T.T.S.

October 26th, 2018

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Abstract

- I compared TTS values for different events:

  - for 1 photoelectron events

  - for 2 photoelectron events

  - for all events (and for all events above 0 C)

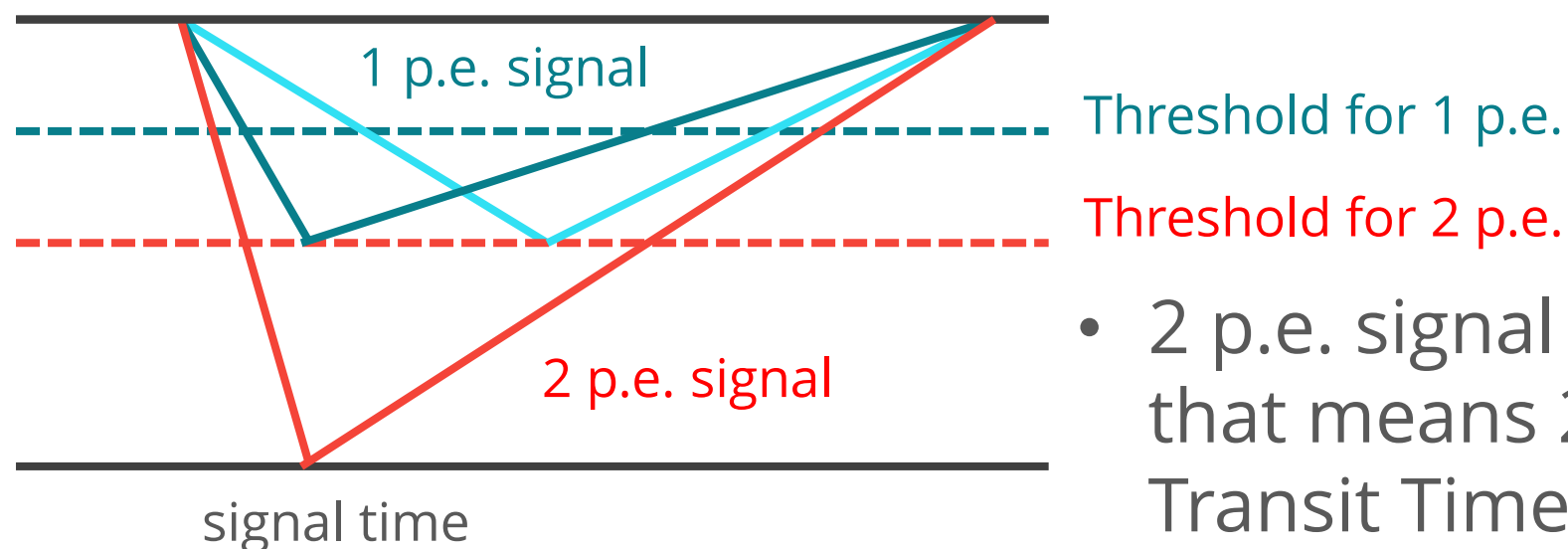 - and this comparison was done against the meas. on the 28th of Sep.

TTS: How to estimate TTS

- ## What is TTS (Transit Time Spread)?

pedestal

Threshold = 1/2 * (pedestal + max of peak)

