#1288 EURAMET Project

Final Report – Appendix 2

InLambda standards based on temperature stabilized delay of fibers

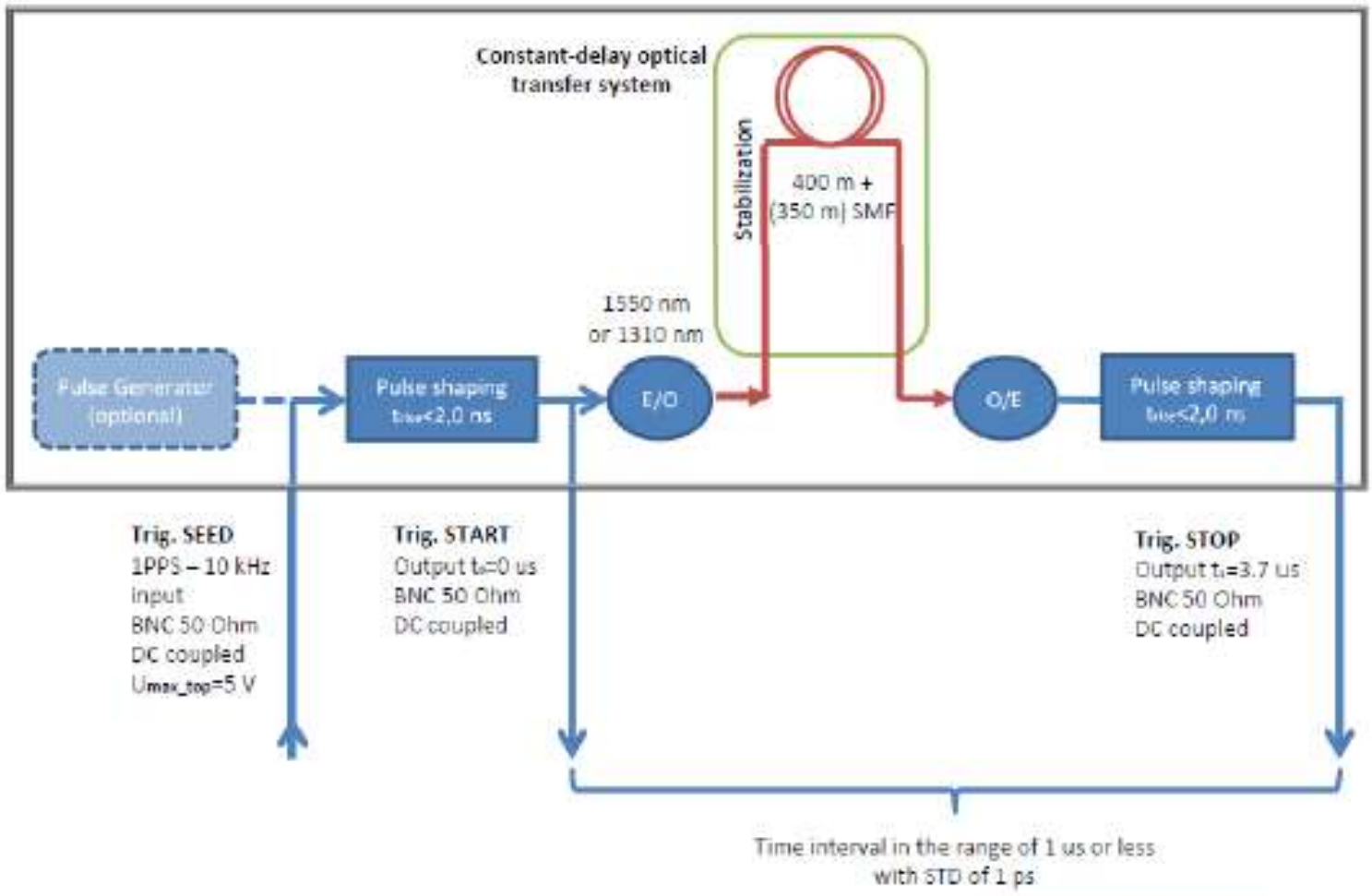
Inλ standard – developed by InLambda - SIQ

front panel

rear panel

3 time intervals/delays:
Inλ 20, Inλ 100, Inλ 300
(c. 20 ns, c. 100 ns, c. 300 ns)

Inλ delay standards – base of operation



Time Interval standards based on temperature stabilized fibers delay

Inλ standards – the main features

Reqiured:
Ext. Input pulses

Nominal value of delay:

