Status Report #4

2019.11.14 Thu

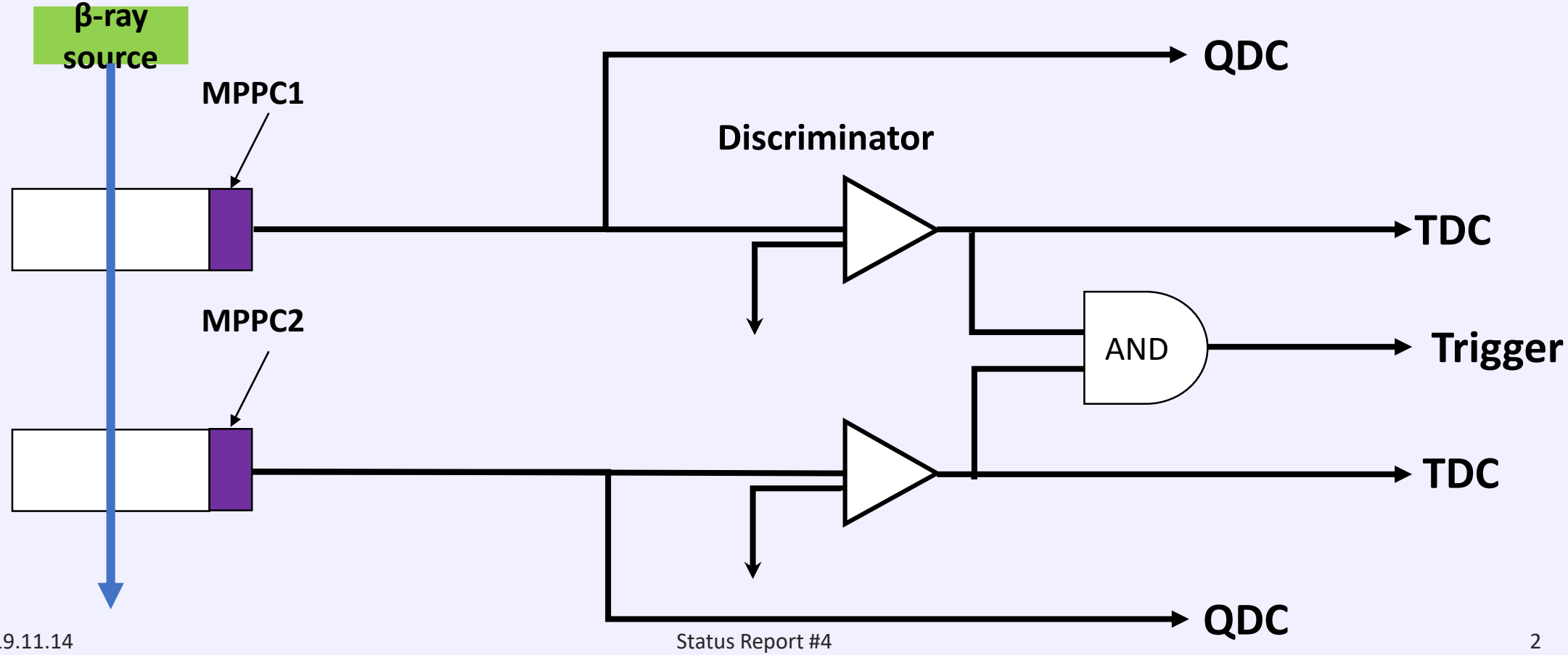
B4 Fujiwara Tomomasa

- FPGA Seminar
- evaluate time resolution MPPC

Time resolution of MPPC: setup

- Leaning analysis procedure using ROOT
- Goal: Evaluate time resolution of MPPC S14400-3015

〈Setup of measurement〉



Time resolution of MPPC

- Calculate ToF from MPPC1.TDC & MPPC2.TDC:

  ToF = MPPC1.TDC – MPPC2.TDC

- $\sigma_{\mathrm{T}} = \sqrt{\sigma_1^2 + \sigma_2^2}$

  σ_{T}: Time resolution of ToF, $\sigma_{1,2}$: Time resolution of MPPC1 & 2

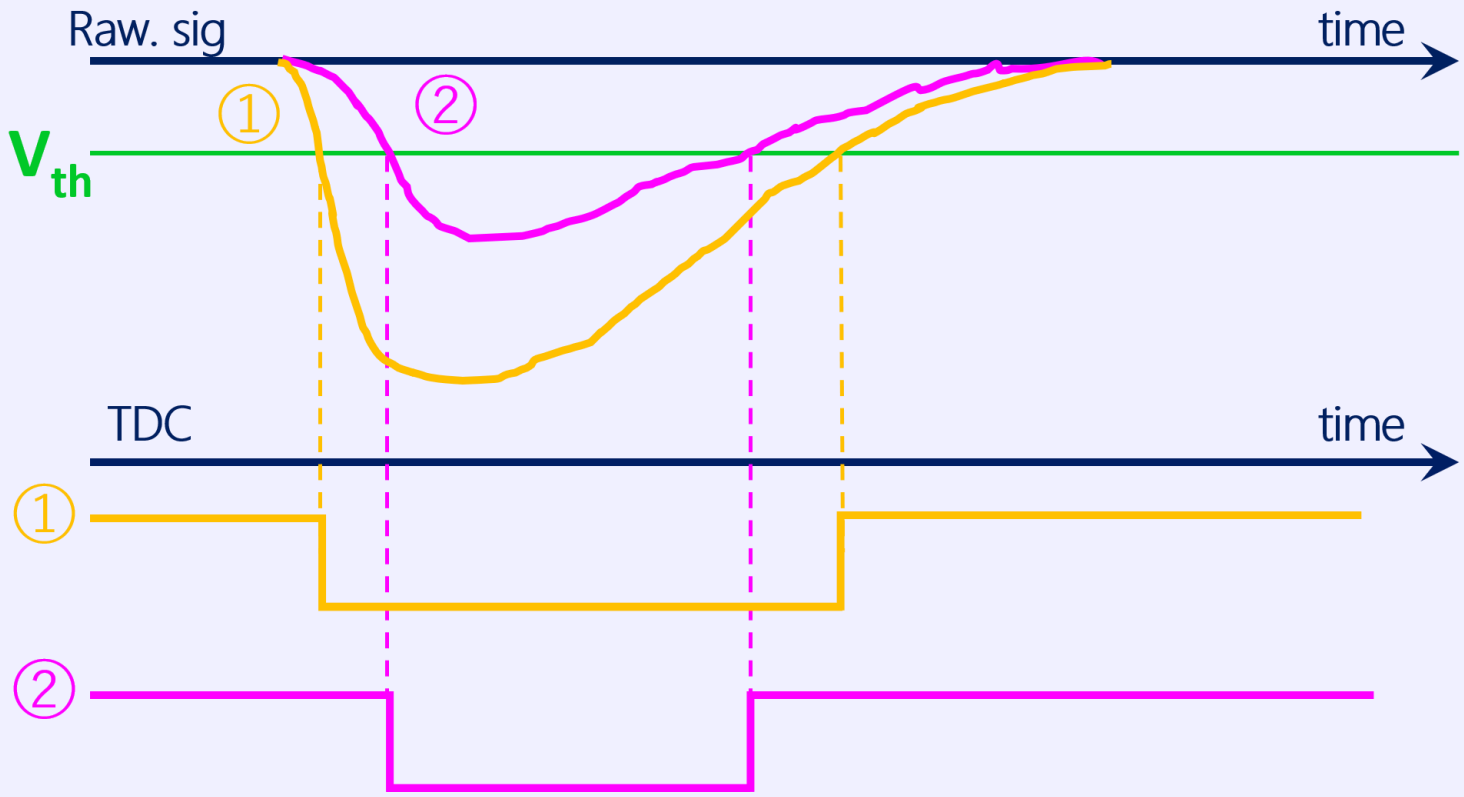
- Assuming $\sigma_1 = \sigma_2 = \sigma_{\mathrm{MPPC}}$,