max of peak
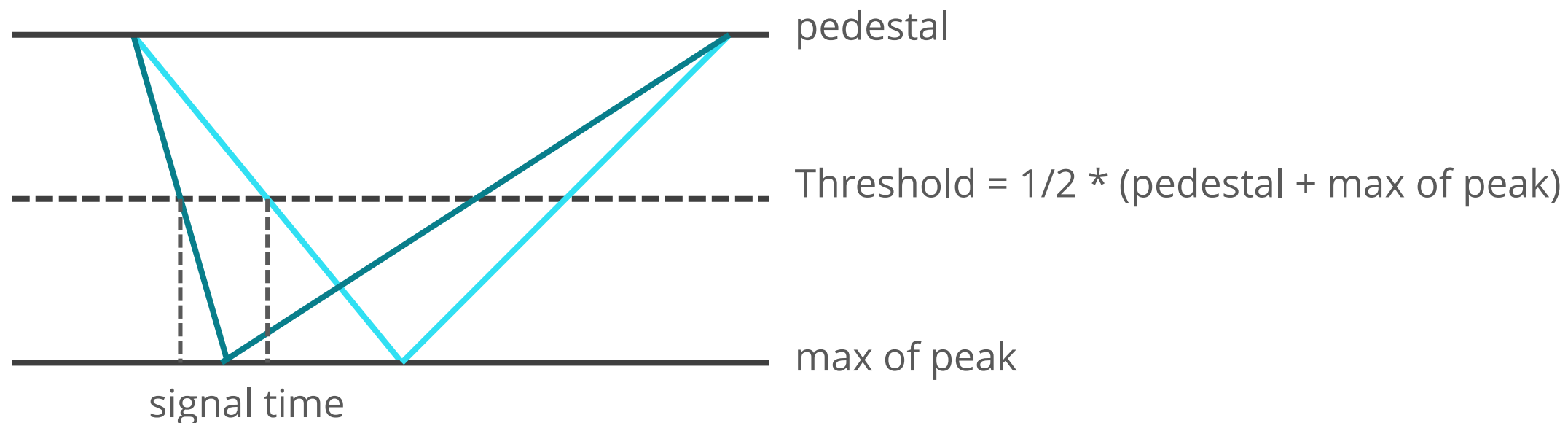
signal time

- signal time – trigger time -> time histogram in which we extract TTS as width

- ## Larger charge signal

1 p.e. signal

Threshold for 1 p.e.

Threshold for 2 p.e.

2 p.e. signal

signal time

- 2 p.e. signal has bigger charge than 1 p.e., that means 2 p.e. has less variation of Transit Time, i.e. smaller TTS.

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TTS: Introduction

- The fitting function is

$$\frac{p_0}{2} \exp\left\{ -p_1 \times \frac{(x - p_3) - p_2^2 \cdot p_1}{2} \right\}$$

$$\times \left[1 + \mathrm{erf}\left(\frac{(x - p_3) - p_2^2 \cdot p_1}{\sqrt{2}p_2} \right) \right] + p_4$$

$$\mathrm{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt$$

- The fitting to the time histogram is firstly done btw tmin and tmax.
  - tmin = GetBinCenter(maximum bin – 20)
  - tmax = GetBinCenter(maximum bin + 40)

- Then, p4 is set to zero and FWHM is looked for as TTS.

- When making a time histogram, 1 photoelectron events are used within +/- 1 sigma in a charge histogram.