Precise matching of pulse outputs = close the same shape of output signals

Rising slope:
< 0.5 ns/V

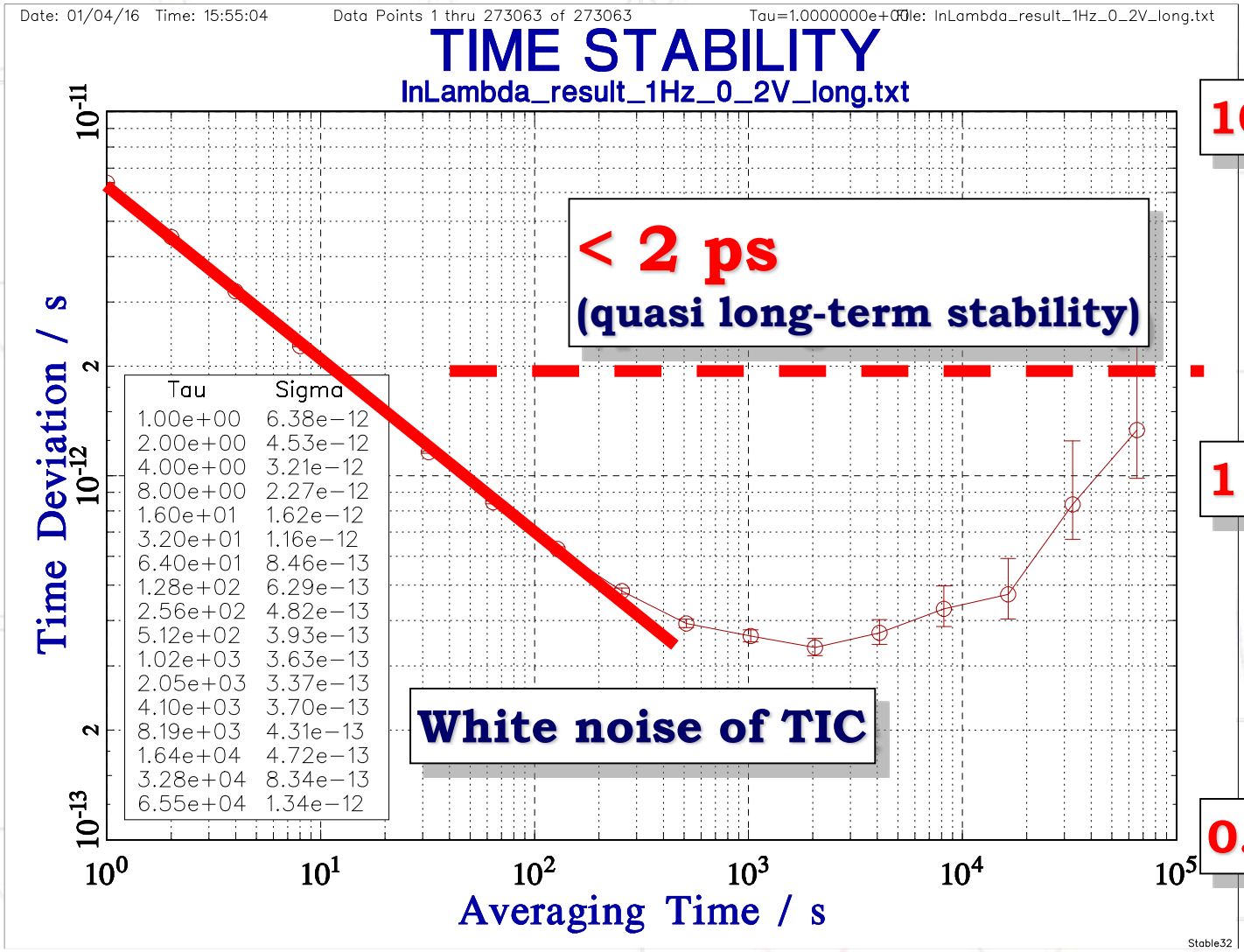
BNC connectors:
50 Ω

Status diode

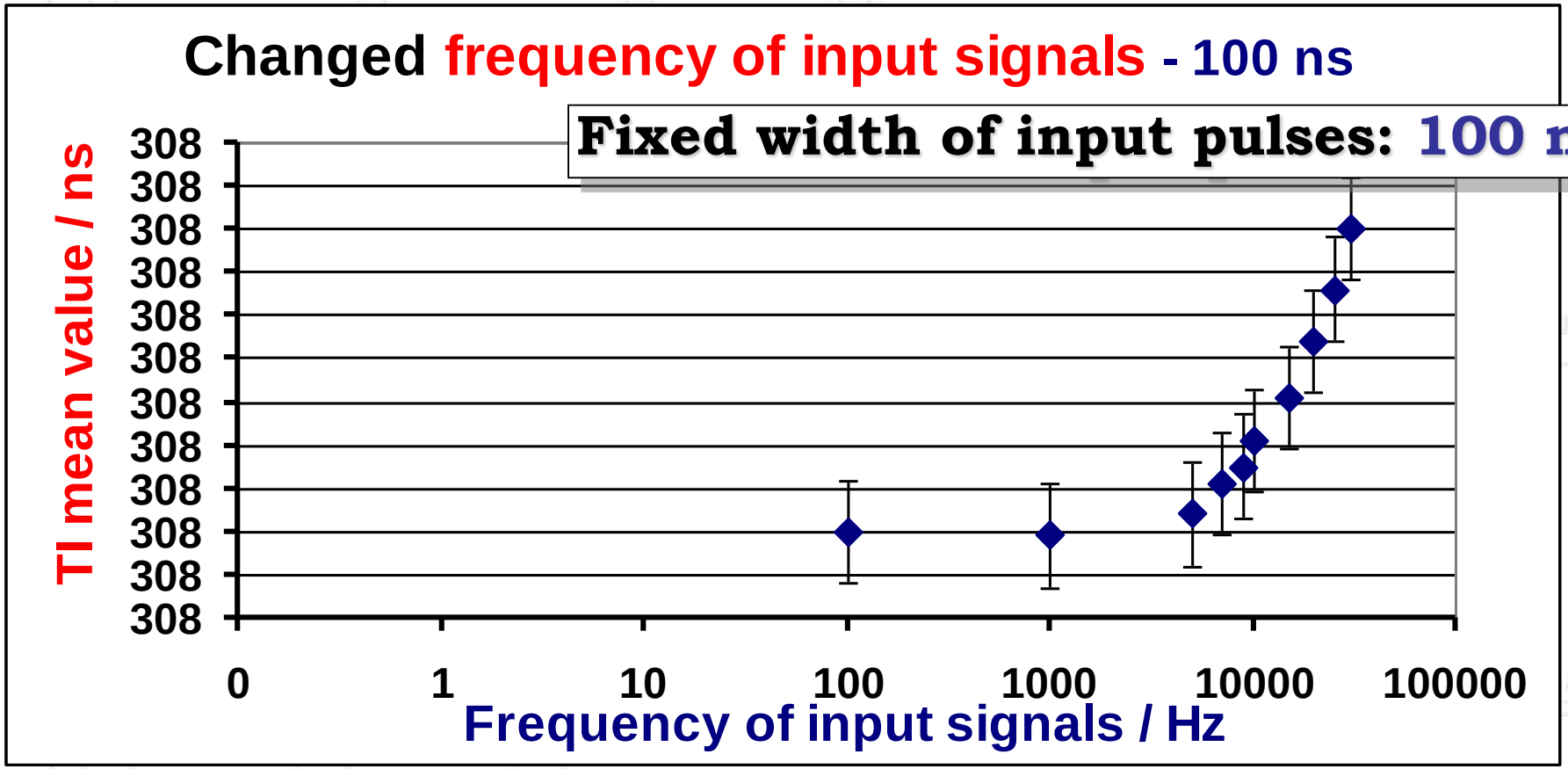
Pulse outputs

rear panel

TDev of output TI measurements

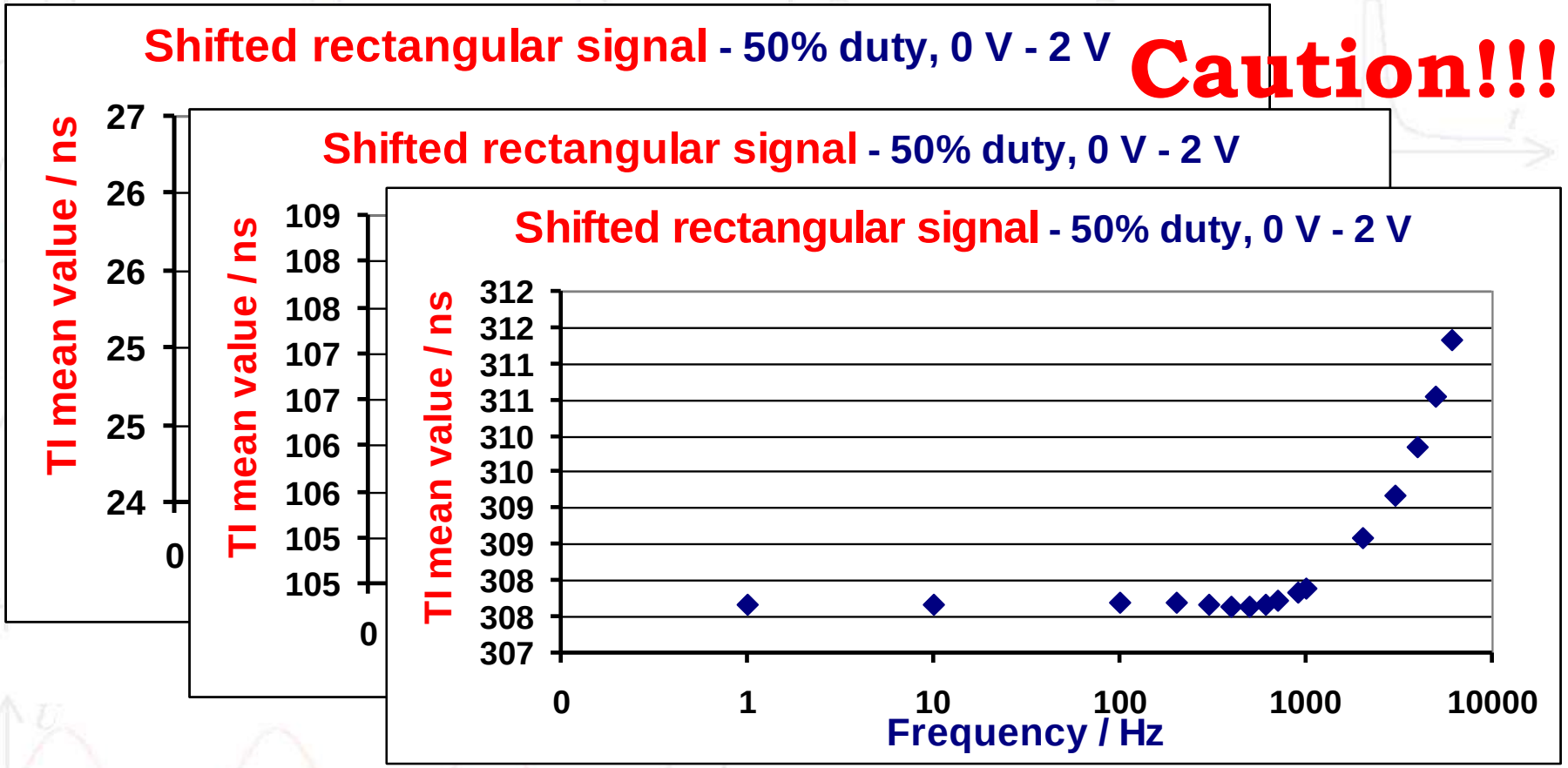


Dependence of generated Time Interval on frequency of input signal



Up to about 5 kHz of input signal, there is no observed change of Time Interval between output signals of InLambda standard

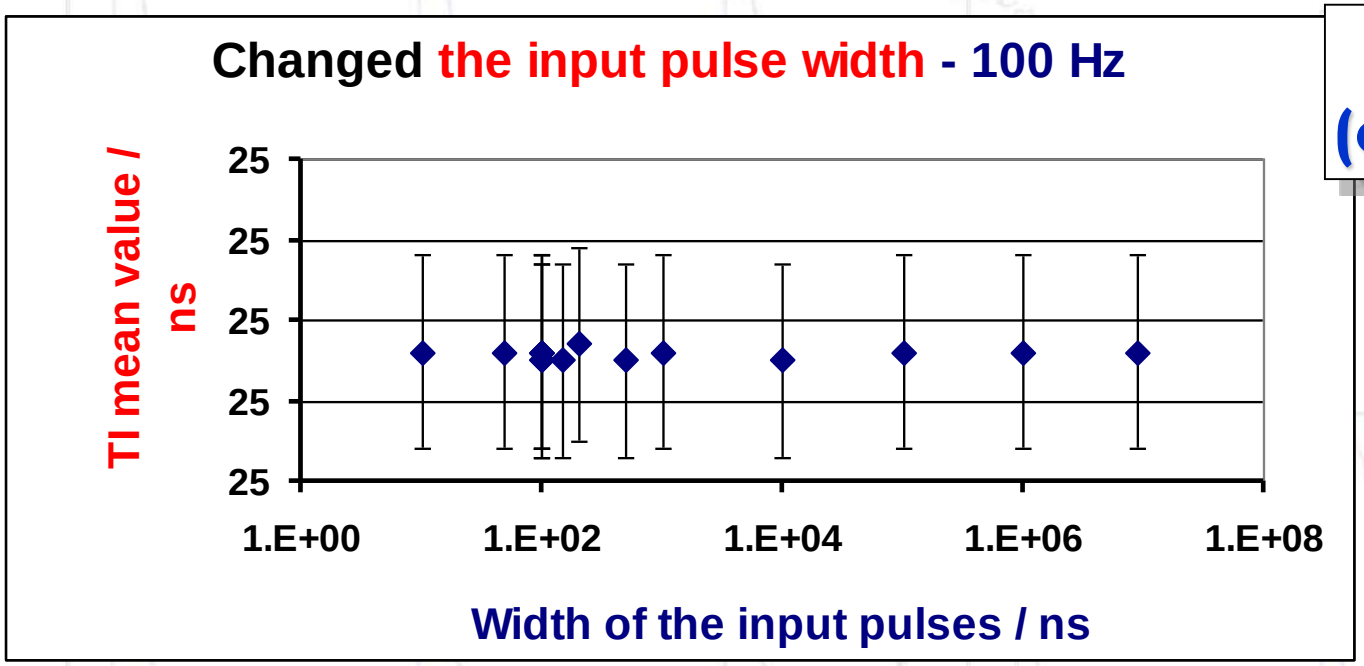
The applied shifted rectangular input signals



Caution!!!

