# Jülich Beam Test Results

L. Zotti

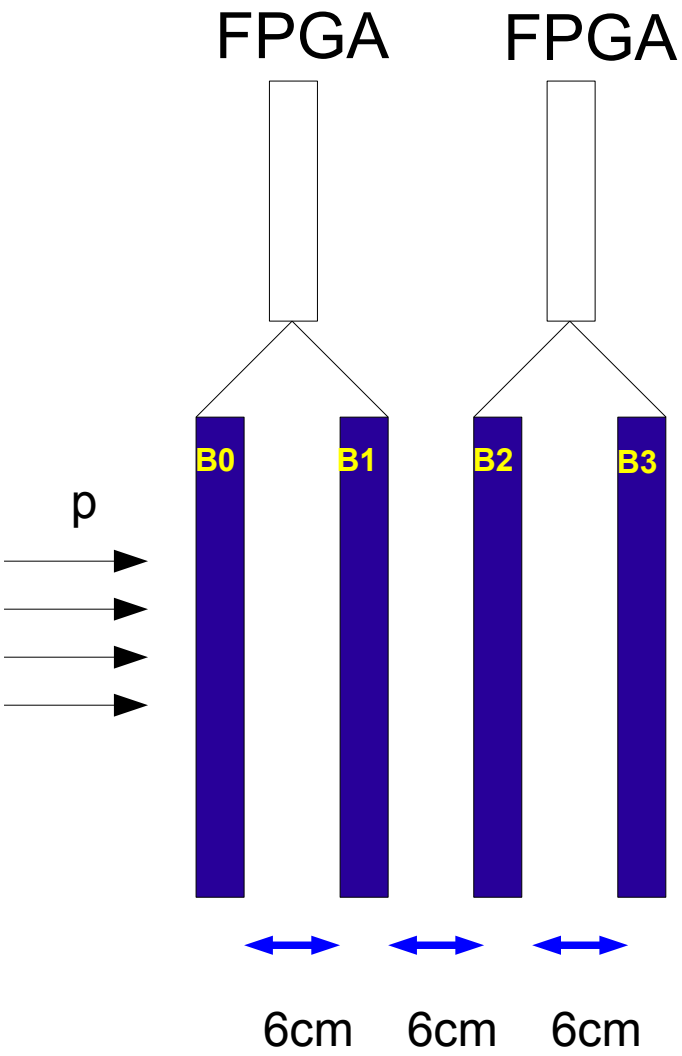




LII Collaboration Meeting, 16-20th March 2015

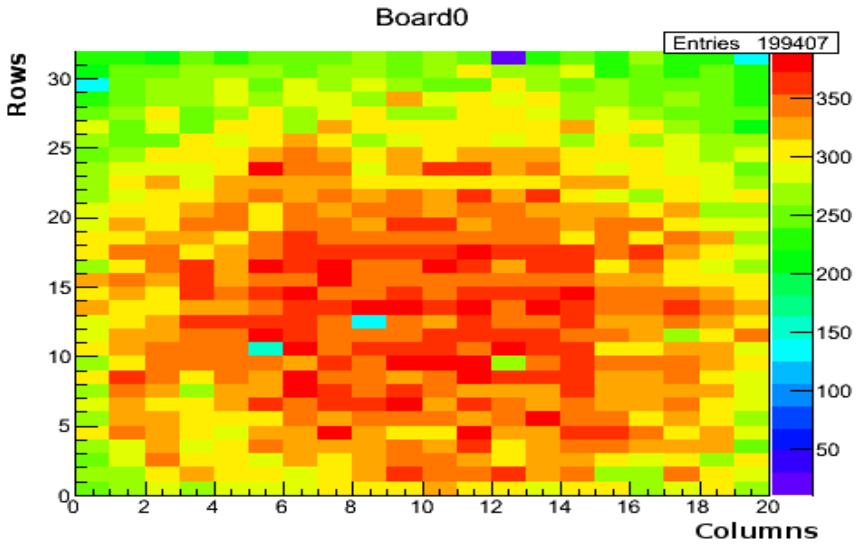
# Jülich Beam Test @ COSY (November2014)

p@2.9 Gev/c




4 Assemblies:

- Topix4
- Epitaxial Silicon Sensor (2x3.2 $mm^2$)



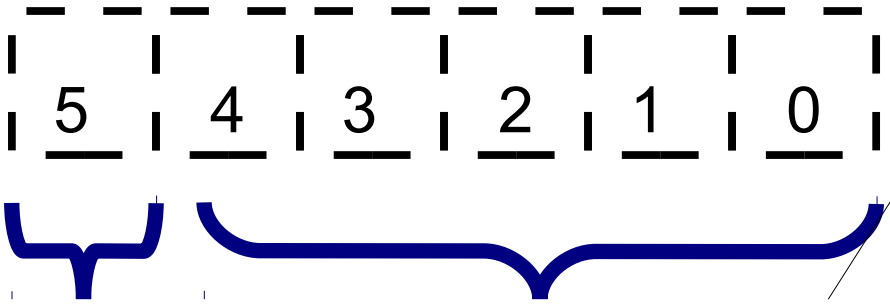

- Clock Frequency Scan
- Theshold Scan
- Bias Scan
- Freeze Scan

## DAQ - LabView (R.Wheadon)

## 8 Bytes Long Packet Header with

- Packet Numbers
- # Following Bytes

## *6 Bytes Event (MSB First)*




**CHIP ID**

- **FRAME HEADER**
- **FRAME DATA**
- **FRAME IDLE**
- **FRAME TRAILER**

| Position | # bits | Data |
|---|---|---|
| 39:38 | 2 | Header (01 for FH) |
| 37:26 | 12 | Chip address |
| 25:18 | 8 | Frame counter |
| 17:6 | 12 | Not used (set to Hex 5A5) |
| 5:0 | 6 | Error Correction Code |