TTS: plots 1
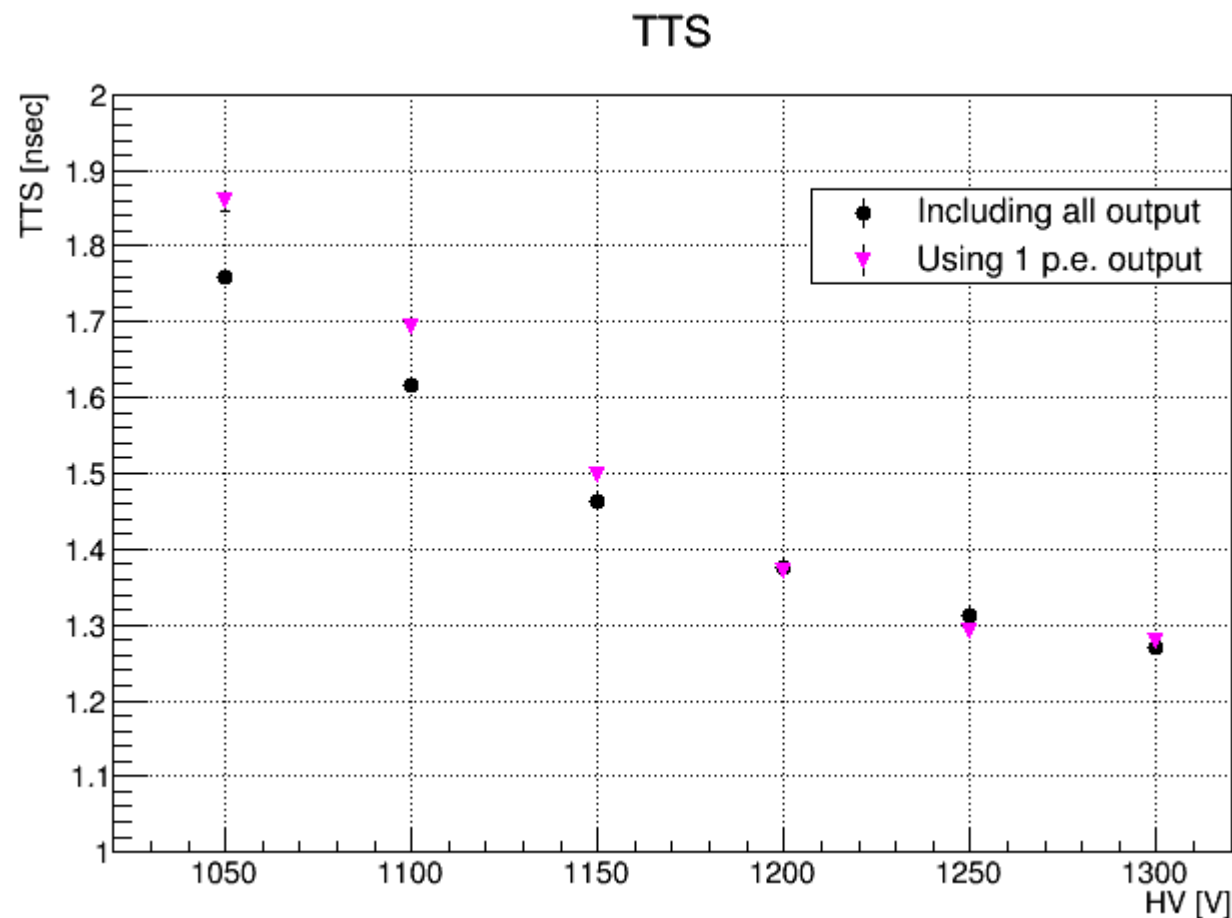
Black: 0 to 100 $[e \times 10^{7} \mathrm{C}]$ events
Pink: 1 photoelectron events
    within +/- 1 sigma in a charge histogram.

- Black locates below Pink in lower HV.
  - to investigate: check the mean and width for each photoelectron event.
  - there are 2 cases: width becomes smaller at high p.e. and-
    -mean doesn't change → total TTS gets smaller.
    -mean changes (shift) → total TTS gets bigger.
  - (it is actually expected that the mixing of two effects appear)