Up to about 200 Hz of the shifted rectangular input signals (duty cycle 50%, low level 0 V, high level 2 V), there is no observed change of Time Interval between output signals.

Dependence of the generated Time Interval on the pulse width of the input signal

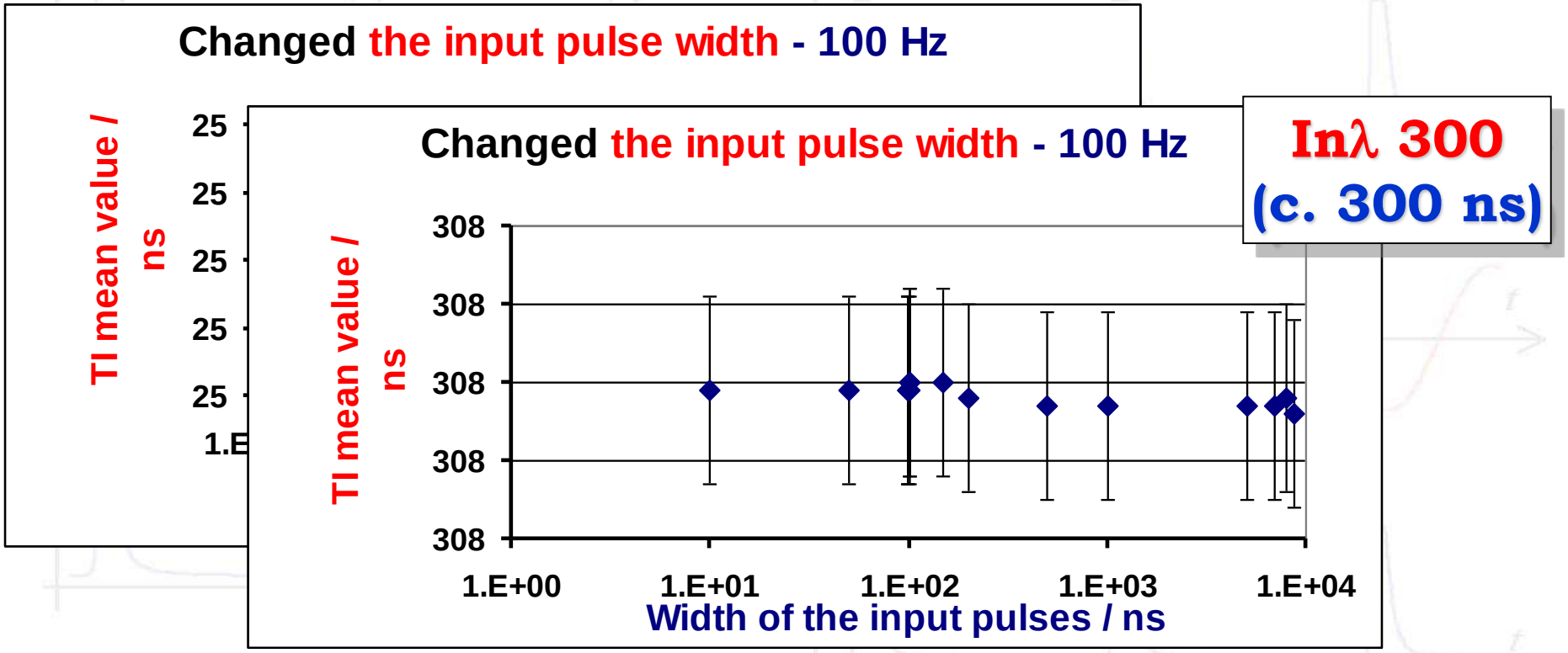


In λ 20 (c. 20 ns)

At frequency 100 Hz of input signal, there is no observed change of Time Interval between output signals at least up to 9 ms of the width of the pulses.

It should be chosen a such pulse width of input pulses not to change the output signals: (e.g. 200 ns?)

Dependence of the generated Time Interval on the pulse width of the input signal

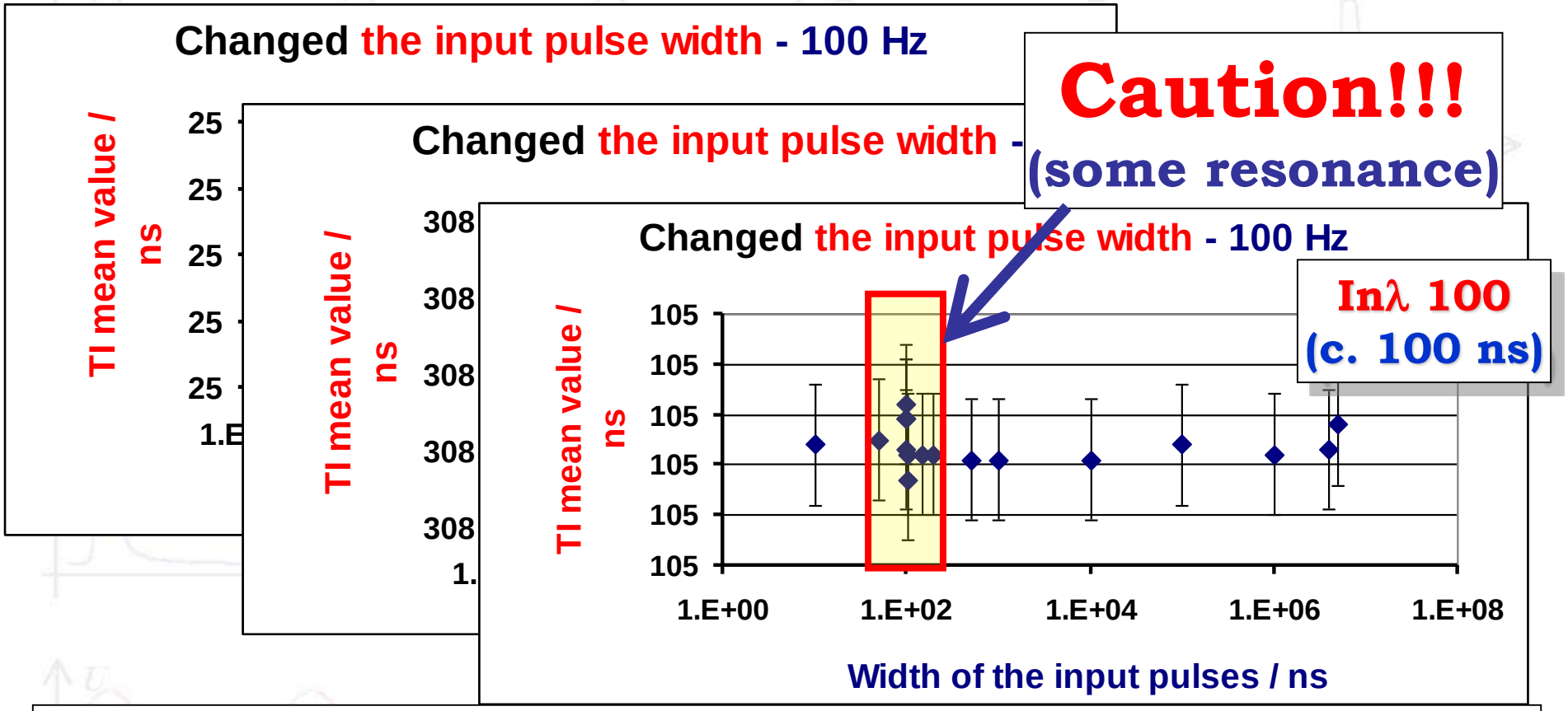


Inλ 300 (c. 300 ns)

At frequency 100 Hz of input signal, there is no observed change of Time Interval between output signals at least up to 9 ms of the width of the pulses.

It should be chosen a such pulse width of input pulses not to change the output signals: (e.g. 200 ns?)