$$\sigma_{\mathrm{MPPC}} = \frac{1}{\sqrt{2}}\sigma_{\mathrm{T}}$$

Time walk correction

- TDC: output only when $V_{\mathrm{sig}} > V_{\mathrm{th}} = 25\mathrm{mV}$

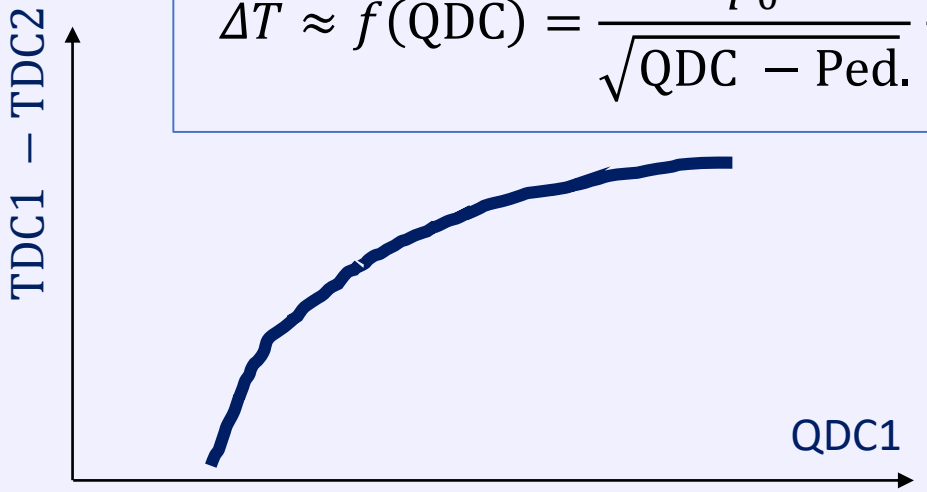
- Rise time of TDC
  →vary by pulse height

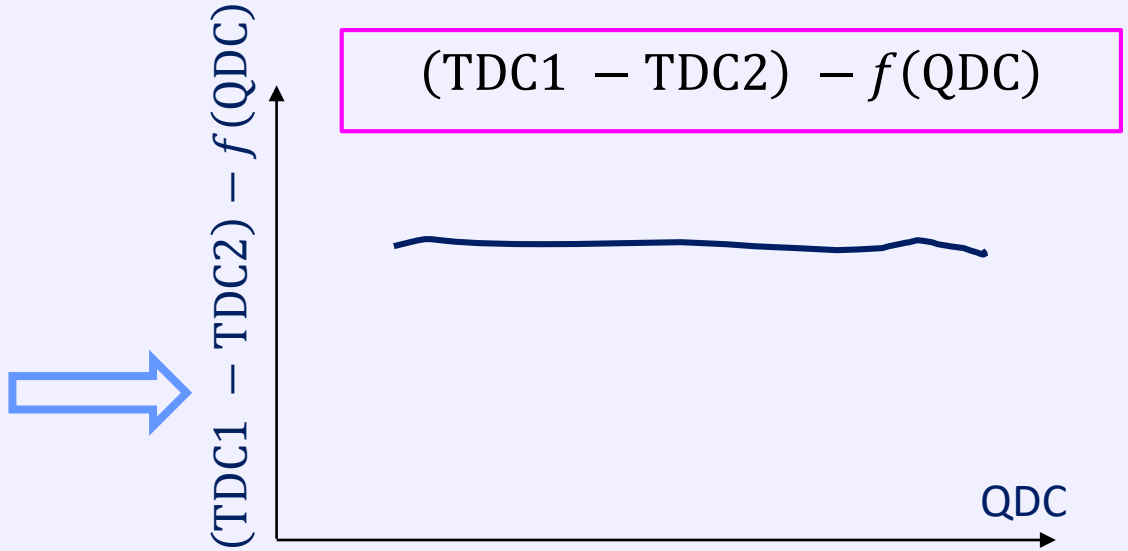


Time walk correction

- Time walk correction
- $\Delta T \equiv \mathrm{TDC1} - \mathrm{TDC2}$

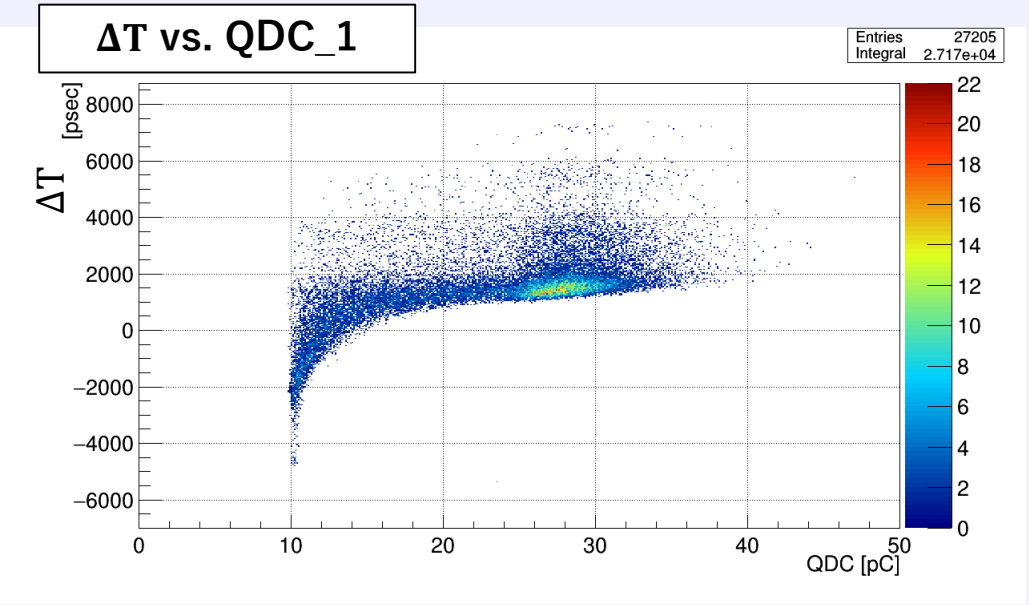
$$\Delta T \approx f(\mathrm{QDC}) = \frac{p_0}{\sqrt{\mathrm{QDC} - \mathrm{Ped.}}} + p_1$$