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TTS: plots 2

TTS

Legend:
- 1 p.e. events
- 2 p.e. events
- above 0 C events
- all events
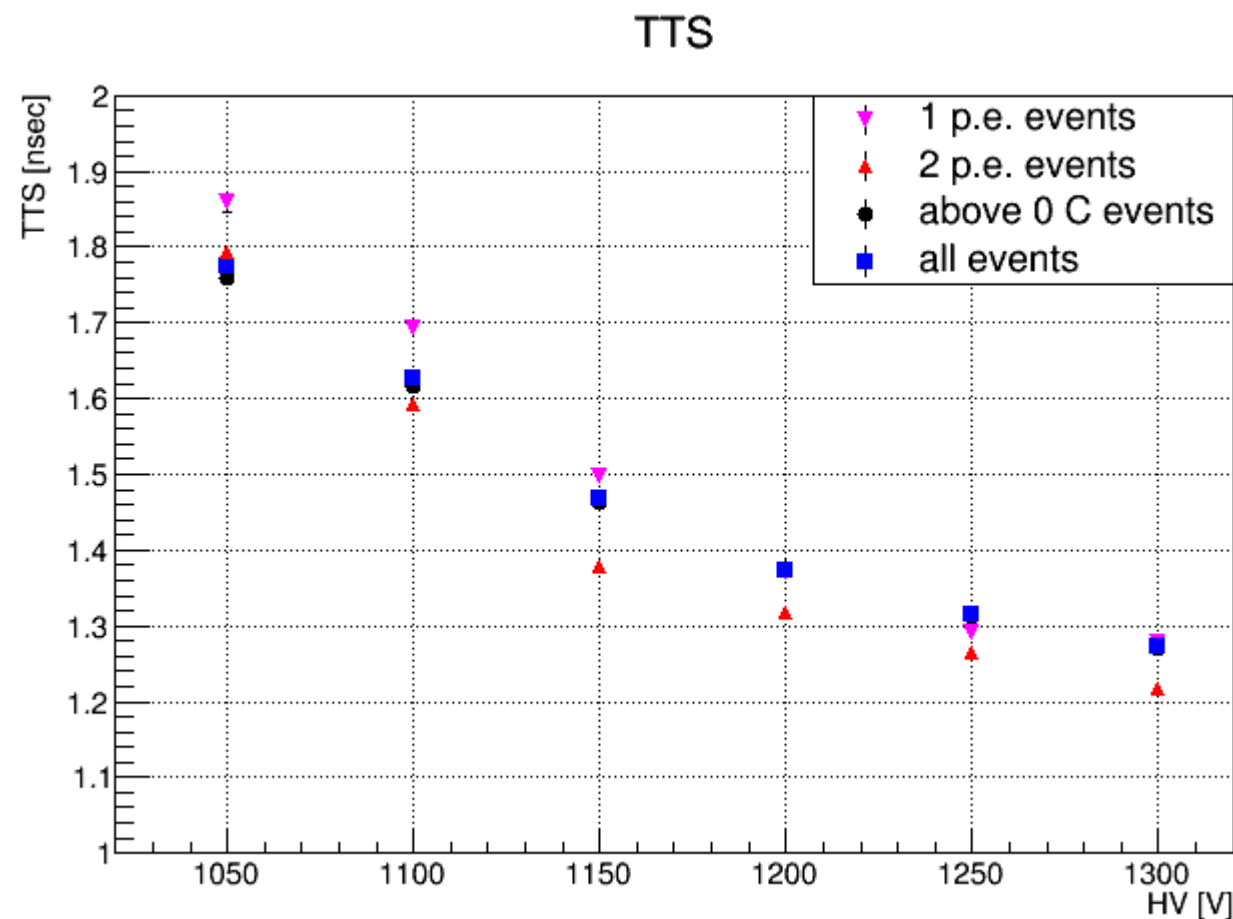
for negative HV measurement
on the 28th of September

- The TTS of 2 p.e. is always smaller than that of 1 p.e.
  - reasonable, because 2 p.e. signal has less fluctuation.
  - did the mean of TT (Transit Time) distribution change? -> next page.
- The magnitude relation of TTS changes around 1150 V.
  - the TTS of "all events" becomes smaller than 1 p.e.

