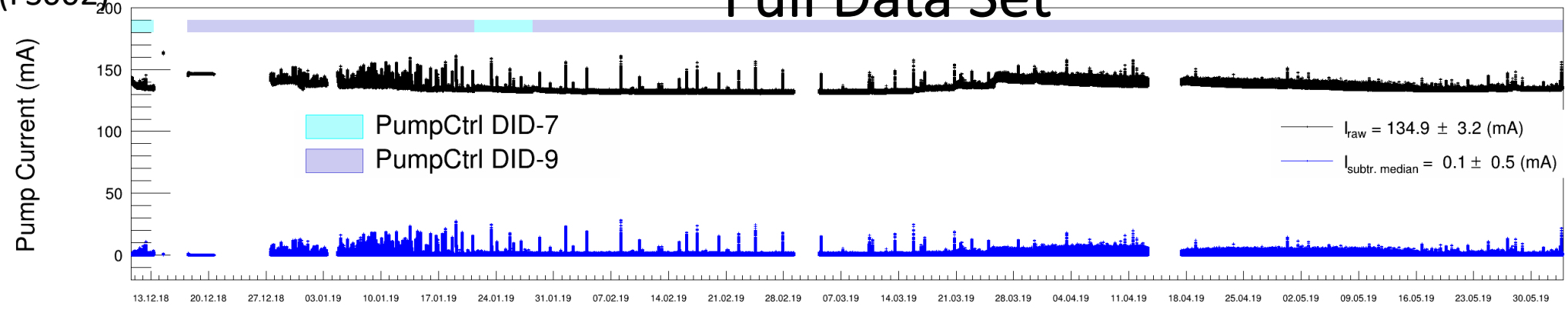
APS (bar)



MK #3 (FS-002)