| Position | # bits | Data |
|---|---|---|
| 39:38 | 2 | Header (11 for data) |
| 37:24 | 14 | Pixel address |
| 23:12 | 12 | Leading edge time stamp |
| 11:0 | 12 | Trailing edge time stamp |

| Position | # bits | Data |
|---|---|---|
| 39:38 | 2 | Header (00 for idle) |
| 37:0 | 16 | Idle patter (Hex 3A55AA55AA) |

| Position | # bits | Data |
|---|---|---|
| 39:38 | 2 | Header (10 for TH) |
| 37:22 | 16 | Number of events |
| 21:6 | 16 | Frame CRC |
| 5:0 | 6 | Error Correction Code |

**Dummy Events:** LE or TE = 2730 or 2729

# Jülich Beam Test @ COSY

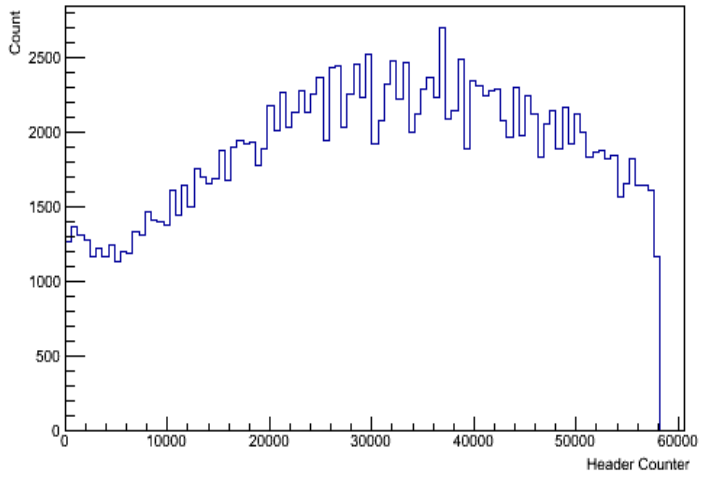
## FACING TIMESTAMP....

**TIMESTAMP = 8bit (FRAME_COUNTER) + 12bit (LEADING_EDGE)**
**.....but @ 50 MHz: 20 ms → with a spill of ~20s: 1000 reset**
**@ 160 MHz: 6.25 ms → with a spill of ~20s: 3200 reset**

**The standard timestamp matching procedure is not able at the moment to find time match....**

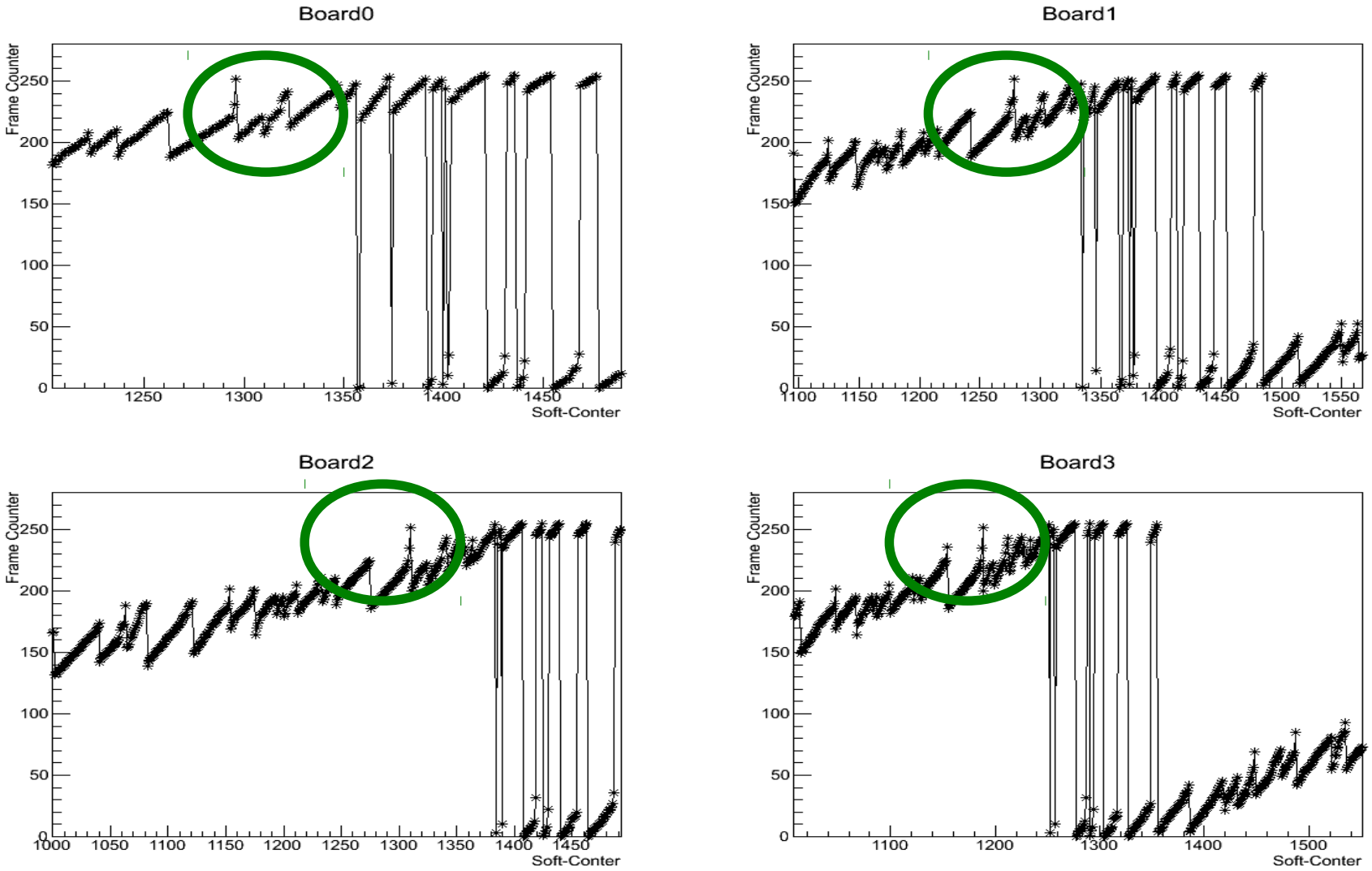
- **An additional 7bit counter was added, but has not been used in the timestamp matching procedure for alignment dubts...**
- **A software counter, labeling the header frame, was added but since empty frame are filtered out, no time reference is present at the moment...**