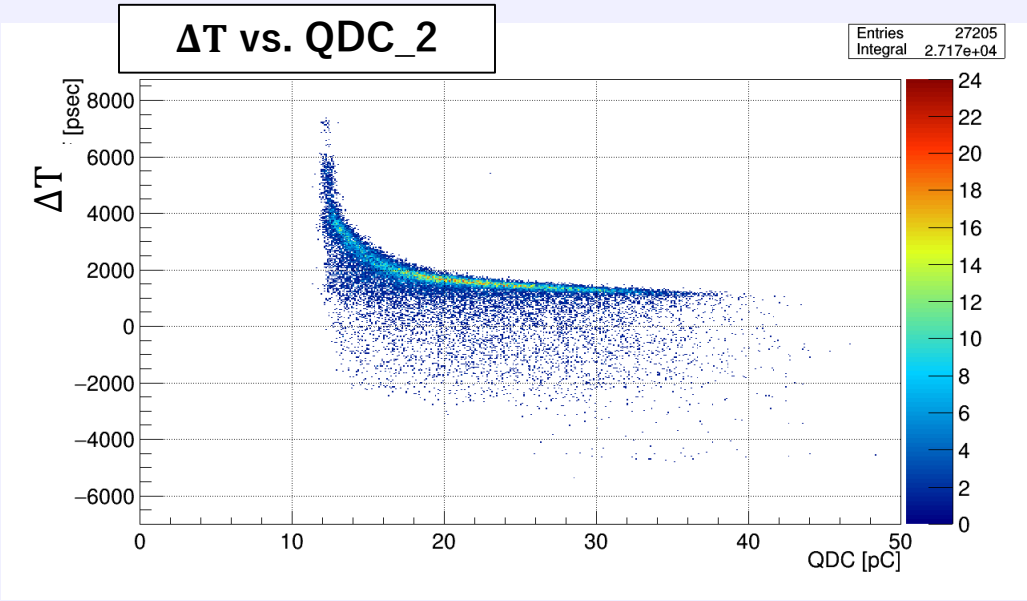




- After correction, $\mathrm{TOF} = \left(\mathrm{TDC1} - \frac{p_{1_0}}{\sqrt{\mathrm{QDC1} - \mathrm{ped}_1}}\right) - \left(\mathrm{TDC2} - \frac{p_{2_0}}{\sqrt{\mathrm{QDC2} - \mathrm{ped}_2}}\right)$