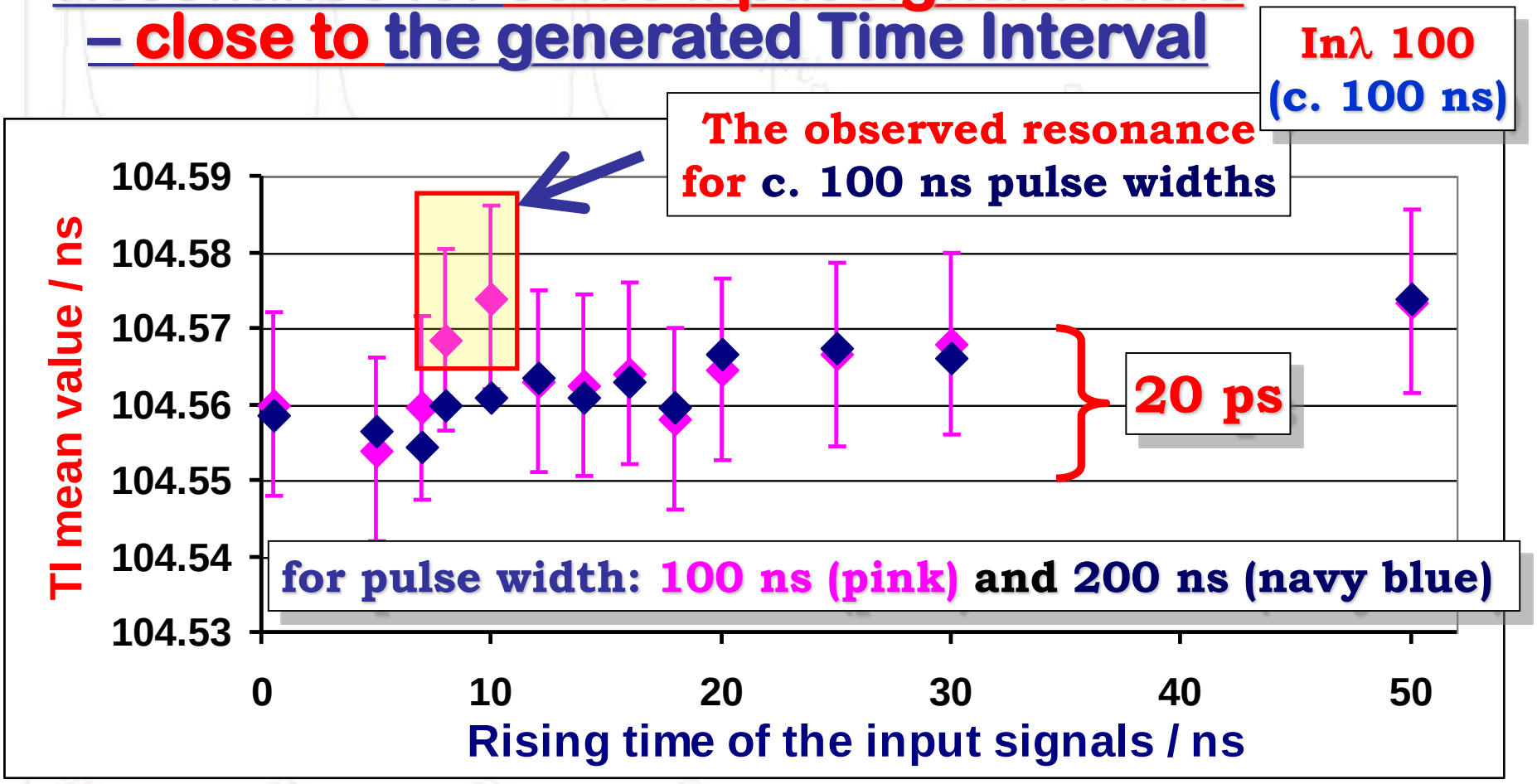
Dependence of the generated Time Interval on the pulse width of the input signal



At frequency 100 Hz of input signal, there is no observed change of Time Interval between output signals at least up to 9 ms of the width of the pulses.

It should be chosen a such pulse width of input pulses not to change the output signals: (e.g. 200 ns?)

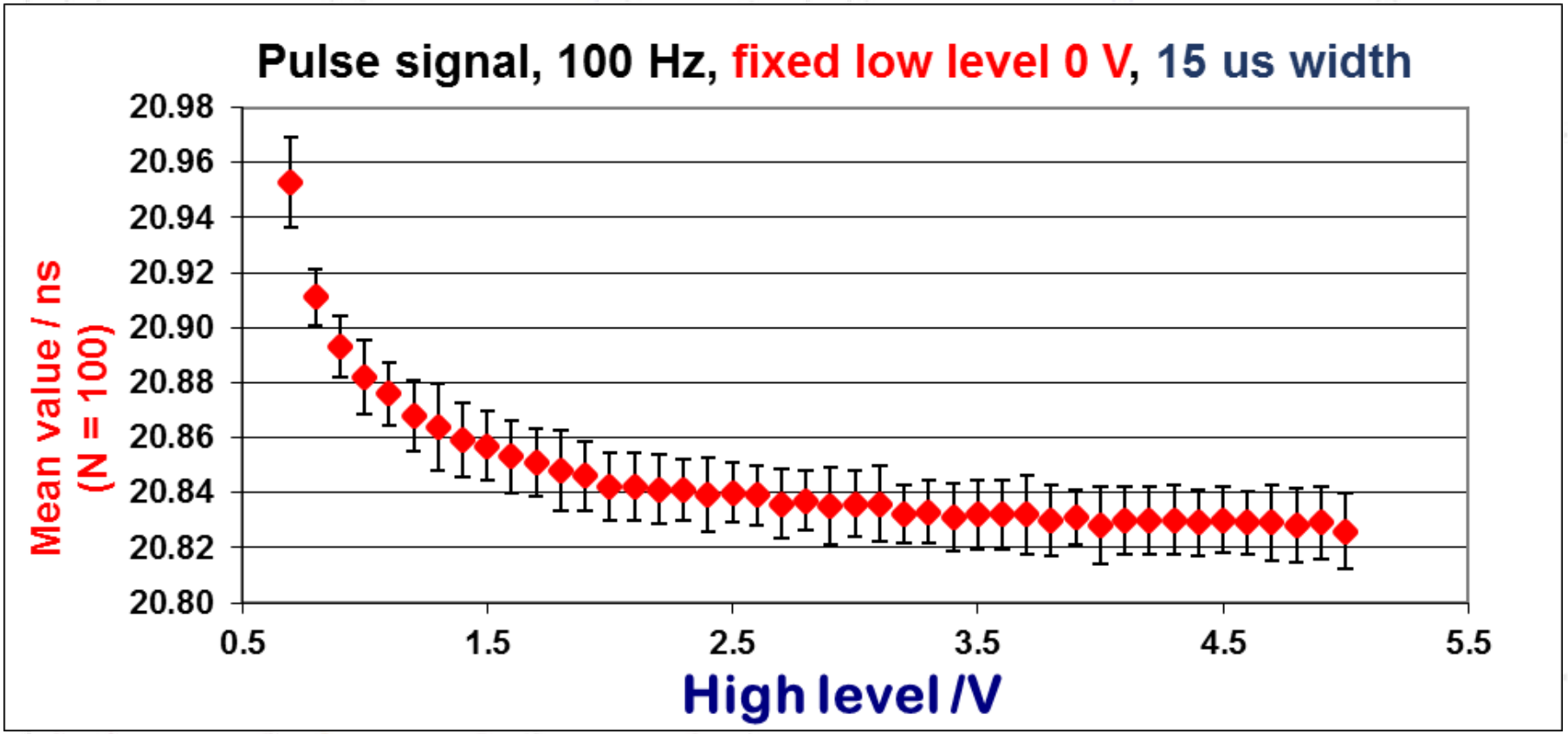
Resonance for some input signal widths – close to the generated Time Interval



Inλ 100 ns driven by:
Start output of Inλ 300 ns driven by 100 Hz from 33250A

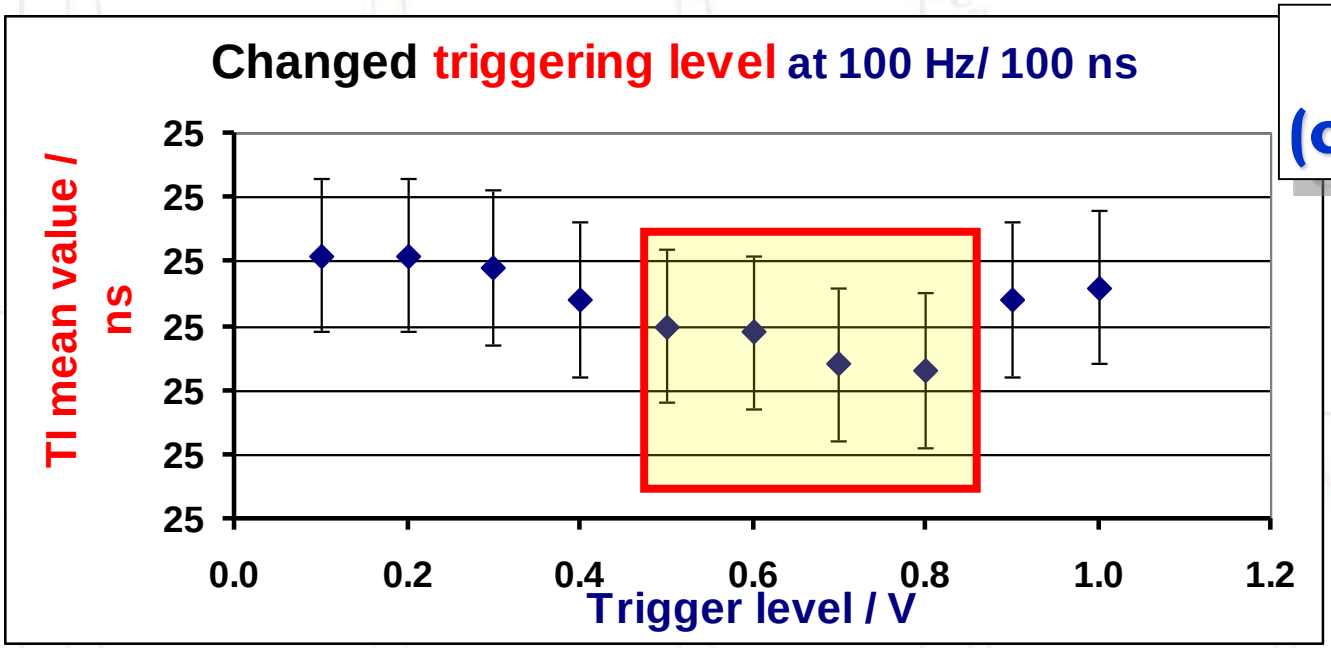
The same effect is observed for c. 20 ns (for InL 20) and for c. 300 ns (for InL 300) pulse widths, too.