- Debug analysis of the acquisition performance
- Comparison of the frame counter behaviour



# Jülich Beam Test @ COSY

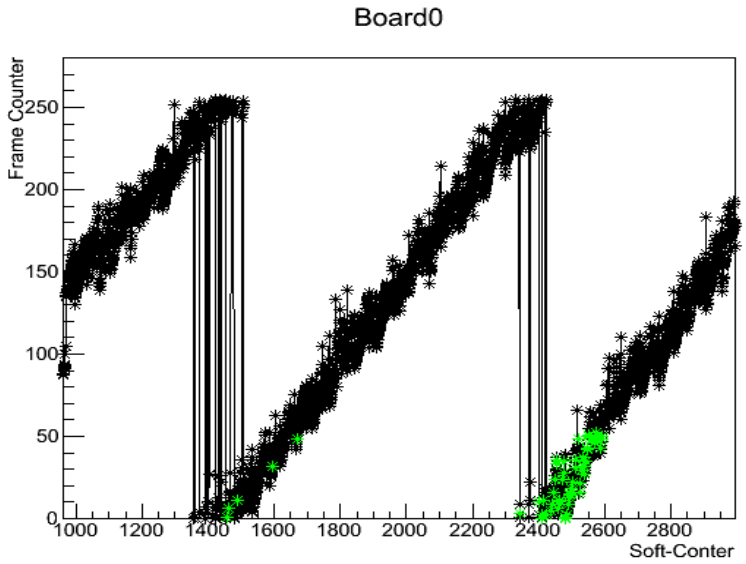
## New TimeStamp Matching Procedure

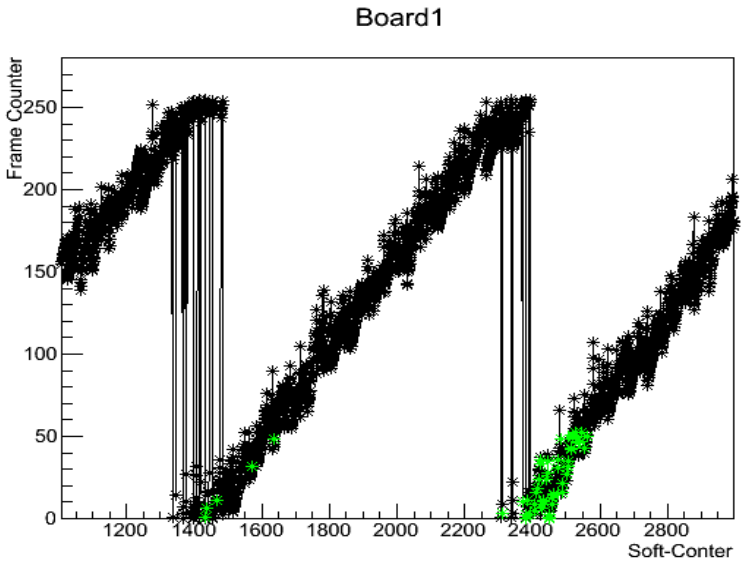


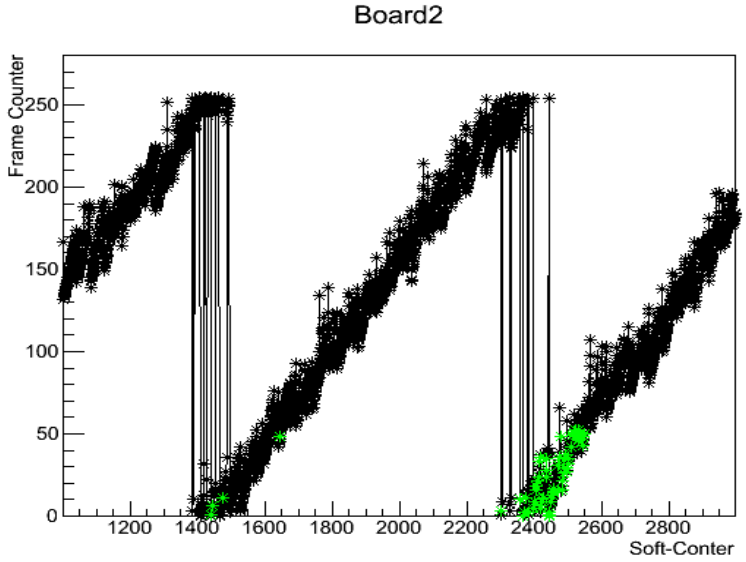

A new code was developed to find match between data set with the same frame counter taking into account disalignment between header counter