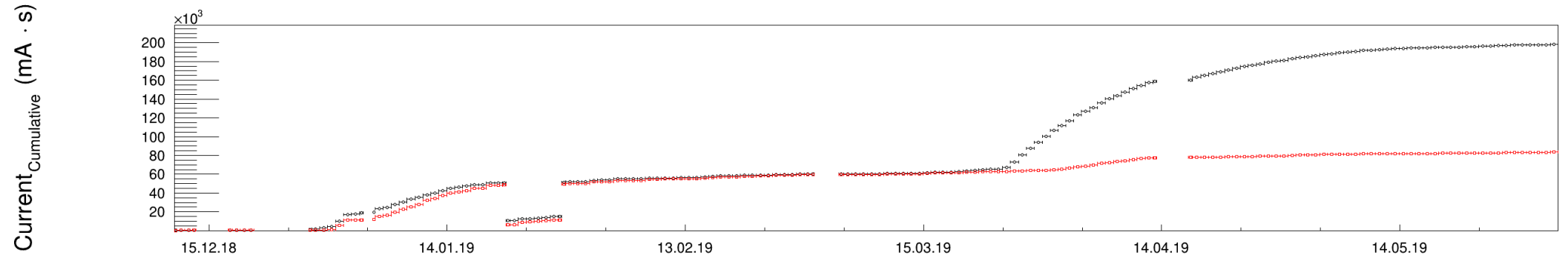
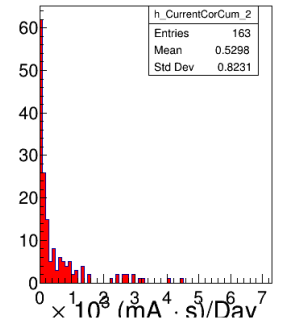
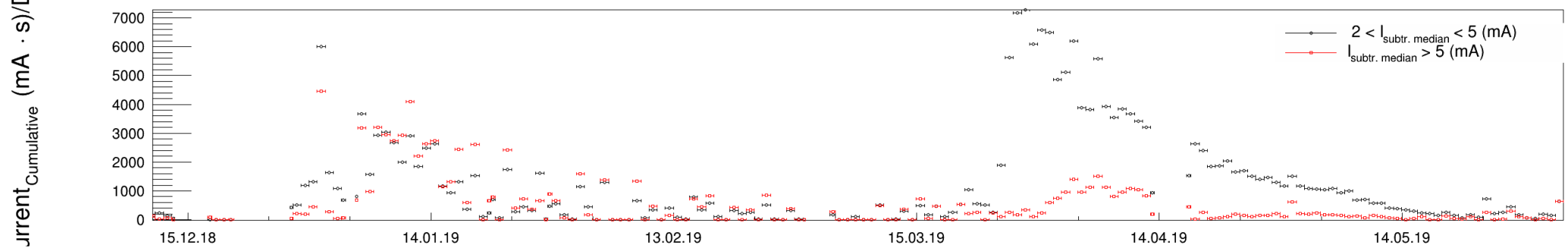
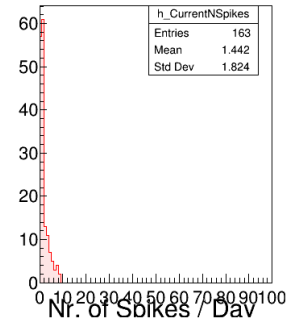
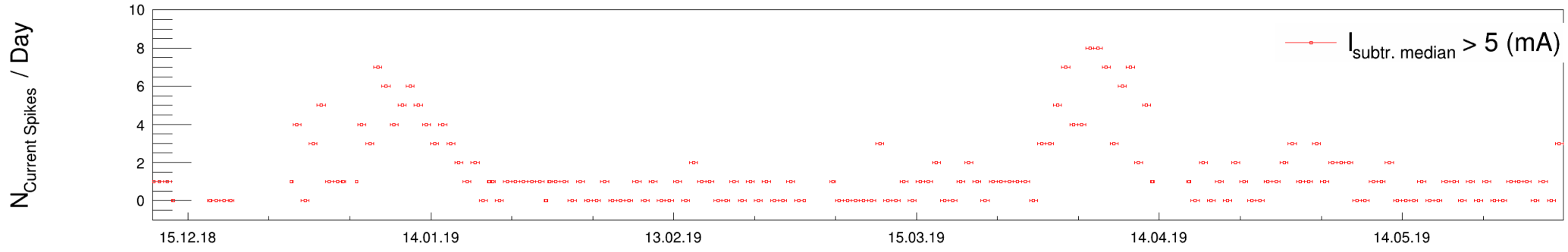
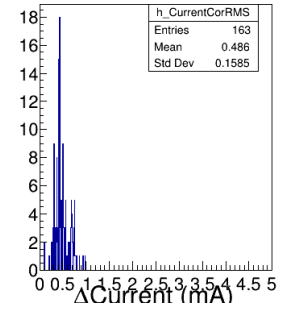