In progress: Constraints for data

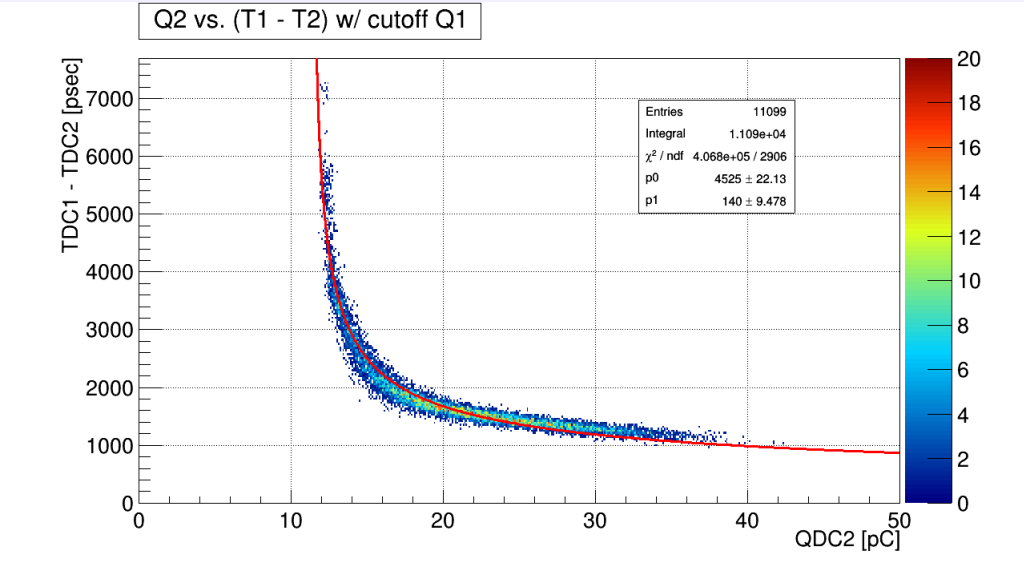




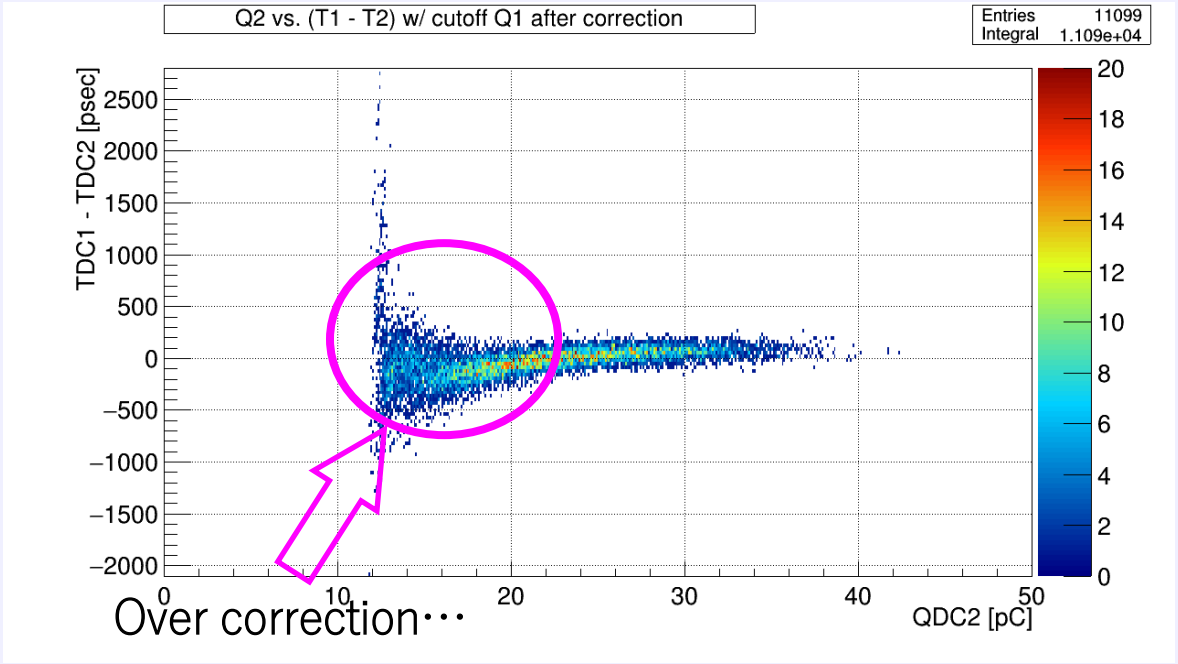
- Before → constrain with MPPC2.QDC
- New → constrain with MPPC1.QDC
  → cutoff; $25.0 < \mathrm{MPPC1.QDC} < 30.5\ [\mathrm{ch}]$

In progress

- w/ cutoff



- QDC2 vs. (TDC1 – TDC2), after correction



fit parameter x0.9 ➡ Work out? (by 永尾さん)

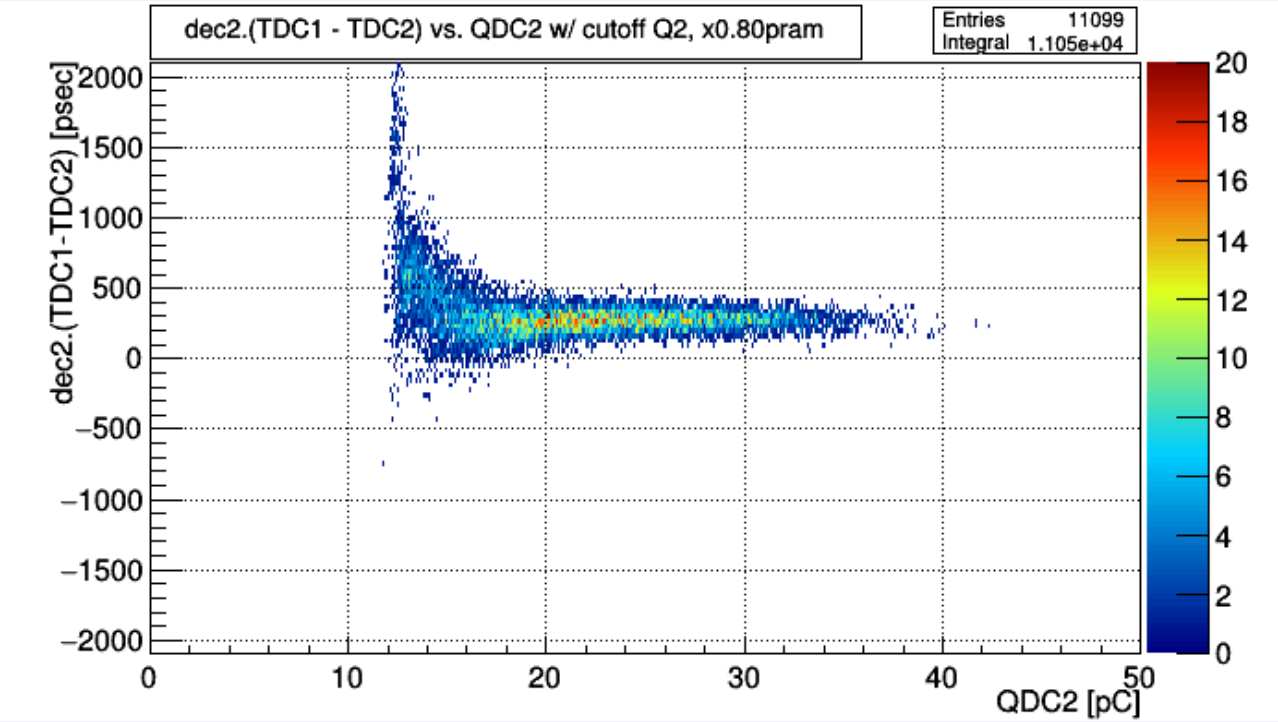
In progress

- Result of fitting:

$$f(\mathrm{QDC2}) = \frac{p_{2_0}}{\sqrt{\mathrm{QDC2[pC]} - \mathrm{Ped[pC]}}} + p_{2_1}$$

$$\begin{cases} p_{2_0} = 4524.74 \pm 22.1292 \ [\mathrm{psec} / (\mathrm{pC})^{1/2}] \\ p_{2_1} = 140.049 \pm 9.47814 \qquad [\mathrm{psec}] \end{cases}$$