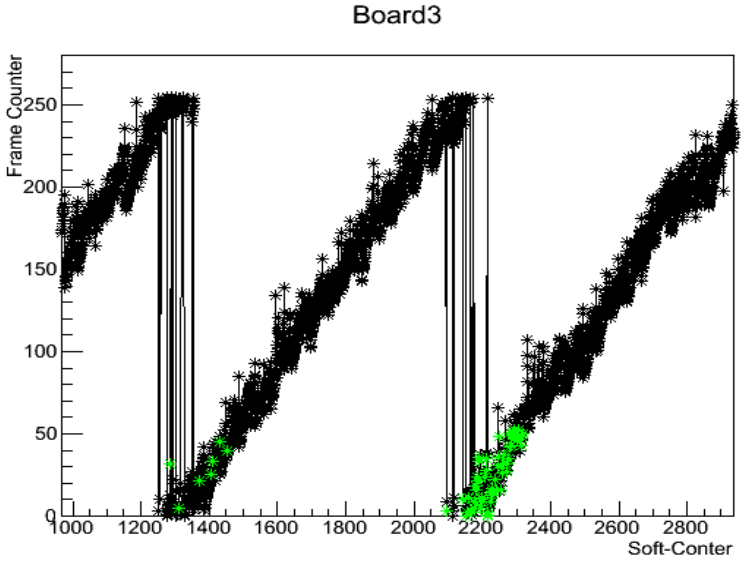
# Jülich Beam Test @ COSY

## New TimeStamp Matching Procedure



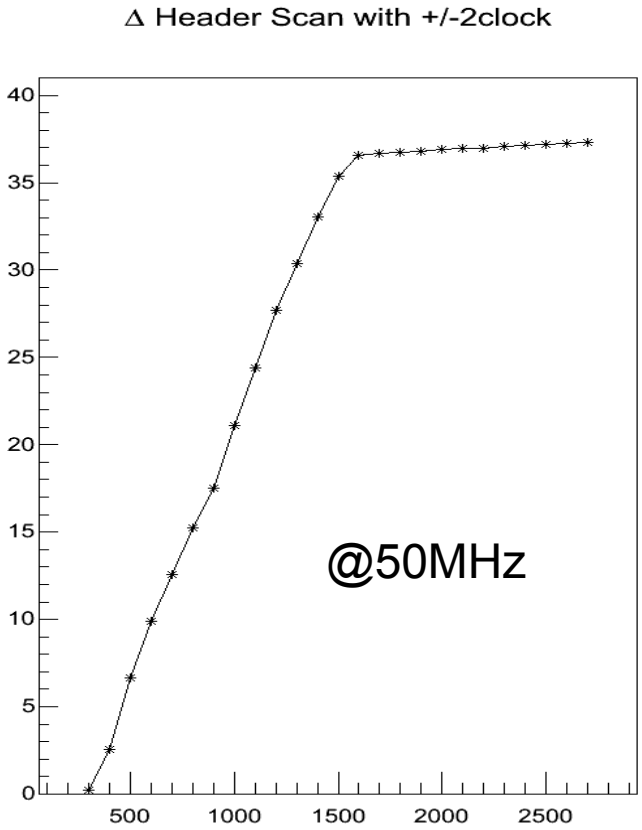



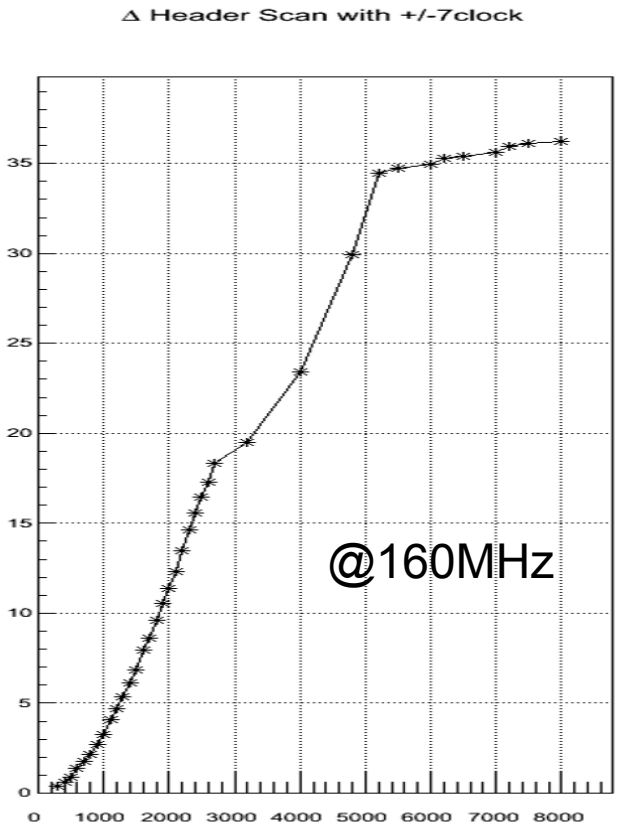
# Jülich Beam Test @ COSY

## New TimeStamp Matching Procedure

The new timestamp matching procedure should take into account different possible disalignment between boards:

- Clock Range: clock synchronization, comparator delay
- Header Counter disalignment



@50MHz

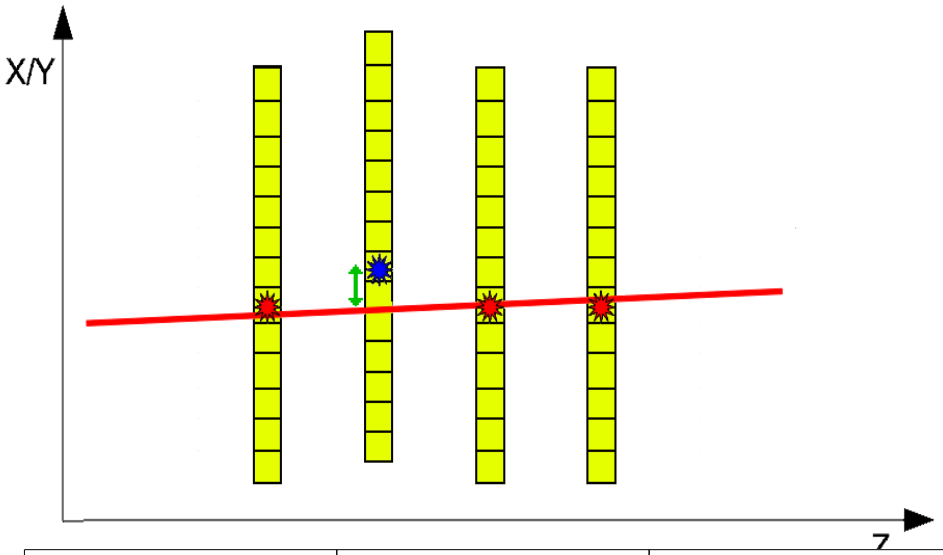
→ Track Selection +/- 2 clock cycle (40ns)
→ Header Delta 1600
→ Cluster Finding +/- 2*5 clock cycle (200ns)

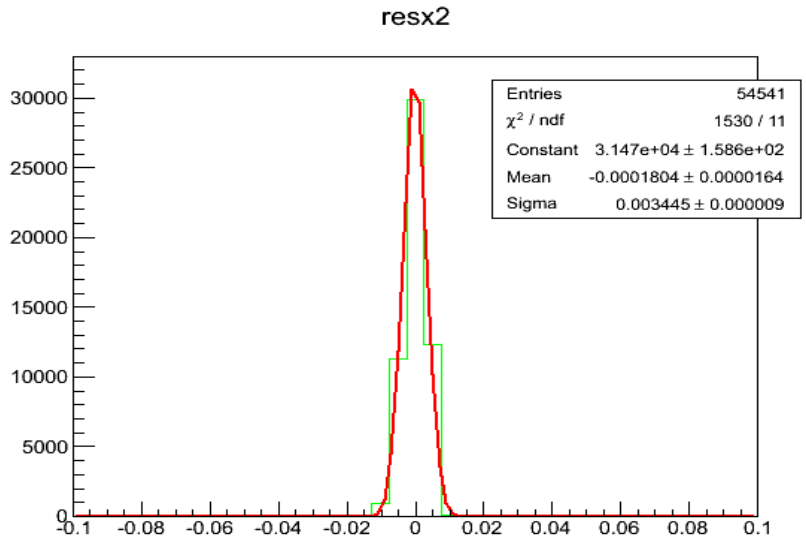
@160MHz

→ Track Selection +/- 7 clock cycle (~43ns)
→ Header Delta 5200
→ Cluster Finding +/- 7*5 clock cycle (200ns)

# Jülich Beam Test @ COSY
## Alignment

Alignment performed on the 50MHz data set.
Residual method: with one fixed board (either B3 and B0 have been evaluated giving similar results)



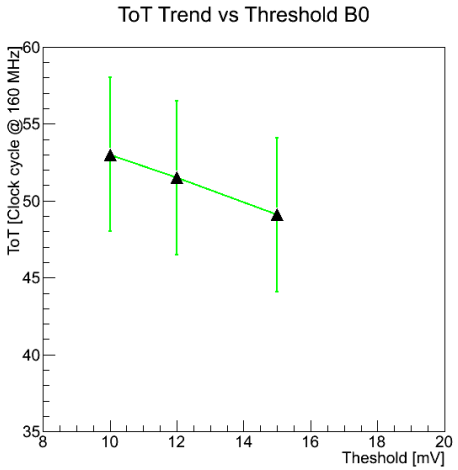

| Board | Δx [μm] | Δy [μm] |
|---|---|---|
| 0 | 56 | 50 |
| 1 | 36 | 32 |
| 2 | 31 | 31 |
| 3 | 52 | 50 |