Dependence of generated Time Interval on the High level of input pulse signal



From about 2 V of the high level of input signal, there is slow change of Time Interval between output signals with increasing the high level of input signal.

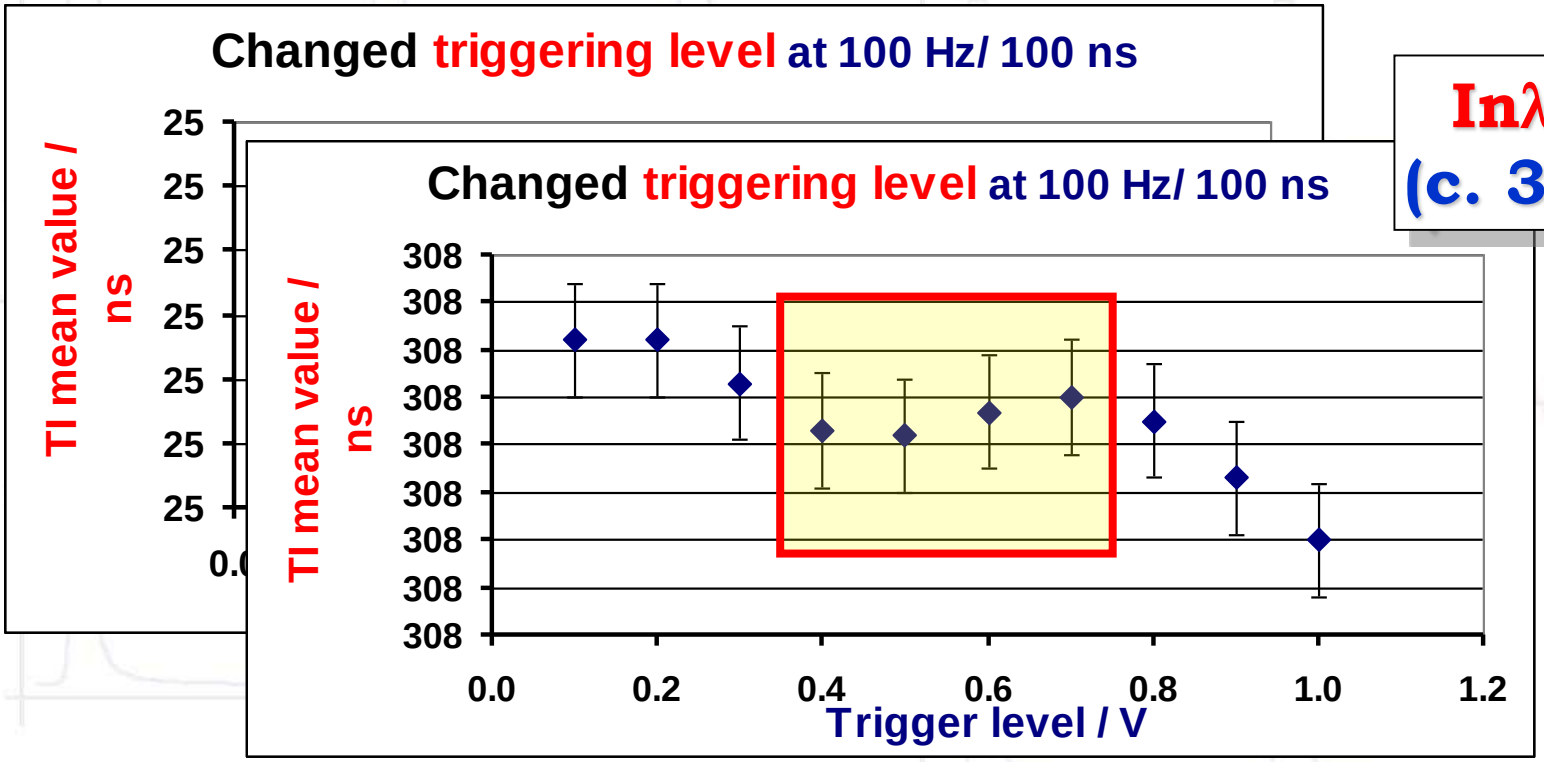
The choice of trigger levels of the measured signals



Inλ 20 (c. 20 ns)

It seems that 0.5 V or 0.6 V of the trigger levels would be better than 0.7 V

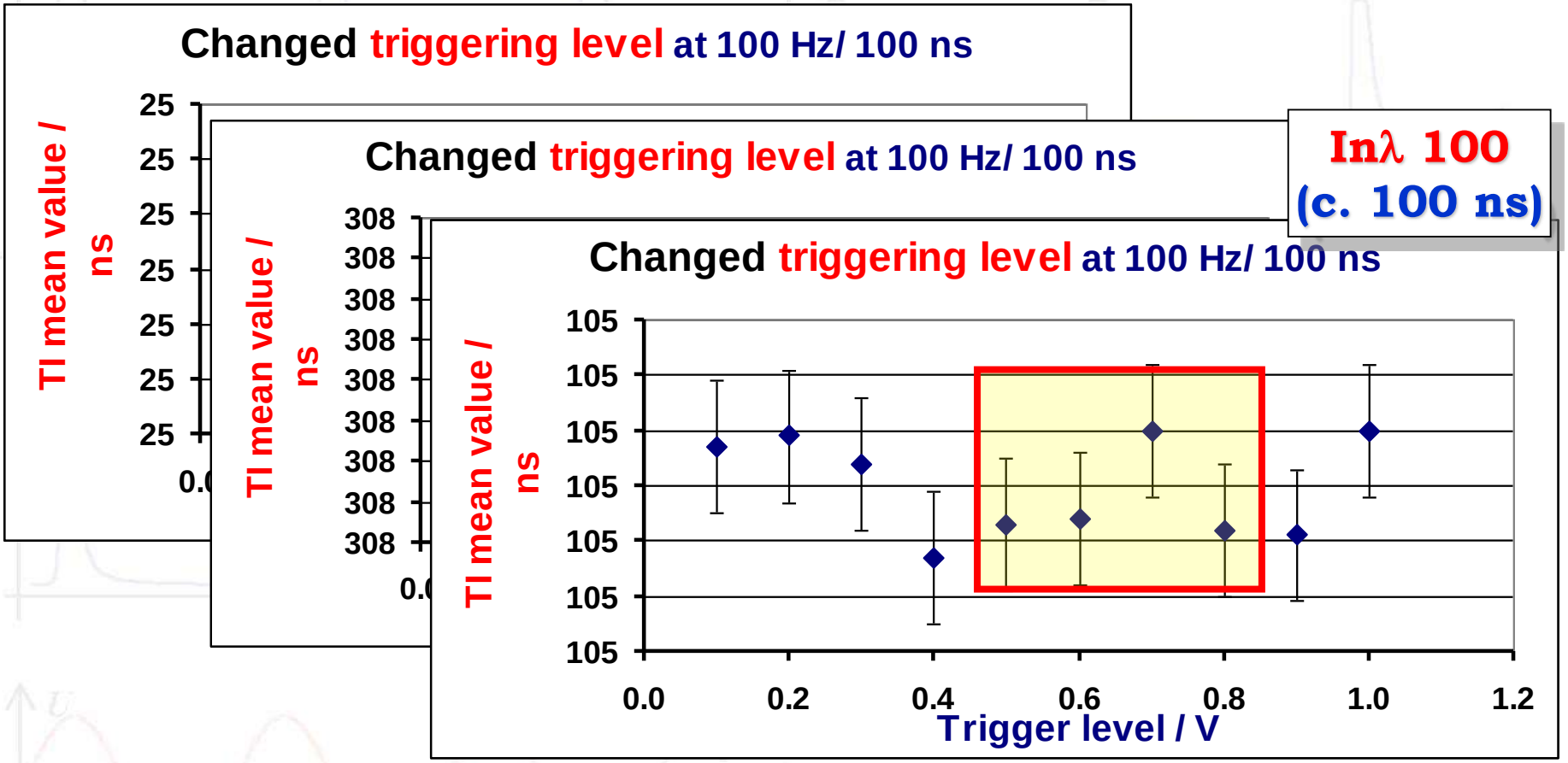
The choice of trigger levels of the measured signals



Inλ 300 (c. 300 ns)