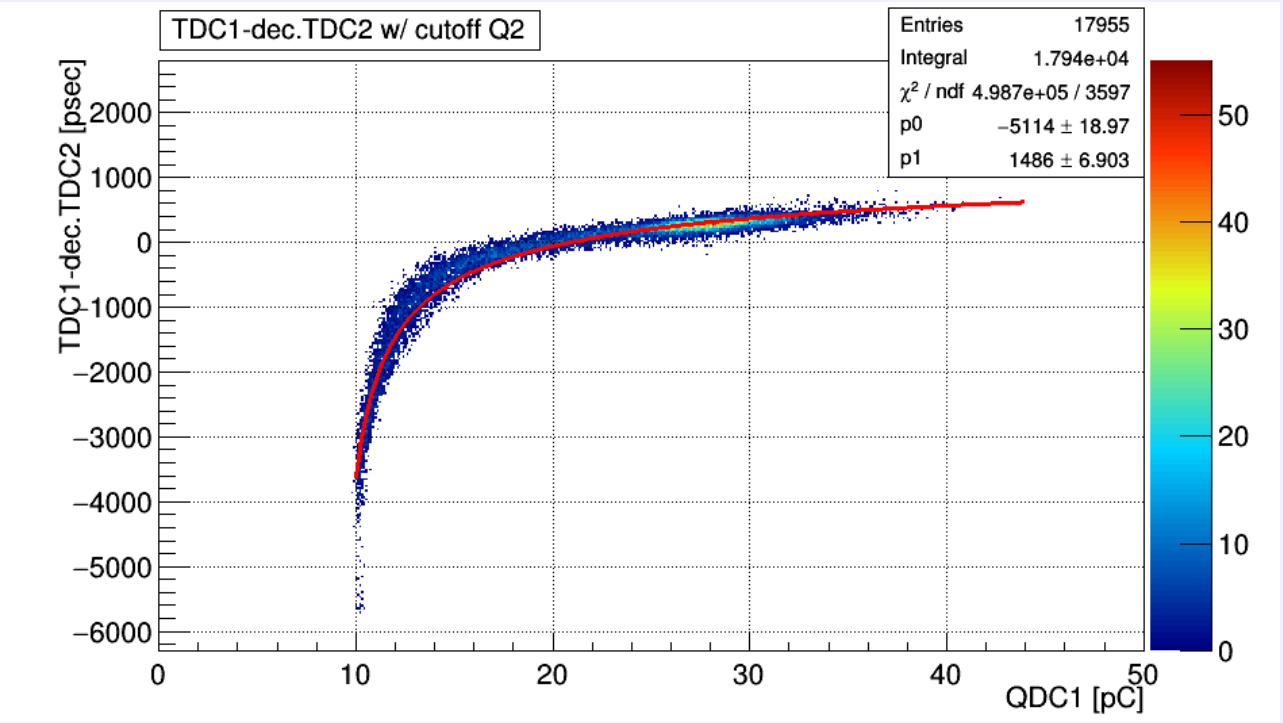
- $0.80 * p_{2_0}$



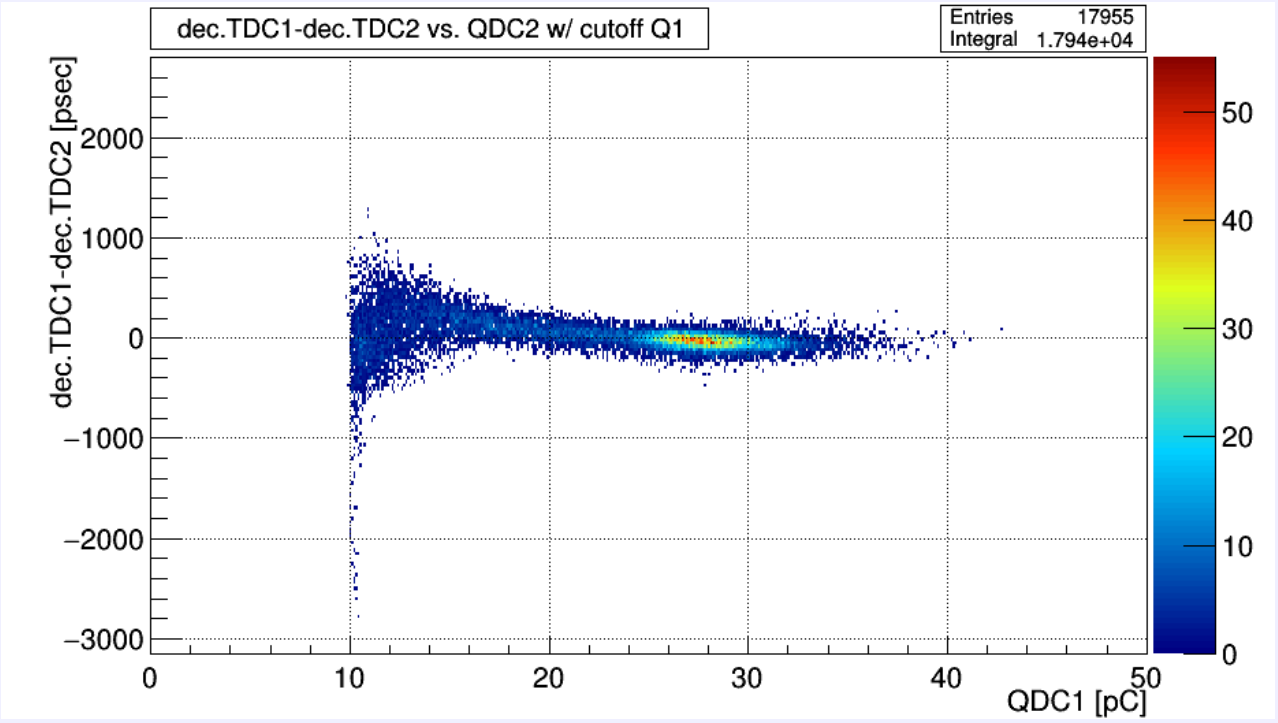
- next cutoff: 17.< QDC2 < 36. [pC]