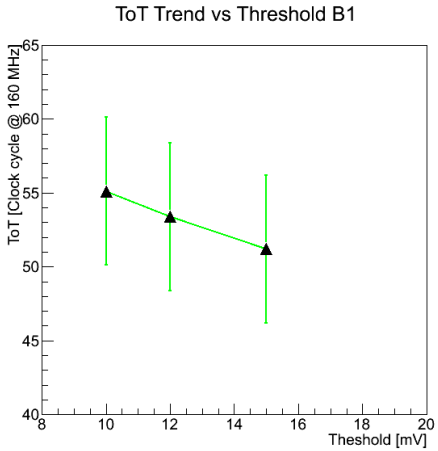
$$\sigma_{track} = \frac{\sqrt[4]{\sigma_0 * \sigma_1 * \sigma_2 * \sigma_3}}{\sqrt{4}}$$

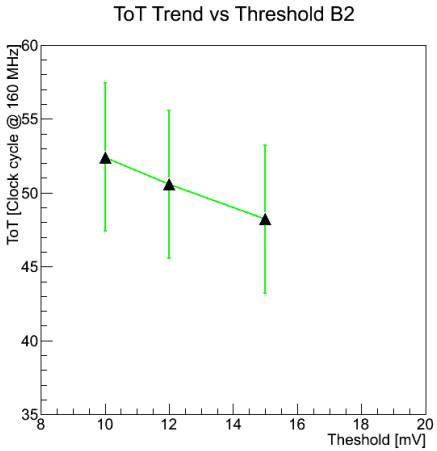
$$\sigma_x = \sigma_y \simeq 20\mu m$$

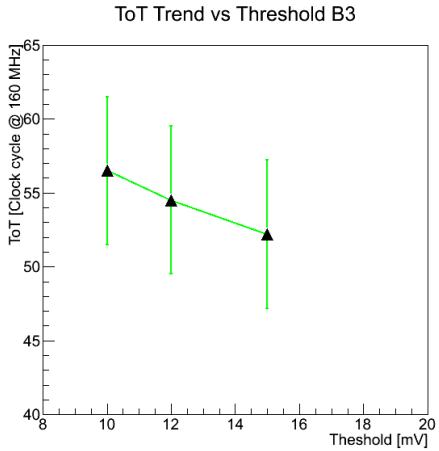
# Jülich Beam Test @ COSY

## Threshold Scan



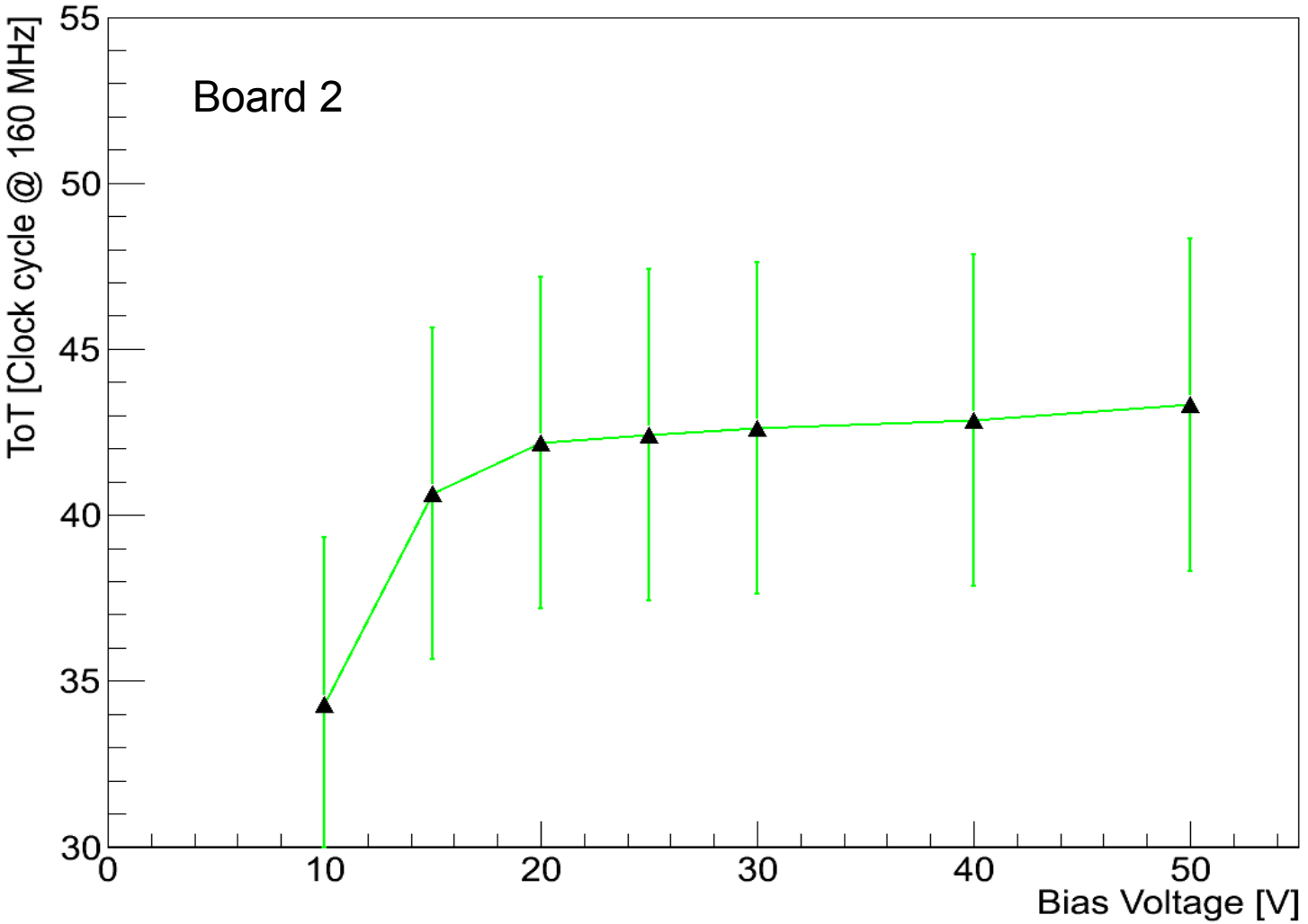

by Olave Jonhatan

| Analog Gain [mV/fC] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B0 | | | B1 | | | B2 | | | B3 | | |
| 79 | ± | 10 | 88 | ± | 11 | 91 | ± | 11 | 85 | ± | 15 |

| Vth [mV] | Voltage Threshold [e-] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B0 | | | B1 | | | B2 | | | B3 | | |