It seems that 0.5 V or 0.6 V of the trigger levels would be better than 0.7 V

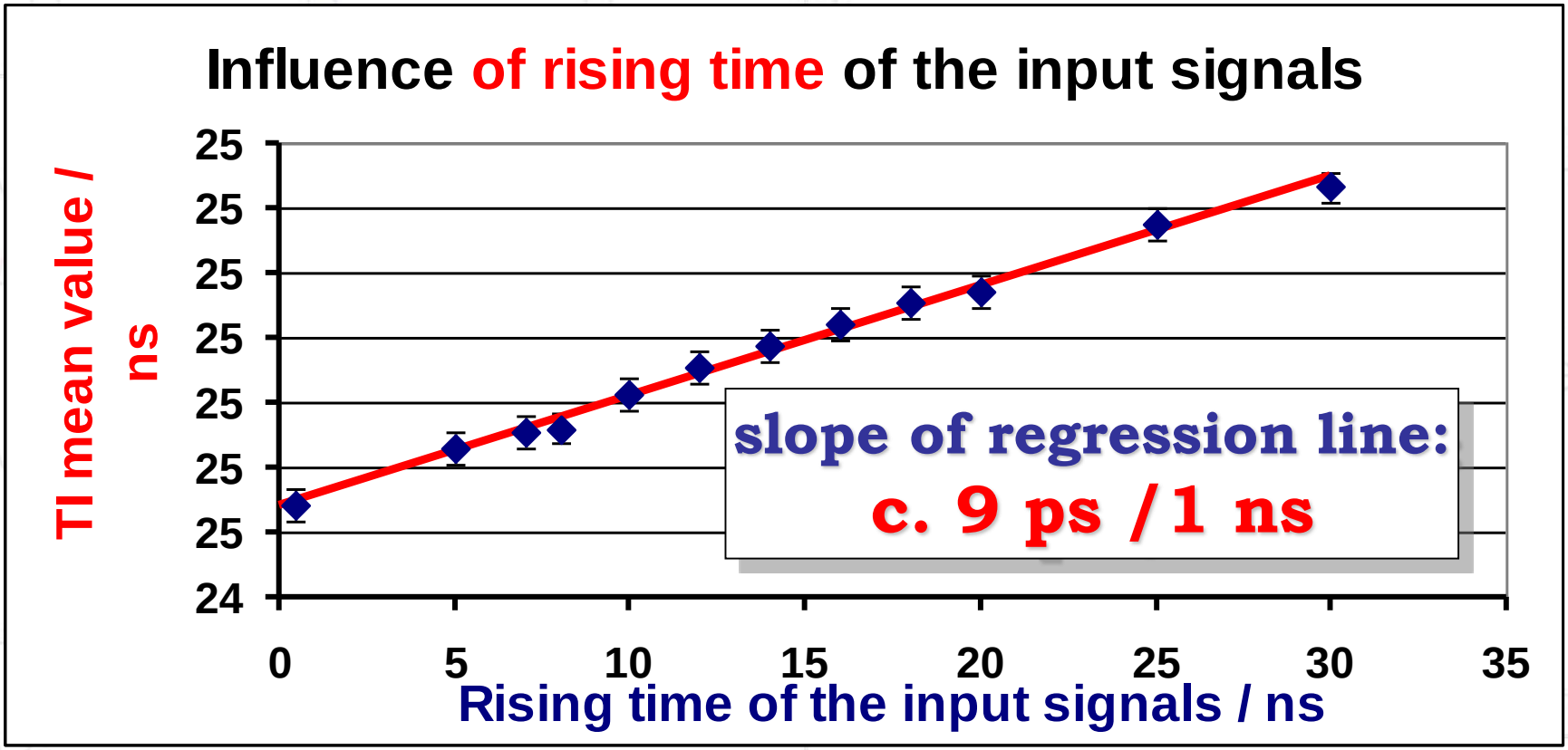
The choice of trigger levels of the measured signals



Inλ 100 (c. 100 ns)

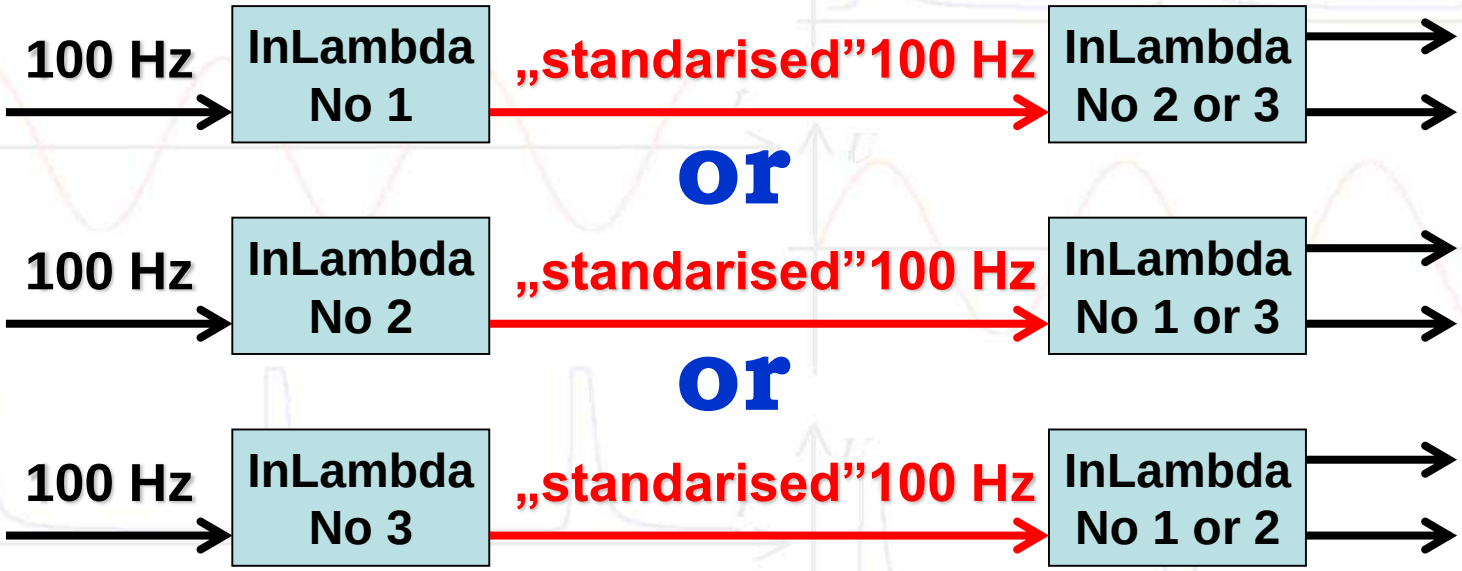
It seems that 0.5 V or 0.6 V of the trigger levels would be better than 0.7 V

Dependence of generated Time Interval on rising time of input signal



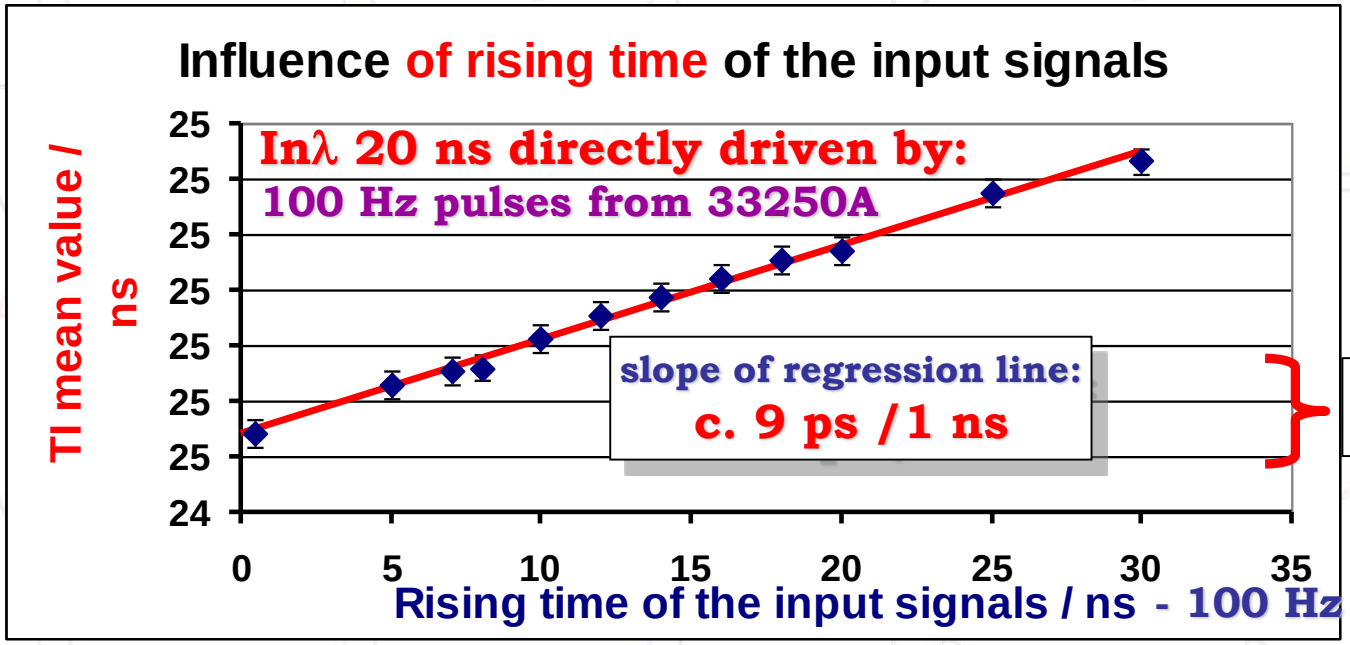
There is observed the change of Time Interval between output signals when the slope of input signals changes

Proposed slope of input signals „standarisation”