In progress

- (TDC1 – TDC2) vs. QDC1 w/cutoff Q2

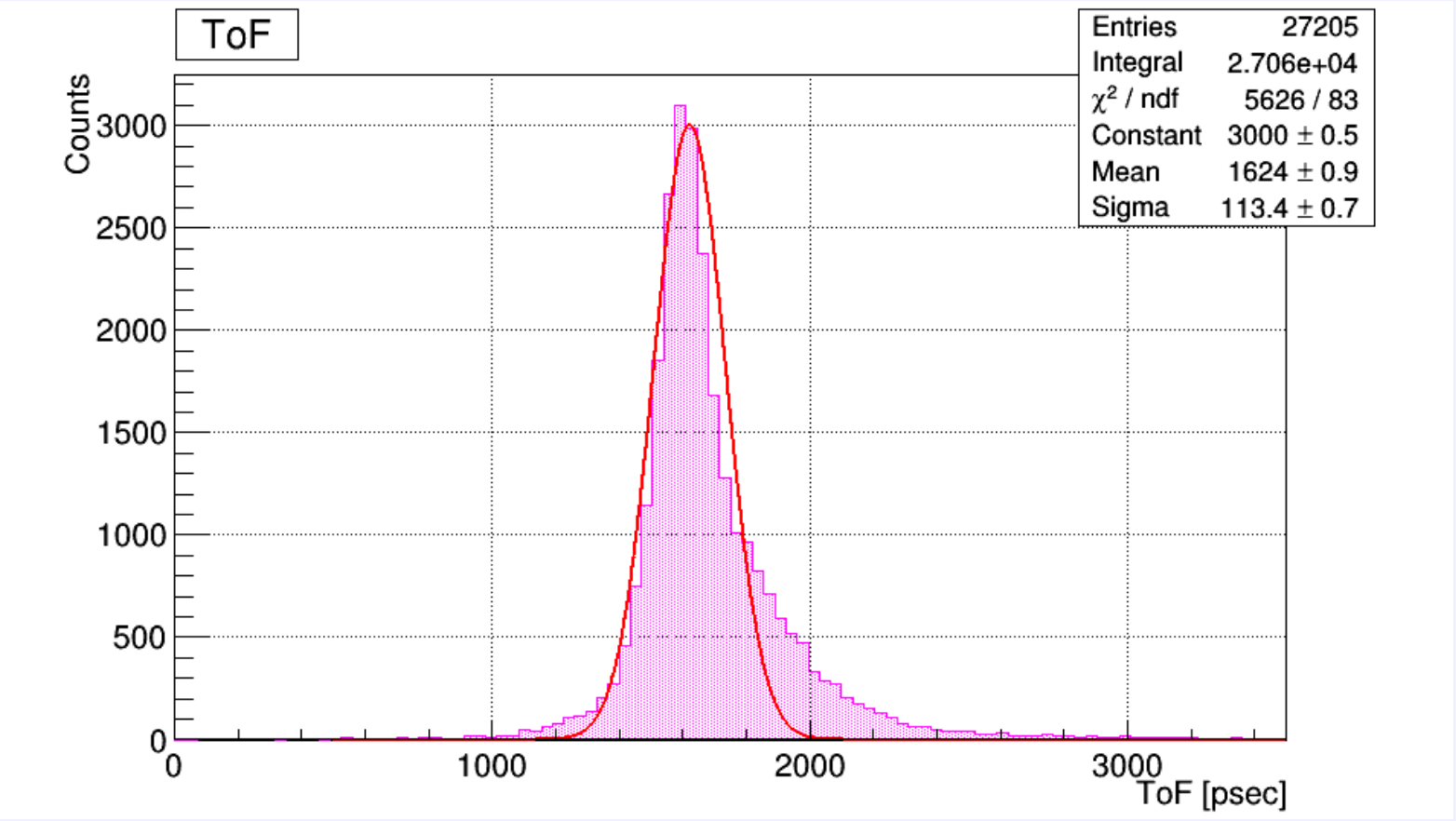


- After correction



In progress

- Result



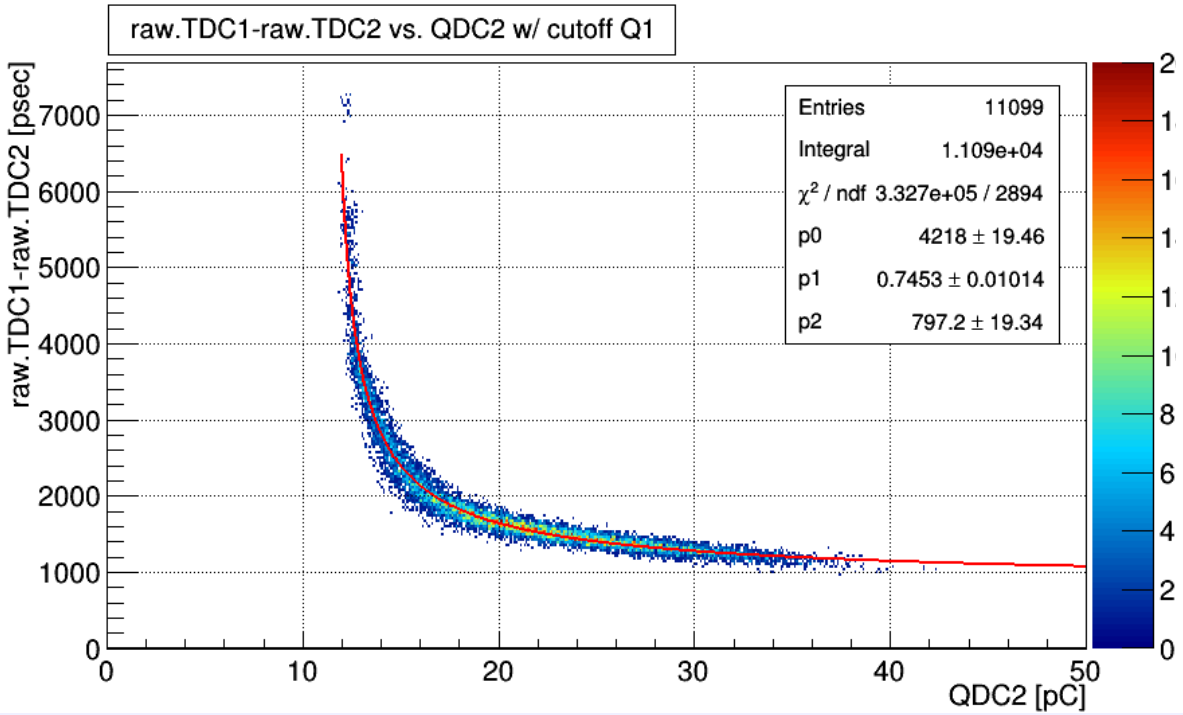
$\sigma_{\mathrm{ToF}} = 113.4 \pm 0.7$ [psec]

$\Rightarrow \boldsymbol{\sigma_{\mathrm{MPPC}} = \frac{1}{\sqrt{2}}\sigma_{\mathrm{ToF}} = 80.17 \pm 0.5}$**[psec]**