| 10 | 791 | ± | 100 | 710 | ± | 89 | 687 | ± | 83 | 735 | ± | 130 |
| 12 | 949 | ± | 120 | 852 | ± | 107 | 824 | ± | 100 | 882 | ± | 156 |
| 15 | 1187 | ± | 150 | 1065 | ± | 133 | 1030 | ± | 125 | 1103 | ± | 195 |
| 20 | 1582 | ± | 200 | 1420 | ± | 178 | 1374 | ± | 166 | 1471 | ± | 260 |
| 22 | 1741 | ± | 220 | 1563 | ± | 195 | 1511 | ± | 183 | 1618 | ± | 285 |

# Jülich Beam Test @ COSY

## Bias Scan



# Conclusions

DONE:

→ new timestamp matching procedure developed to face the absence of time reference

→ offline alignment performed

→ analysis of different scan data sets

WORK IN PROGRESS:

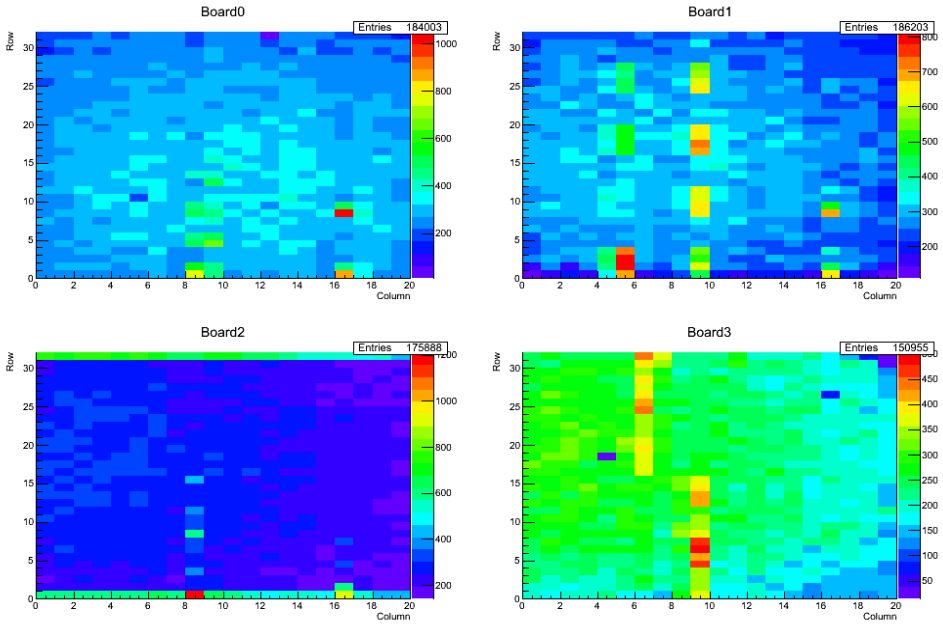
→ Efficiency evaluation as a function of Bias and Threshold Scan