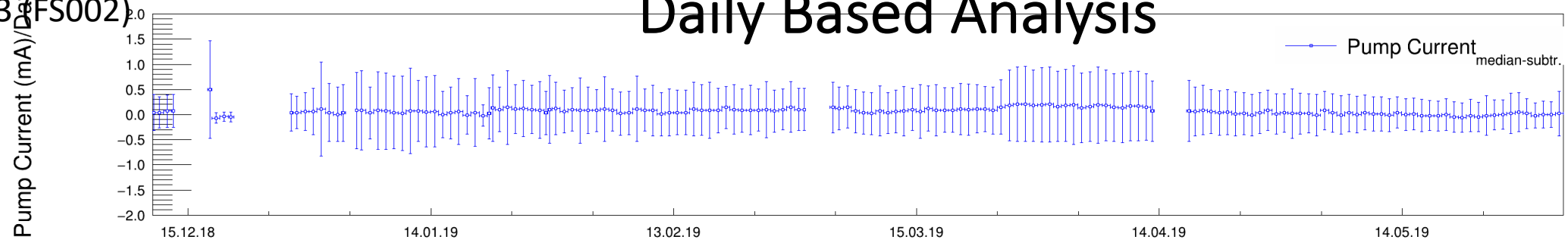
- $T_{\text{pump}} = +15^{\circ}\text{C}$ with IPA (Dec. 17-20, 2018)
- $T_{\text{pump}} = +0^{\circ}\text{C}$, $T_s = +5^{\circ}\text{C}$ (constant condition)
- Stop running pump on 03.06.2019