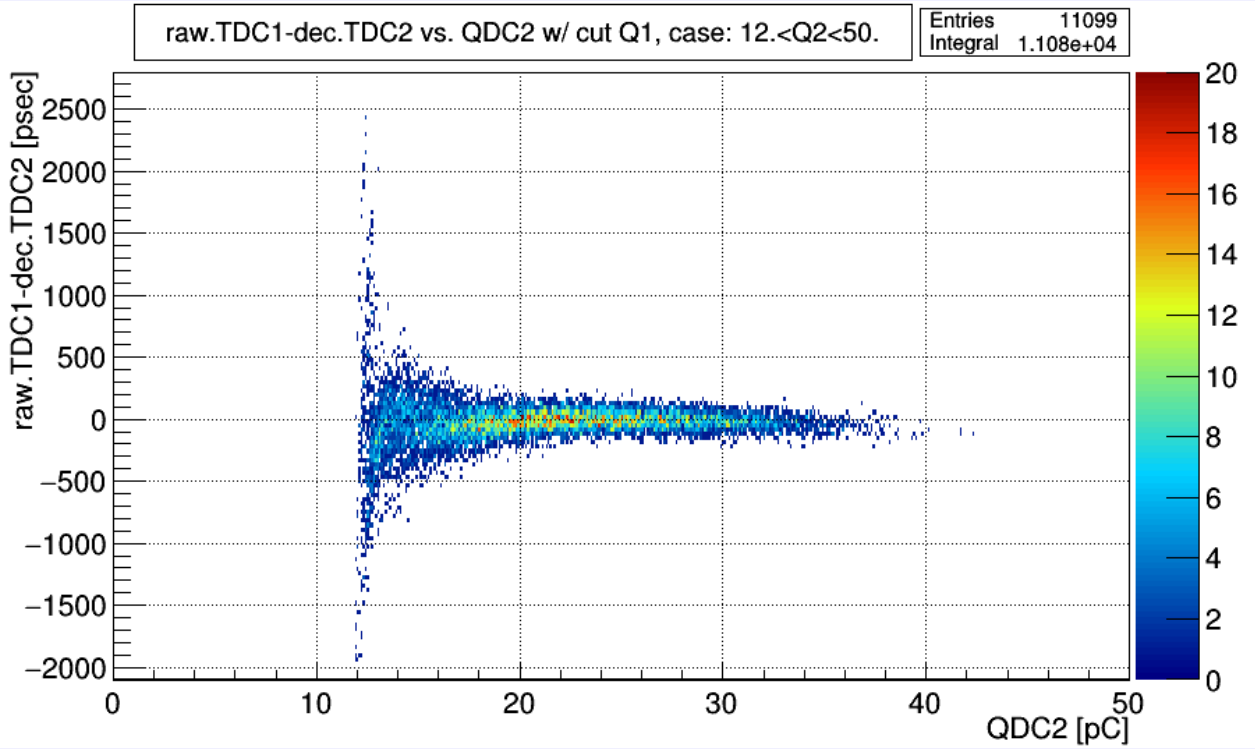
In progress

- assume another functional type:

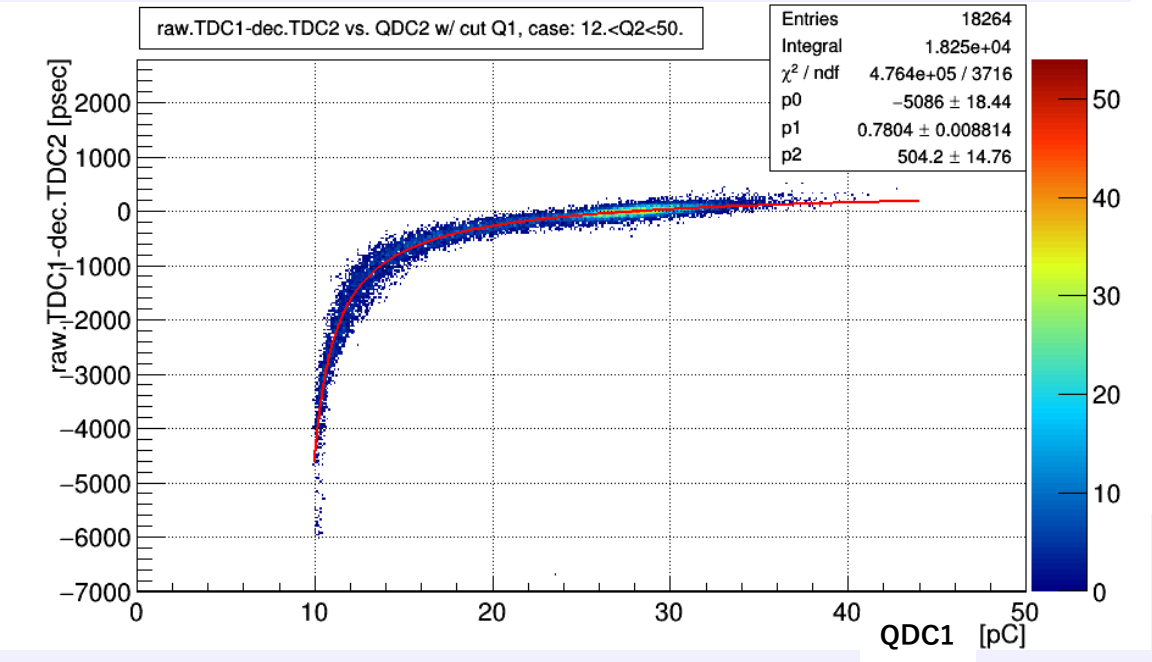
$$g(\mathrm{QDC}) = \frac{p_0}{(\mathrm{QDC} - \mathrm{Ped})^{p_1}} + p_2$$

