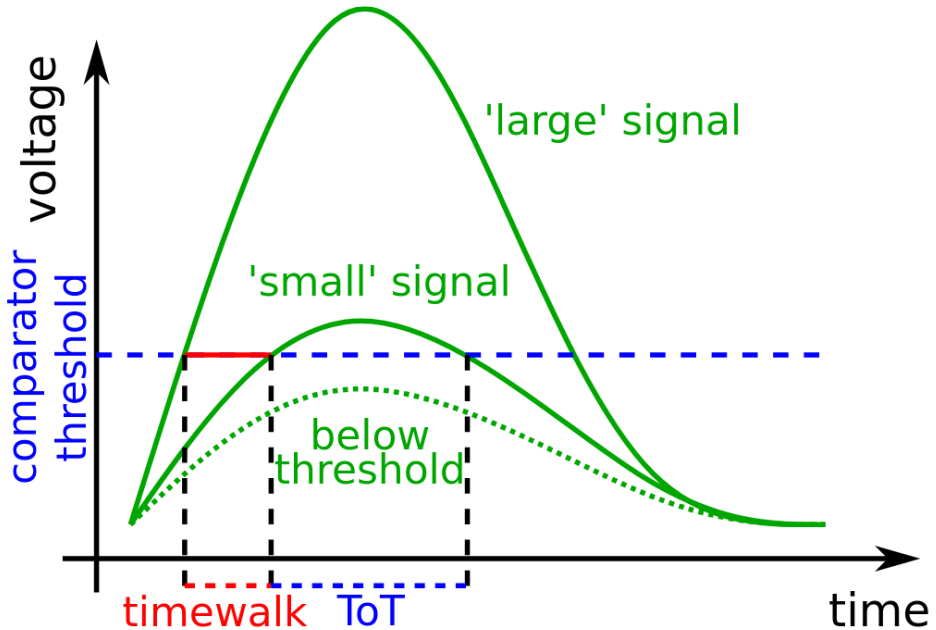
UNIVERSITÄT BONN

DEEP

Per Pixel timewalk calibration

Lohengrin meeting
6.8.2025

GLOBAL TIMEWALK



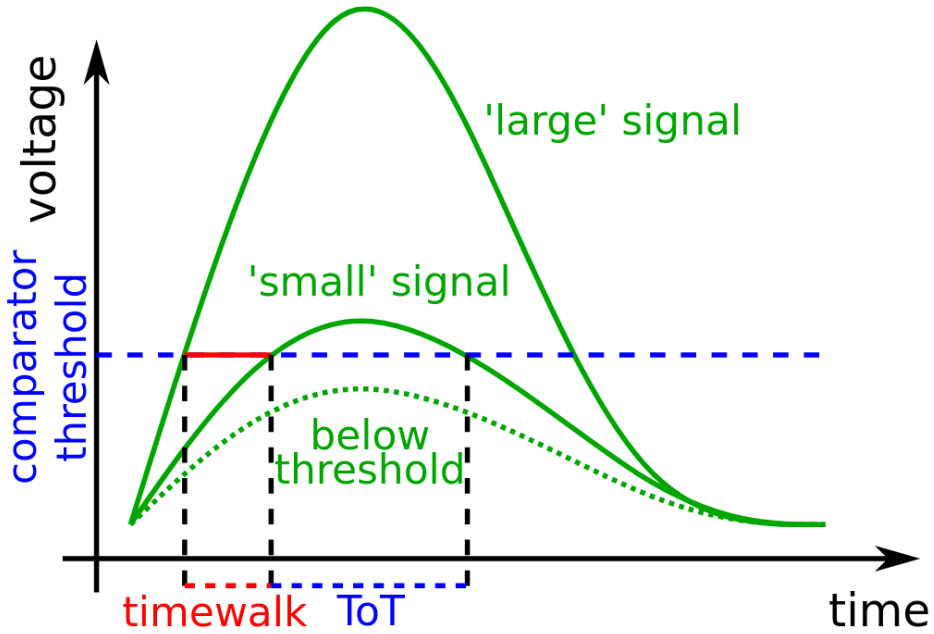
Timewalk correction so far:

$$\Delta T = \exp\left(a \cdot \mathrm{ToT} + b\right) + c$$

(quite) linear relationship between E and ToT value

→ Three parameters per chip

PIXELWISE TIMEWALK



Timewalk correction so far:

$$\Delta T = \exp\left(a \cdot \mathrm{ToT} + b\right) + c$$

(quite) linear relationship between E and ToT value

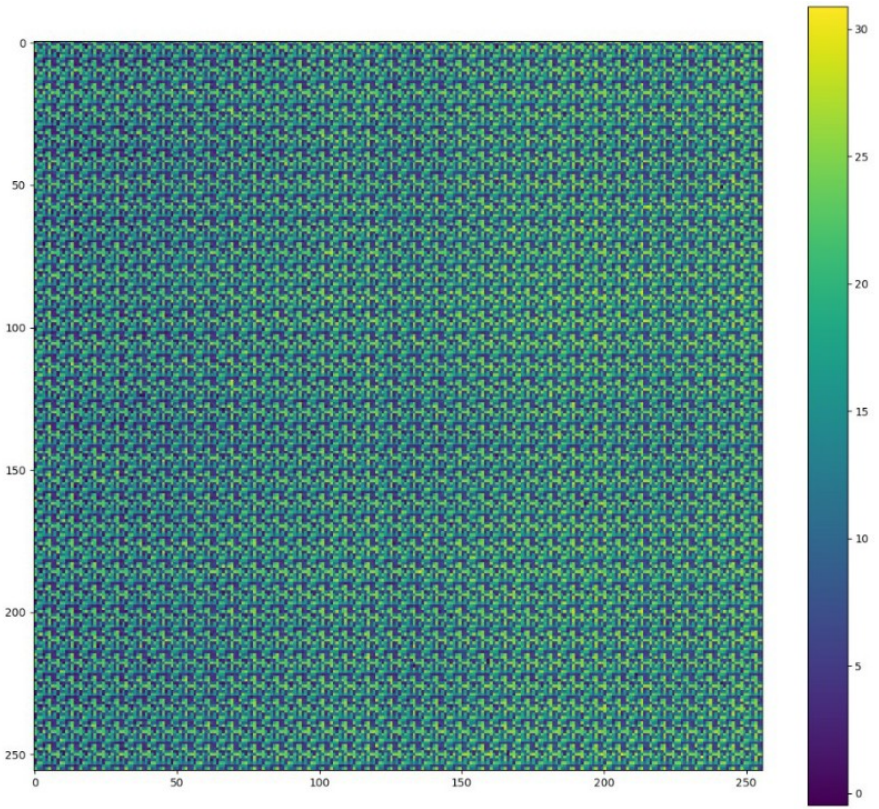
$$\Delta T(x,y) = \exp\left(a(x,y) \cdot \mathrm{ToT} + b(x,y)\right) + c(x,y)$$

x/y dependency

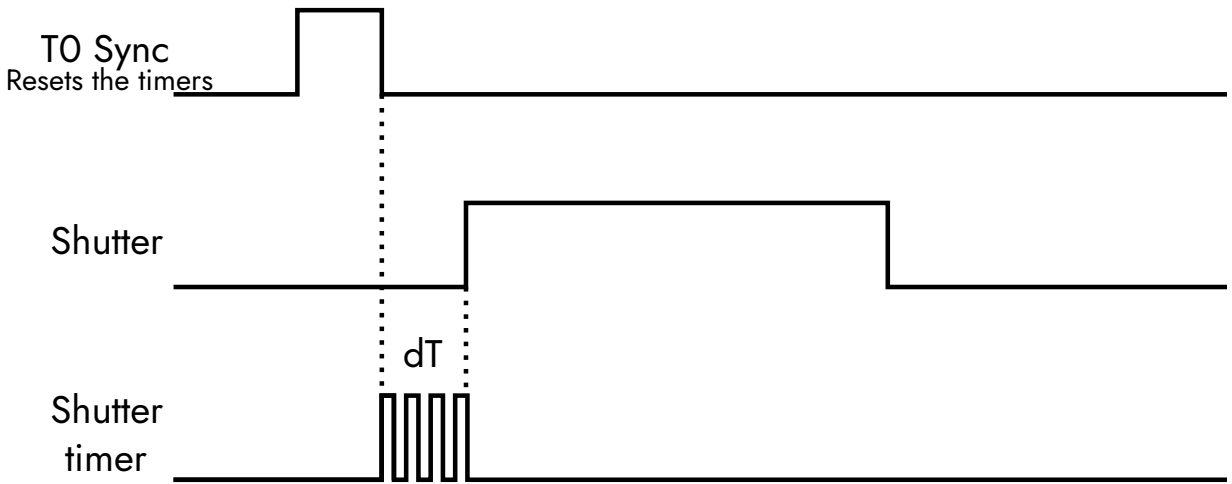
→ ~200k parameters per chip

PER PIXEL TIMEWALK

First attempt from last year: Map of fit parameter C



CORRECTING THE TIMING



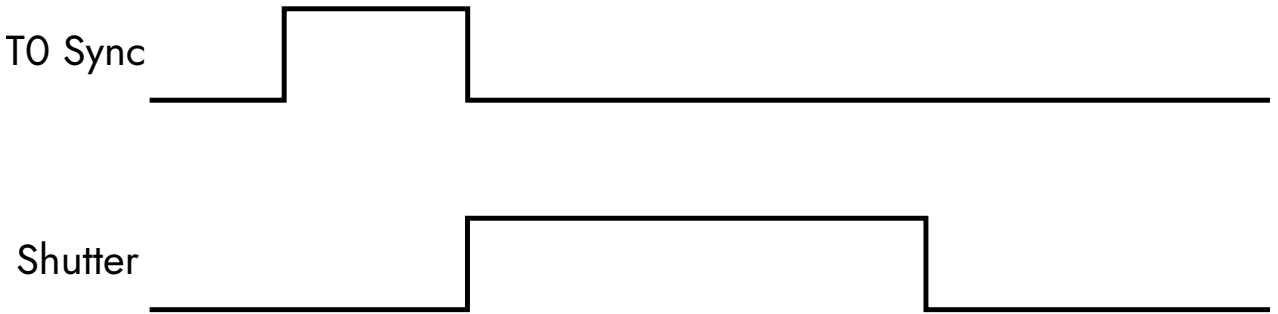
Issue:

- Commands via Ethernet @125 MHz
- Output signals generated via modules @40 MHz
- Shutter timer module @640 Mhz

→ Synchronisation nightmare

Single error destroys the whole calibration

CORRECTING THE TIMING



Solution:

- Remove shutter timer
- Sync falling edge of T0 with rising edge of Shutter **on FPGA**

→ Ensures that timers are always 0 when data taking starts

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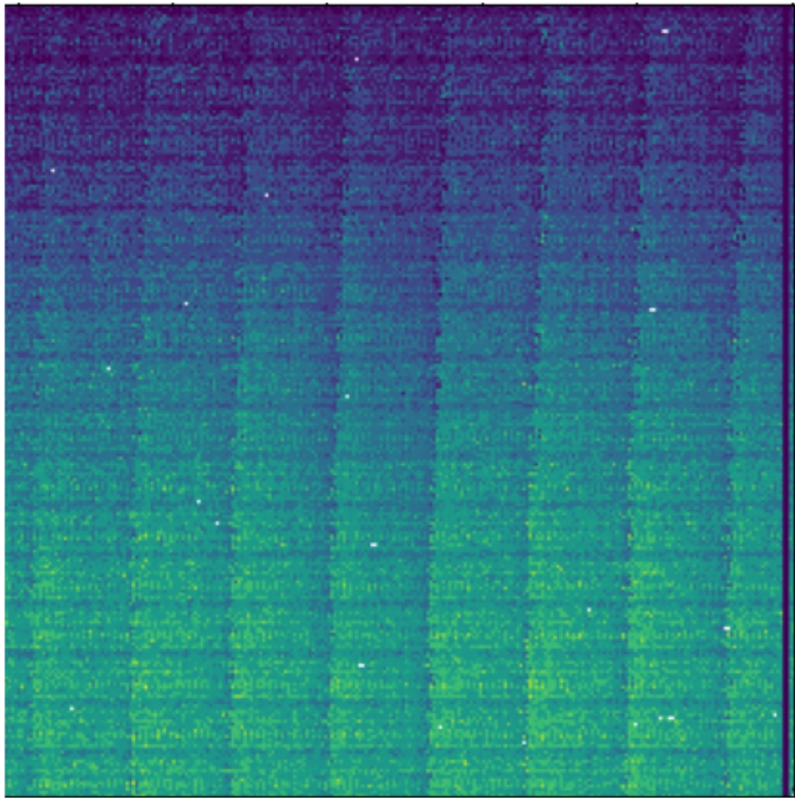
PER PIXEL TIMEWALK

New attempt: Map of fit parameter C



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COMPARISON

Standard deviation of the timestamps per event:

No correction: 22 ns
Global timewalk correction: 13.4 ns
Per pixel timewalk correction: 13.2 ns

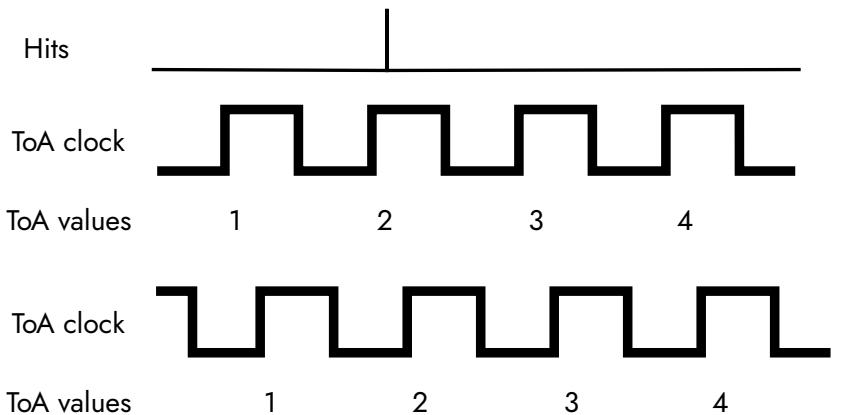
HOW STABLE ARE THE CLOCKS?

Same clock source

→ clocks stay synchronized on all Timepix3 chips

Possible issues:

- Different cable lengths:



- Jitter (we know the voltages and clocks aren't super stable)

HOW TO CHECK IF THE TIME OFFSETS ARE CORRECTABLE?

1) Use data of **two chips**
2) Look at **one pixel per plane** which are **often hit simultaneously** (→ which are at the same projected position)
3) Look at events where **both pixels are hit** and the data has the **same ToT** per chip (although the ToT between the chips can vary)
4) The **time difference** between the two hits must be more or less **identical between multiple events**

Is it?

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No

Differences of up to 50ns in the timestamps