TTS: Time histogram
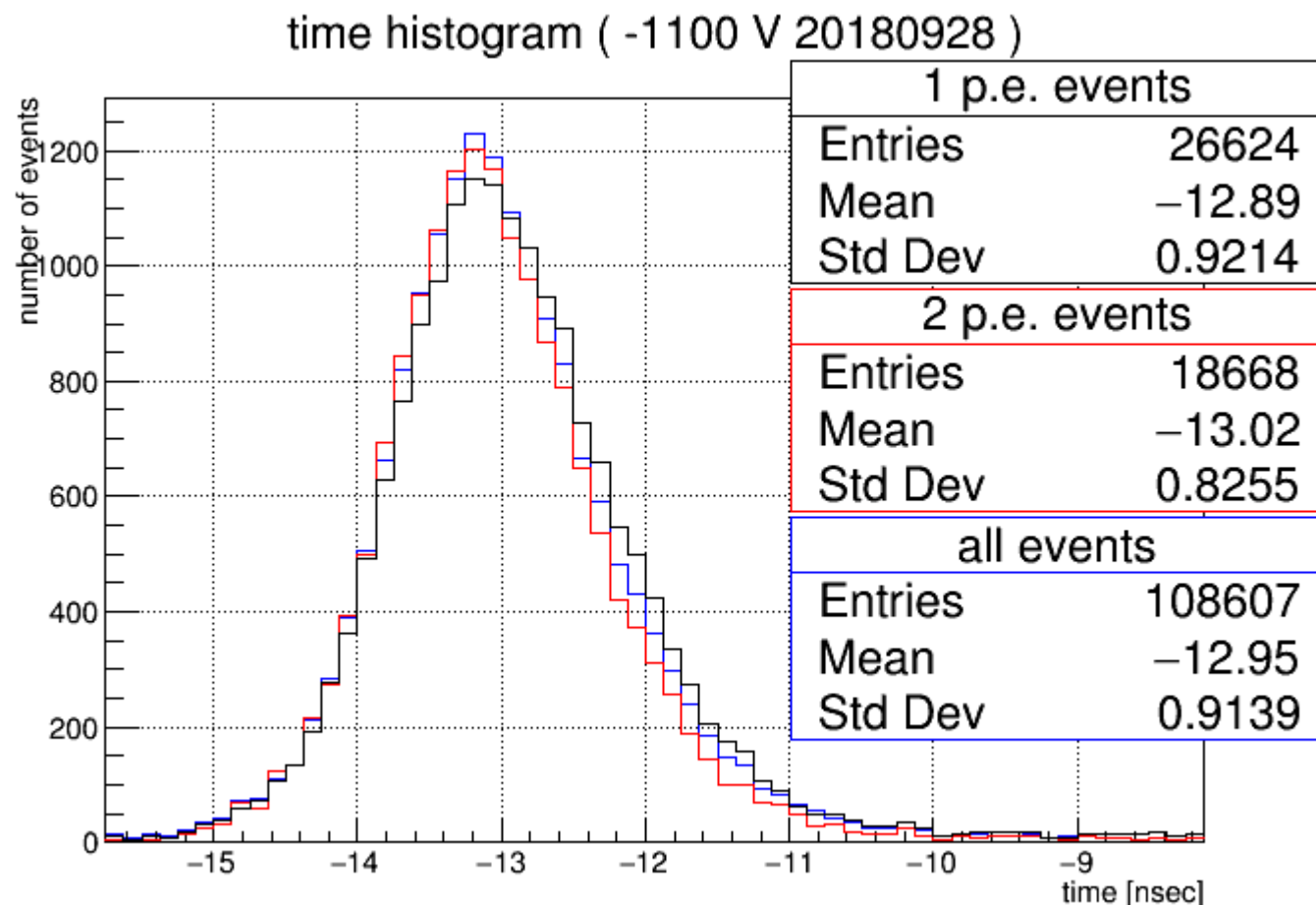
the histogram of "all events" was scaled at 2/3.