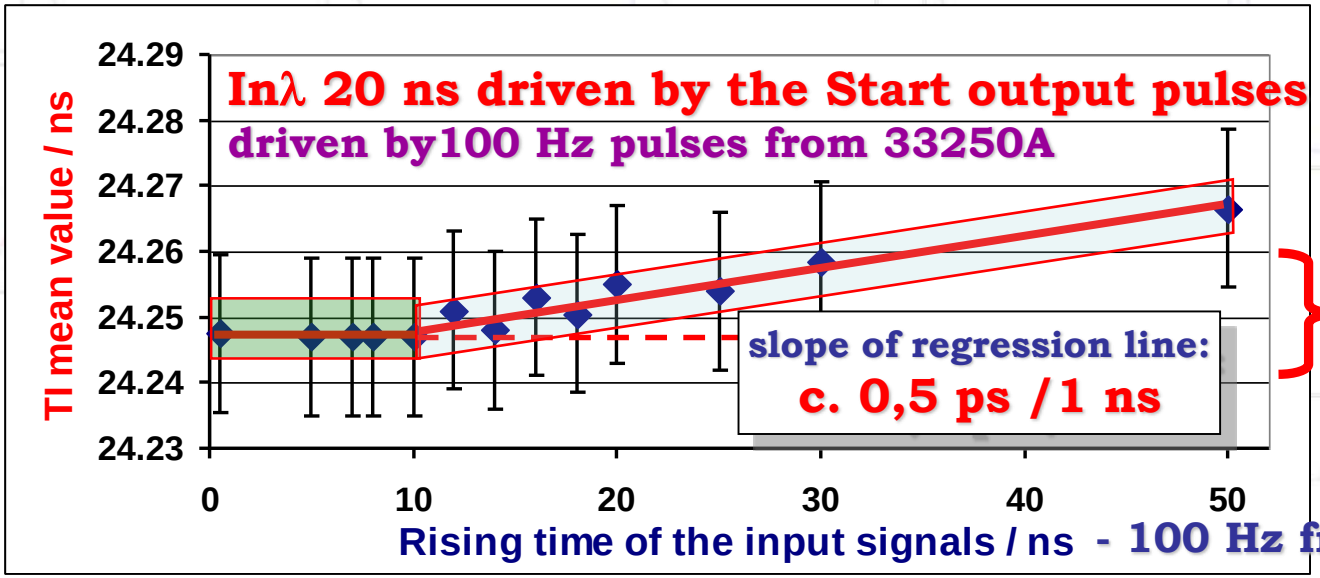


The problem of the change of Time Interval between output signals when the slope of input signals changes can be reduced by the usage of the Start output signal of one InLambda standard to the input of the other InLambda standard beeing measured.

Dependence of generated Time Interval on the rising time of input signal

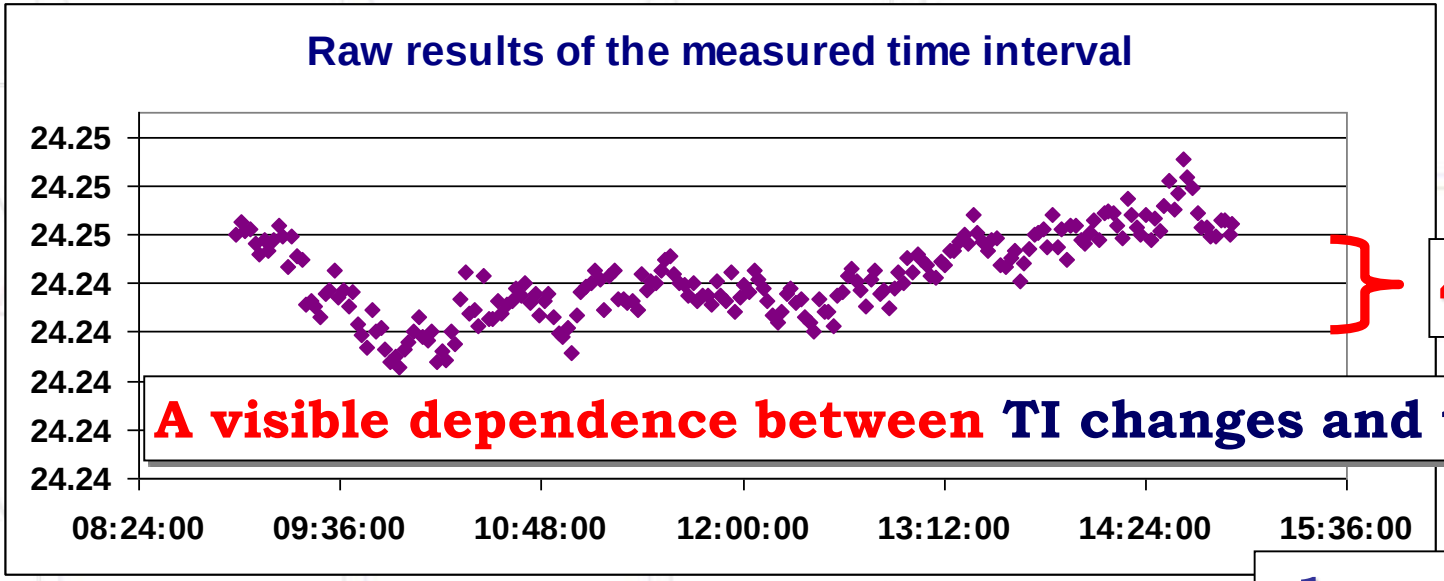


100 ps



20 ps

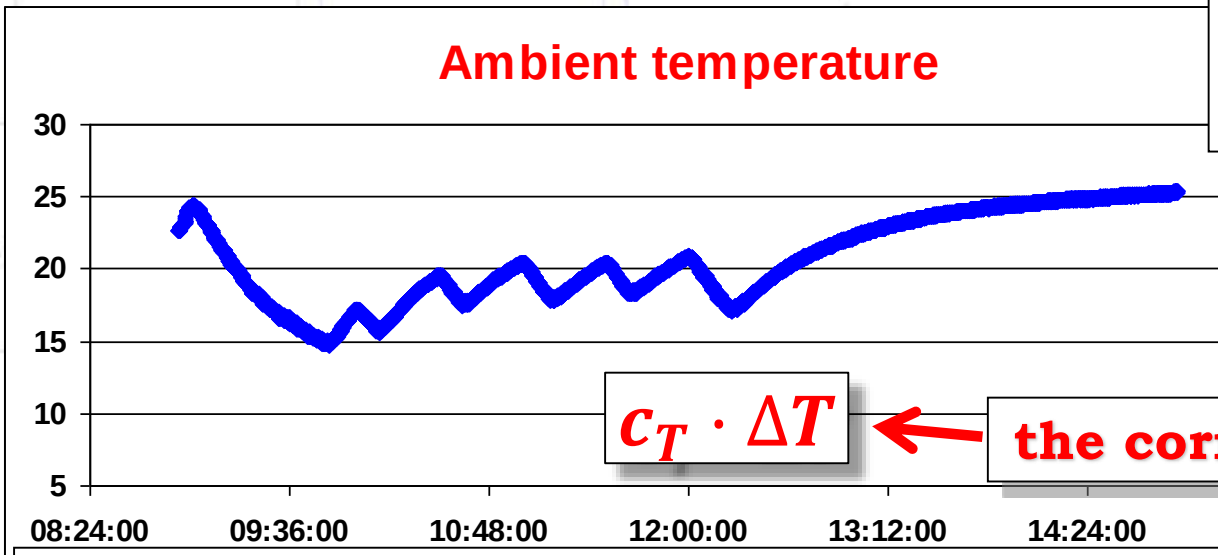
Influence of temperature - Inλ 20



4 ps

A visible dependence between TI changes and temperature.

dependence of:
c. 0,6 ps / 1 K

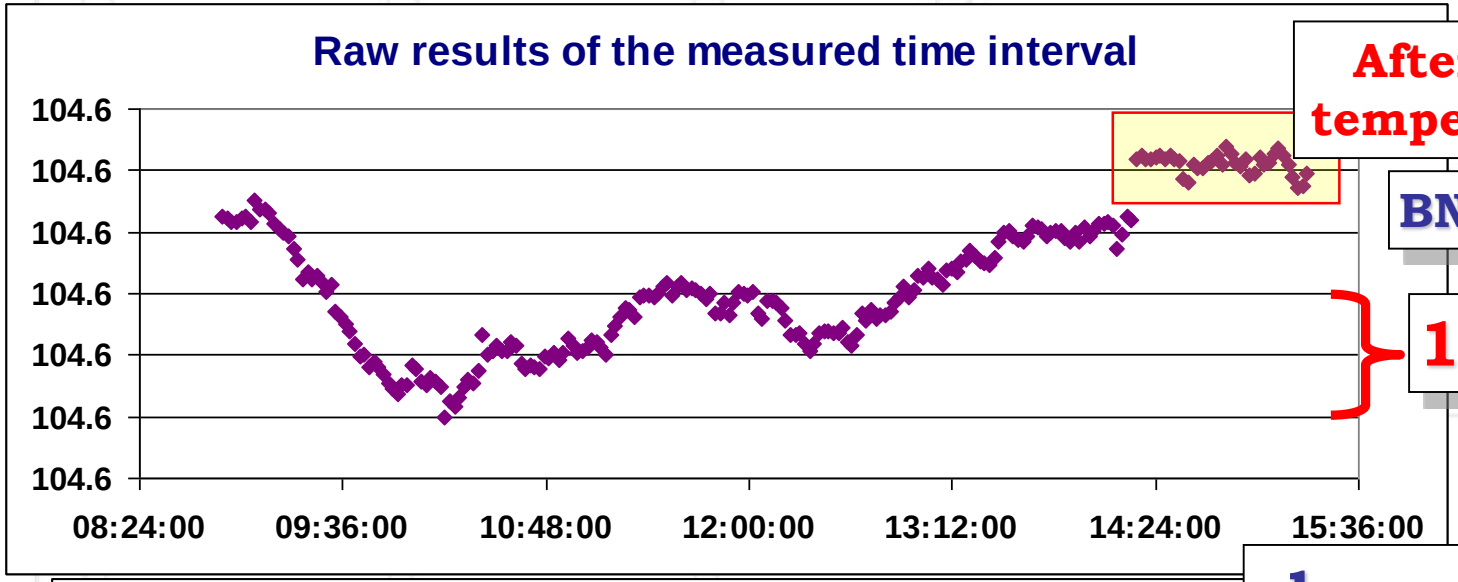


10 K

$c_T \cdot \Delta T$ ← the correction for $T \neq T_{Ref}$

The observed effect - at the noise level of TIC.