Full Data Set



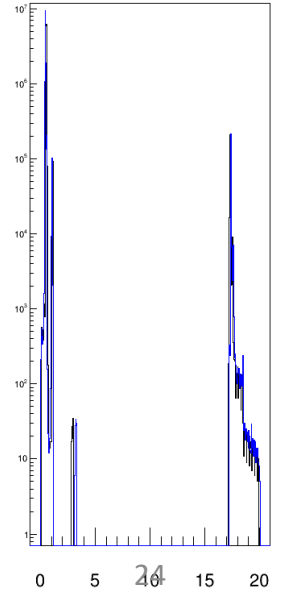
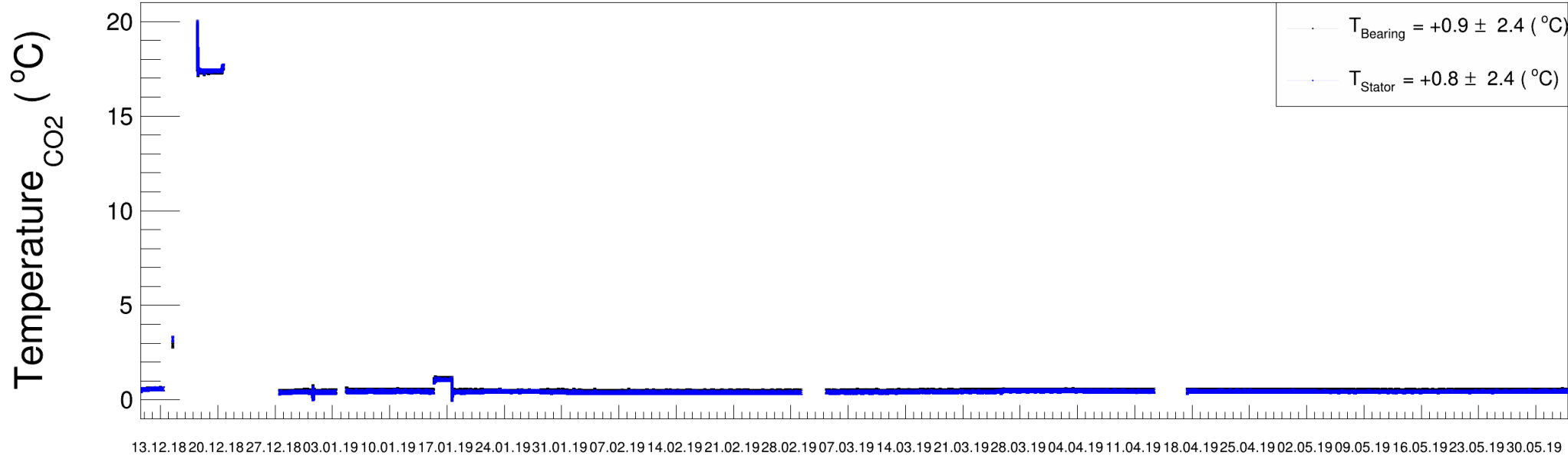
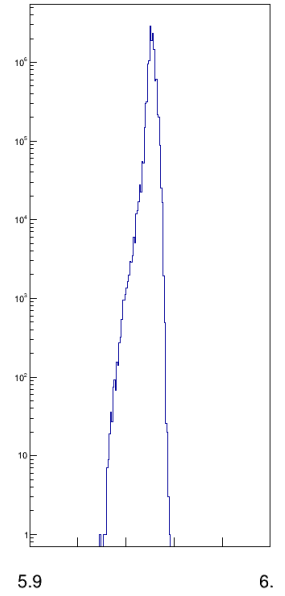
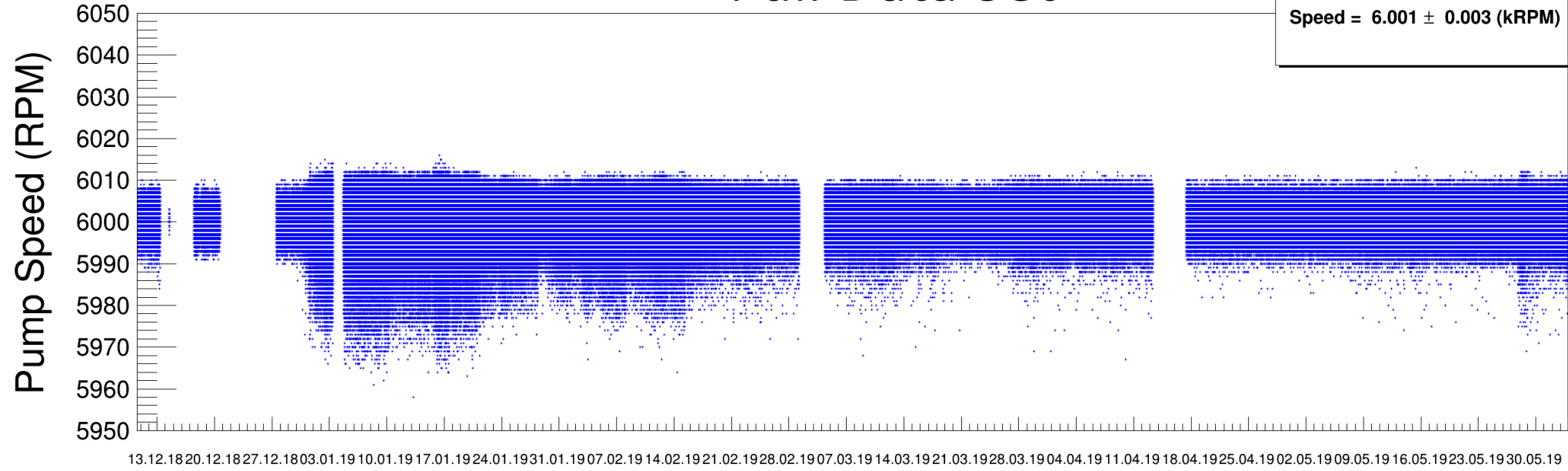
Daily Based Analysis