- The mean of 2 p.e. slightly (<1%) shifted to the left compared to that of 1 p.e.
  - Therefore, the main reason that variation of TTS increases at lower HV would be that the difference in TTS (p2) of each p.e. increases, rather than the mean of distribution change.
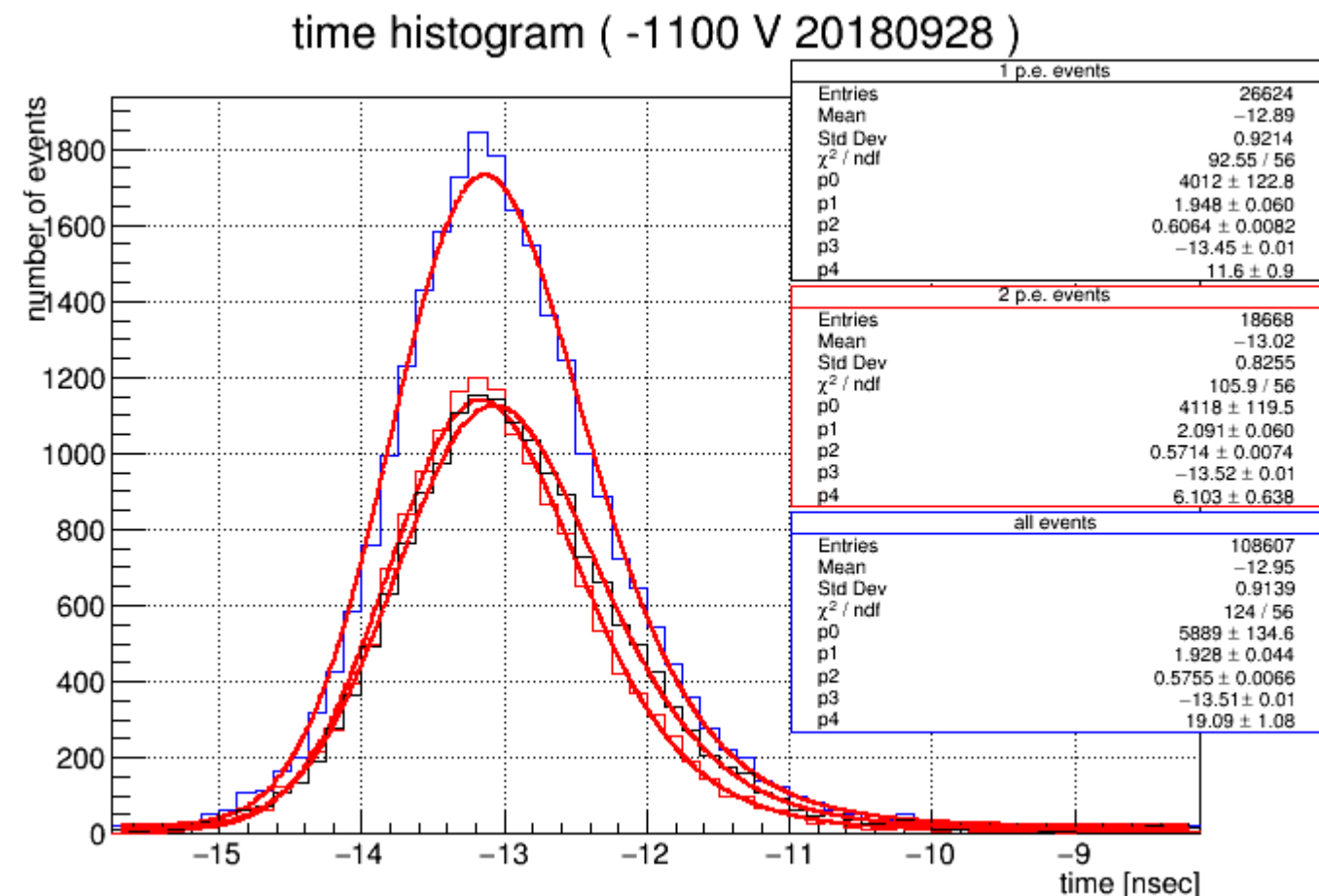
Summary

- At lower HV, the difference of TTS btw 1 p.e. and 2 p.e. become larger. This is the main reason why TTS has variation at lower HV.
  - and probably that of 1 p.e. and 3 p.e., … is also larger.
  - while the mean of distribution of transit time hardly changes.