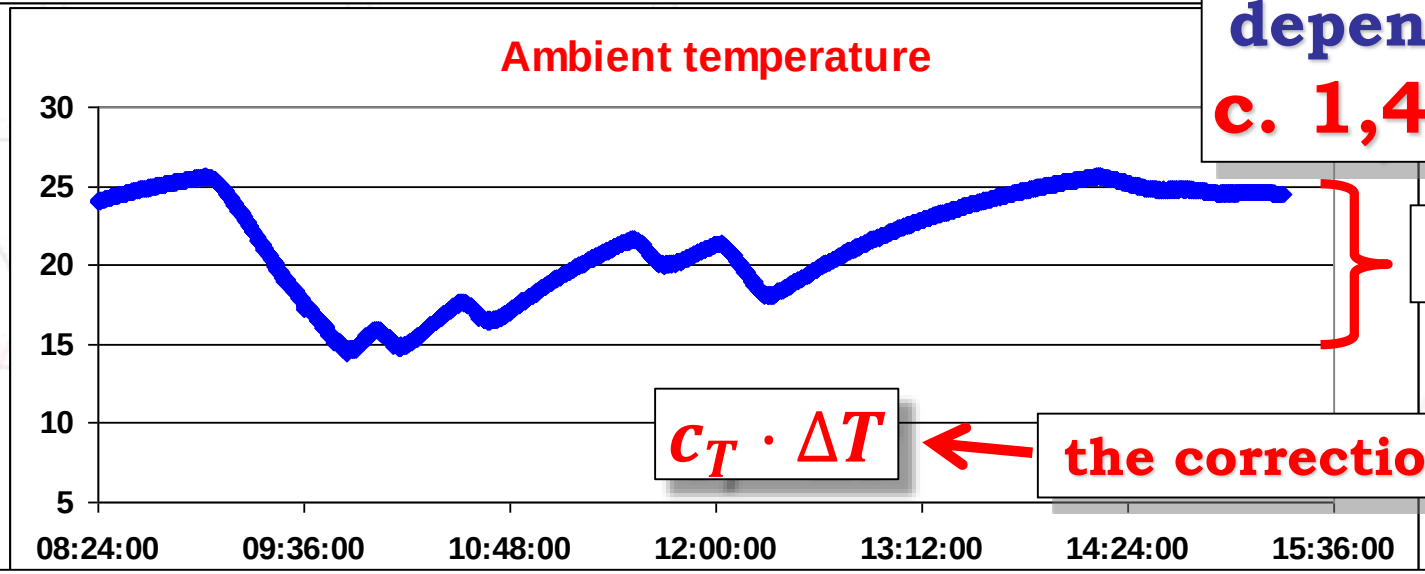
Influence of temperature - Inλ 100



After openinig the temperature chamber

BNC connectors

10 ps



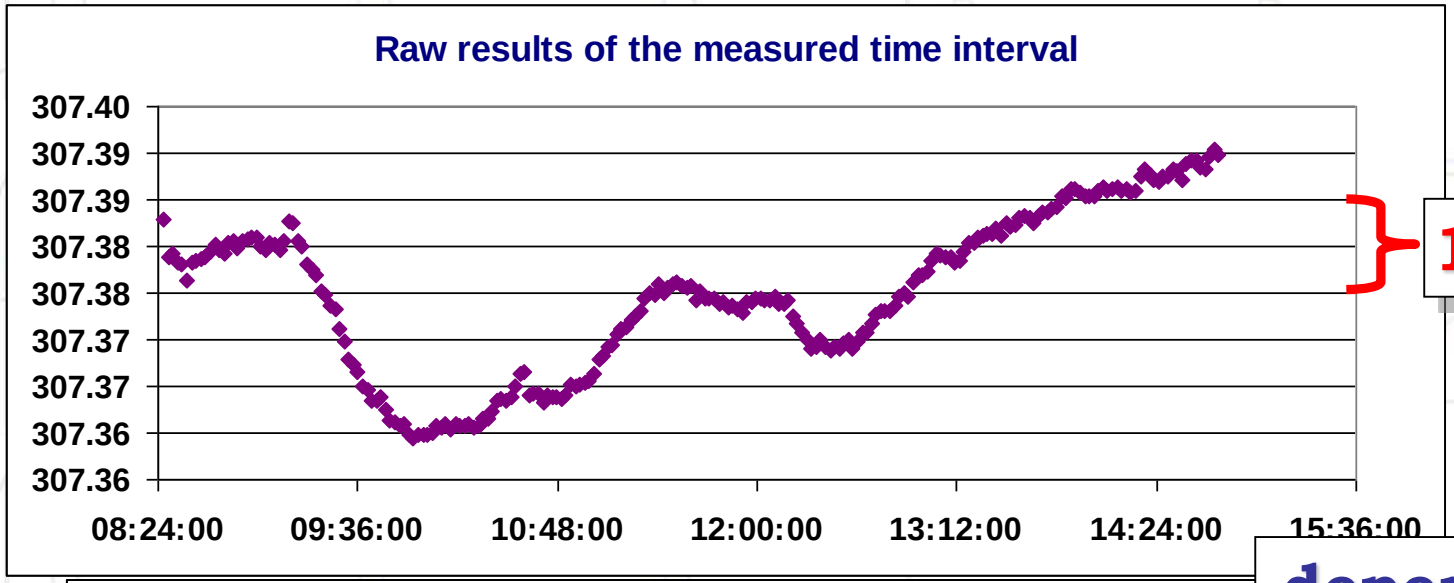
dependence of:
c. 1,4 ps /1 K

10 K

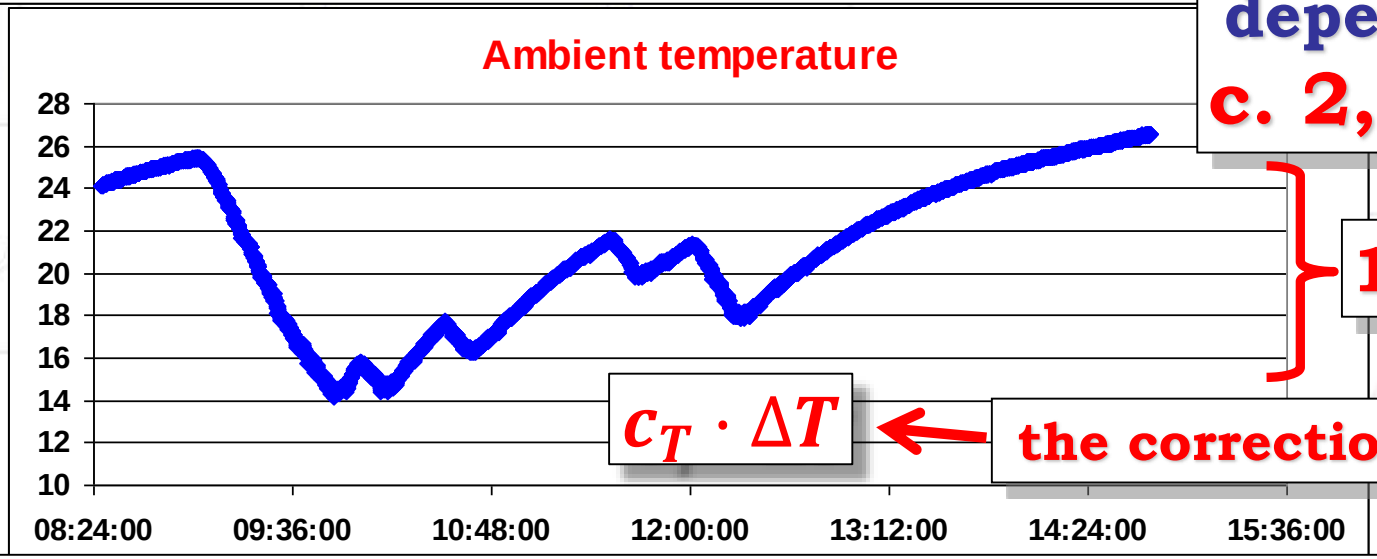
$c_T \cdot \Delta T$ ← the correction for $T \neq T_{Ref}$

The observed effect – more than the noise level of TIC.

Influence of temperature - Inλ 300



10 ps



dependence of:
c. 2,5 ps / 1 K

10 K

$c_T \cdot \Delta T$ ← the correction for $T \neq T_{Ref}$

The observed effect – more than the noise level of TIC.

Conclusions

InLambda Time Interval generators are stable enough to be travelling standards for Time Interval Supplementary Comparison.

The estimated accuracy of InLambda standards is/ can be appr. at the level of ± 10 ps (for p= c. 95%).

Proposed reference conditions (input signals):

≤200 Hz pulses
Low Level – 0 V, High Level – 2 V
rising time < 10 ns
not to long pulse width (and avoide resonances)

Trigger levels: should be fixed, eg. to

0.5 V or 0.6 V for both output signals

Each participant should measure and give to the report the rising time of the used input pulses and the ambient temperature.

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