→ Evalutation of the ToT in term of electrons

# BACKUP SLIDES

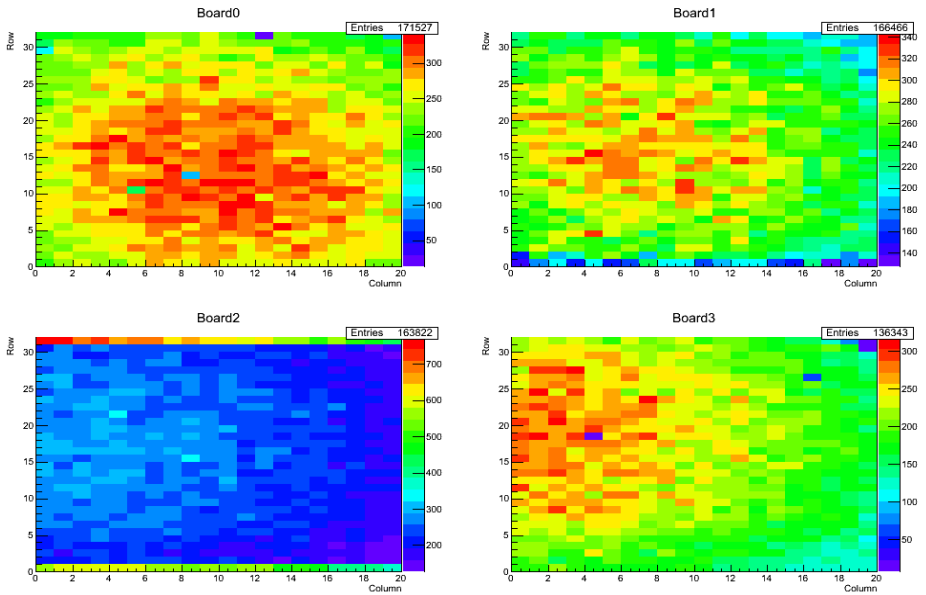
# Julich Beam Test @ COSY

## HIT MAPS

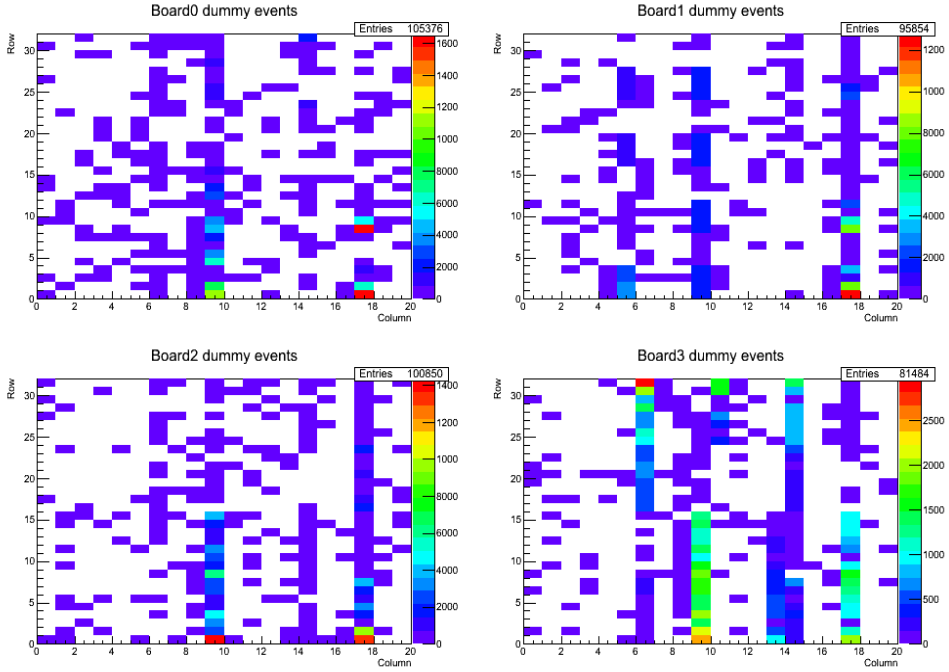



**@ 160 MHz**
**Rate 14 $10^3$ (~22hit per pixel/s)**
**50% of dummy**

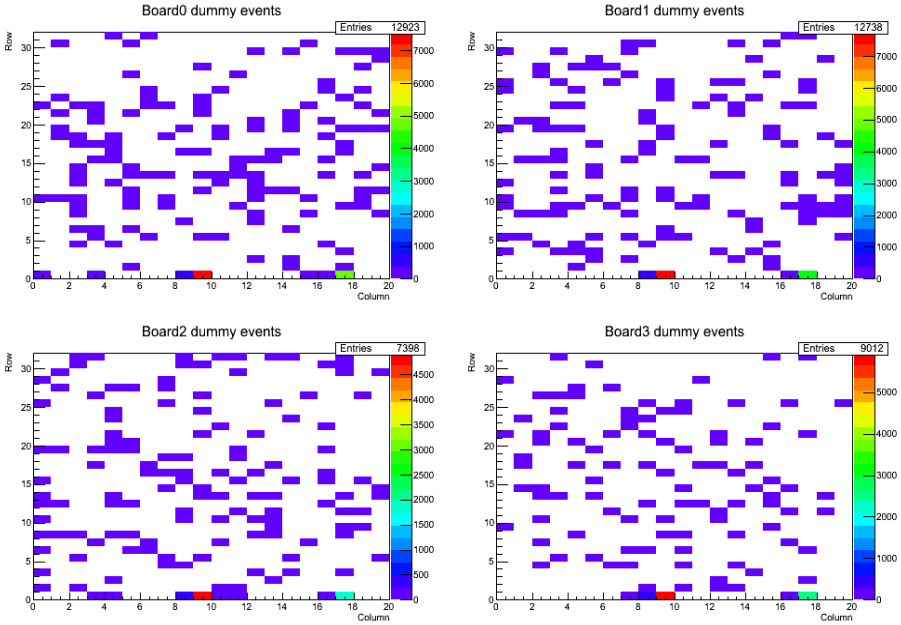
**@ 50 MHz**
**Rate 9 $10^3$ (~14hit per pixel/s)**
**8% of dummy**



# Julich Beam Test @ COSY
## DUMMY EVENTS




**@ 160 MHz**
**Rate 14 $10^3$ (~22hit per pixel/s)**
**50% of dummy**




**@ 50 MHz**
**Rate 9 $10^3$ (~14hit per pixel/s)**
**8% of dummy**