MK3 (FS002)



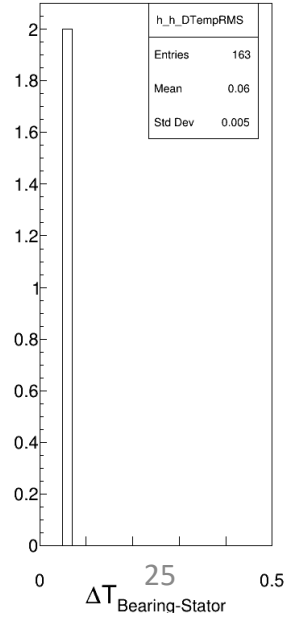
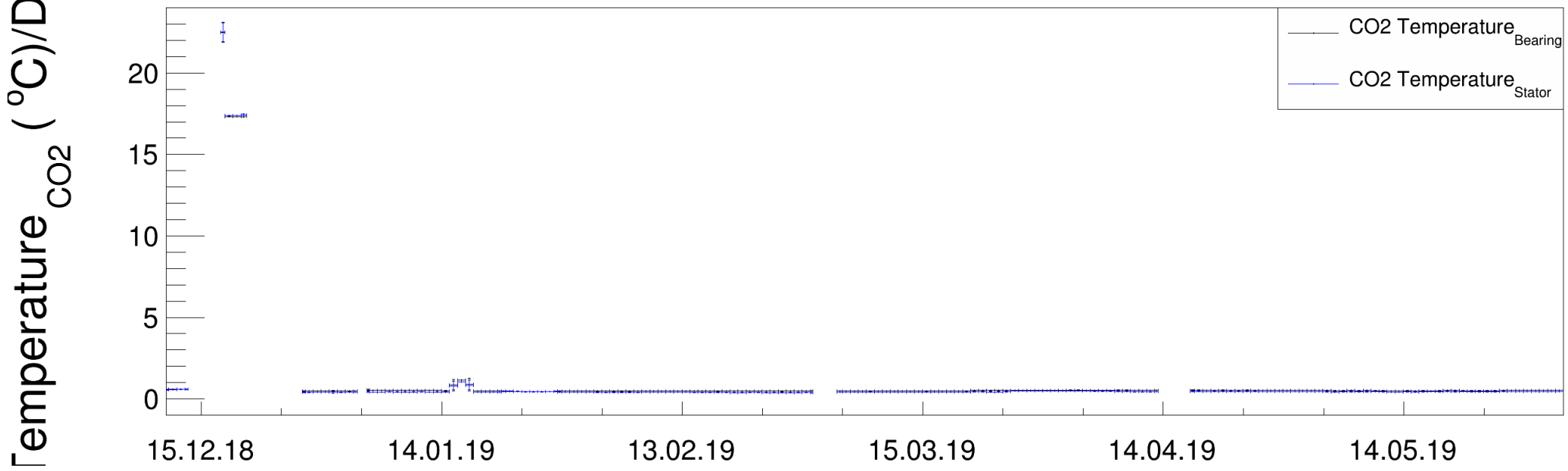
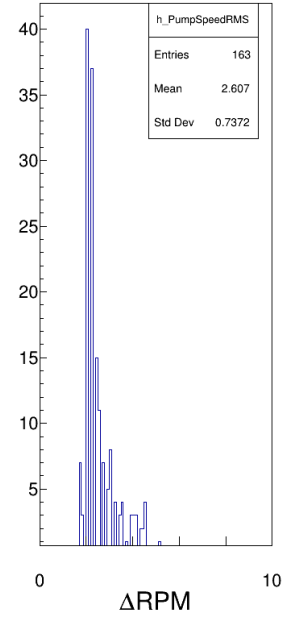
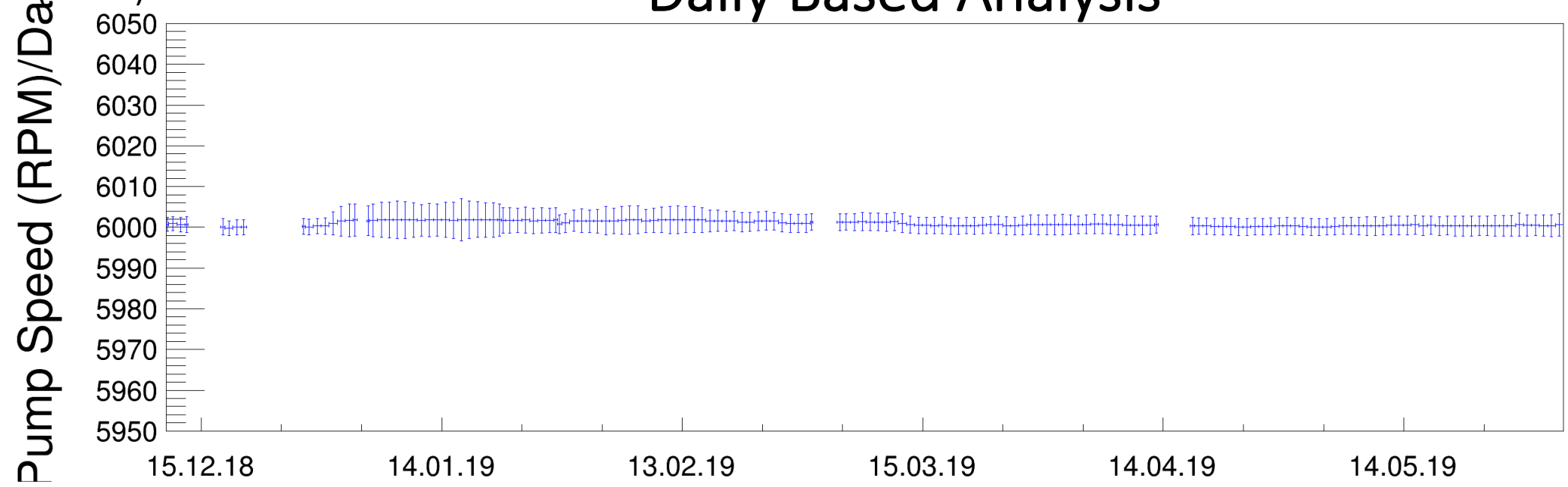
MK3 (FS002)

Full Data Set



Daily Based Analysis

MK3 (FS002)



MK3