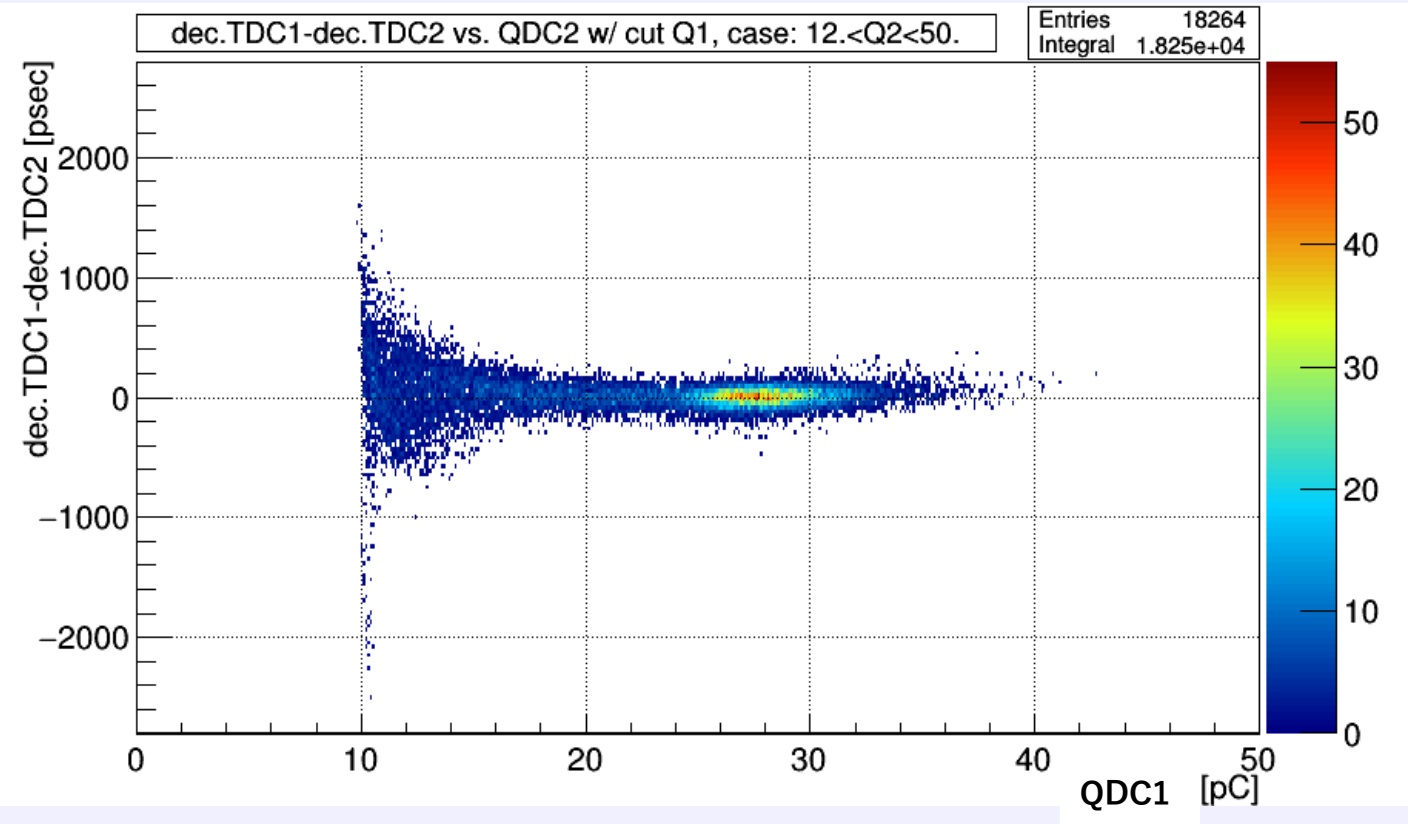


- after correction



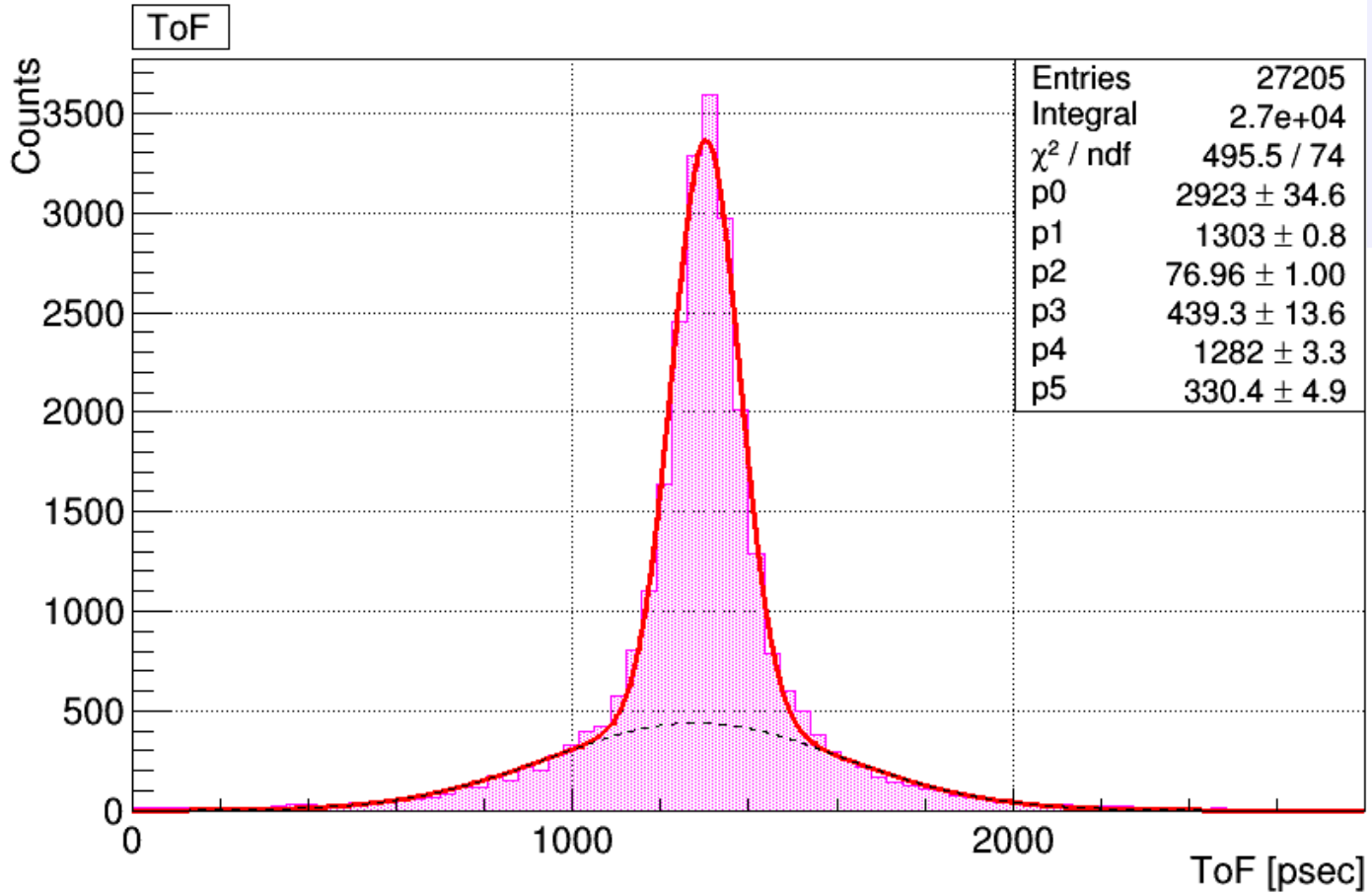
In progress


raw.TDC1-dec.TDC2 vs. QDC2 w/ cut Q1, case: 12.<Q2<50.
Entries 18264
Integral 1.825e+04
χ² / ndf 4.764e+05 / 3716
p0 −5086 ± 18.44
p1 0.7804 ± 0.008814
p2 504.2 ± 14.76
raw.TDC1-dec.TDC2 [psec]
QDC1 [pC]


dec.TDC1-dec.TDC2 vs. QDC2 w/ cut Q1, case: 12.<Q2<50.
Entries 18264
Integral 1.825e+04
dec.TDC1-dec.TDC2 [psec]
QDC1 [pC]

In progress

- Reslut: fitting w/ 2gaussian



$\sigma_{\mathrm{ToF}} = 76.96 \pm 1.00$ [psec]

$\Rightarrow \boldsymbol{\sigma_{\mathrm{MPPC}} = \frac{1}{\sqrt{2}}\sigma_{\mathrm{ToF}} = 54.42 \pm 0.71}$ **[psec]**

To do next

- evaluate time resolution of other run data

  ⇒compare among different condition

- 日本物理学会会員登録・物理学会申し込み