Langeswochende and Feiertag studies presents:

Possible Reasons for Efficiency Deficits

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A Raw Data Analysis

KEK, 4.10.2017

B. Spruck

Observations on Lowest Level – Overview

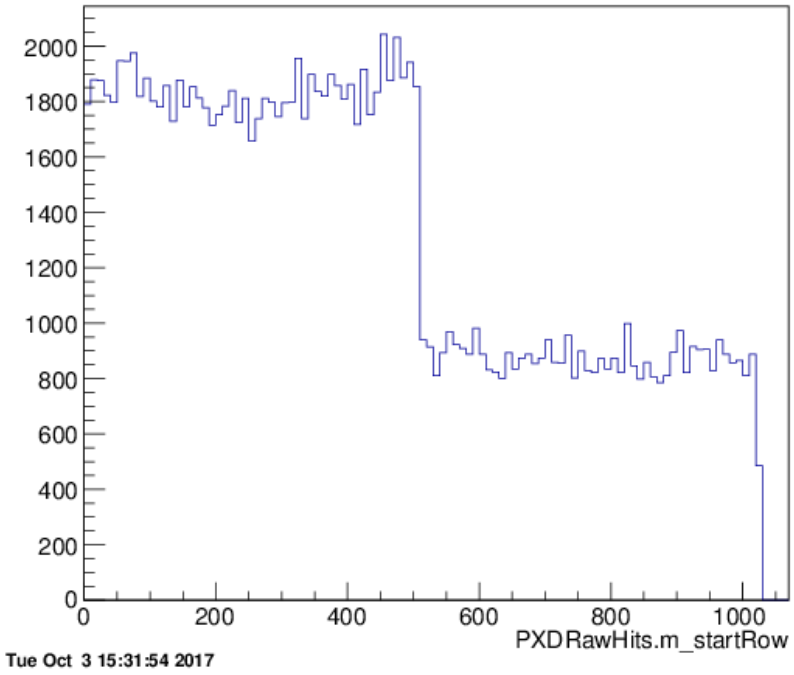
(none of them might be the real origin of the efficiency problem!)

- A few DHH header fields are not filled according to what we expect
  - (actually they have not been filled correctly since TB2016)
  - Thus no error/consistency check for this fields has been done
- DHH is not sending out information on “dropped” DHP frames (dropped because there were not hits in them).
  - We cannot judge afterwards if a frame contains no data or was not send for other reason
  - (reminder: second frame not send problem in PERSY phase)
  - This would be a promising candidate for efficiency problem.
- Additional DHP frames not belonging to this event
  - Clear indication that something is strange

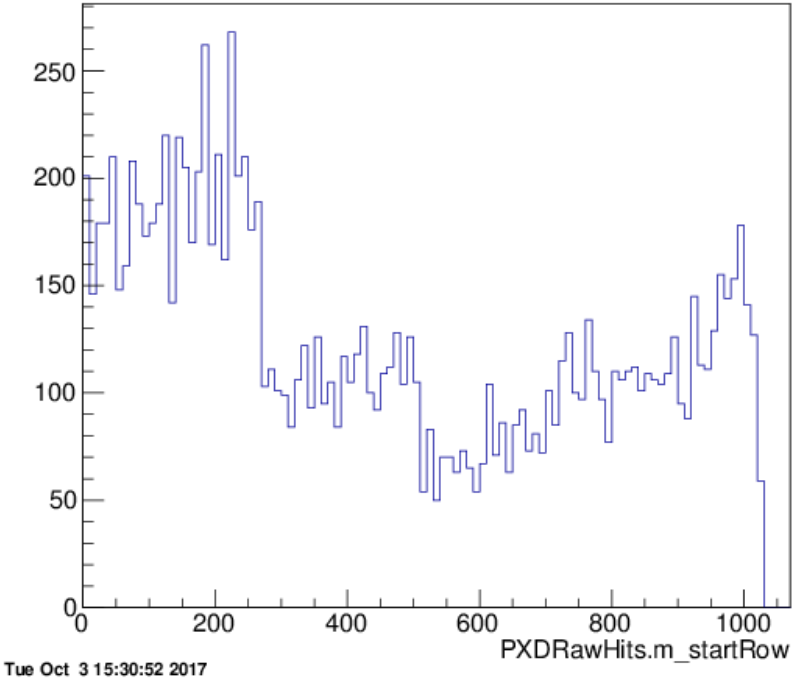
Header Fields 1

- Trigger Offset (aka “Row when trigger has happened” aka “Starting Row for frame readout”)
  - Expected: random distribution
  - Seen: random from 0-511 and 512-1023, with a large step at 511/512
- Seeing efficiency dependencies on the start row might give us hints on problems.

Run 176; events without framenr problem



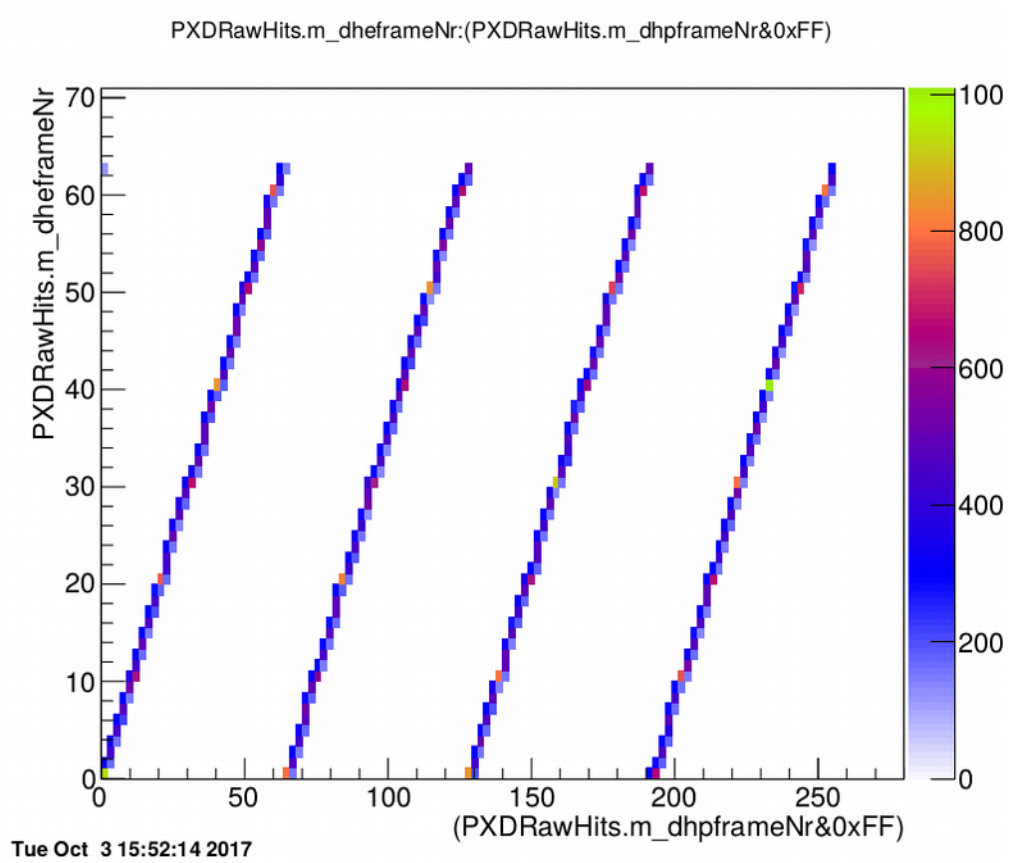
Run 176; events with framenr problem



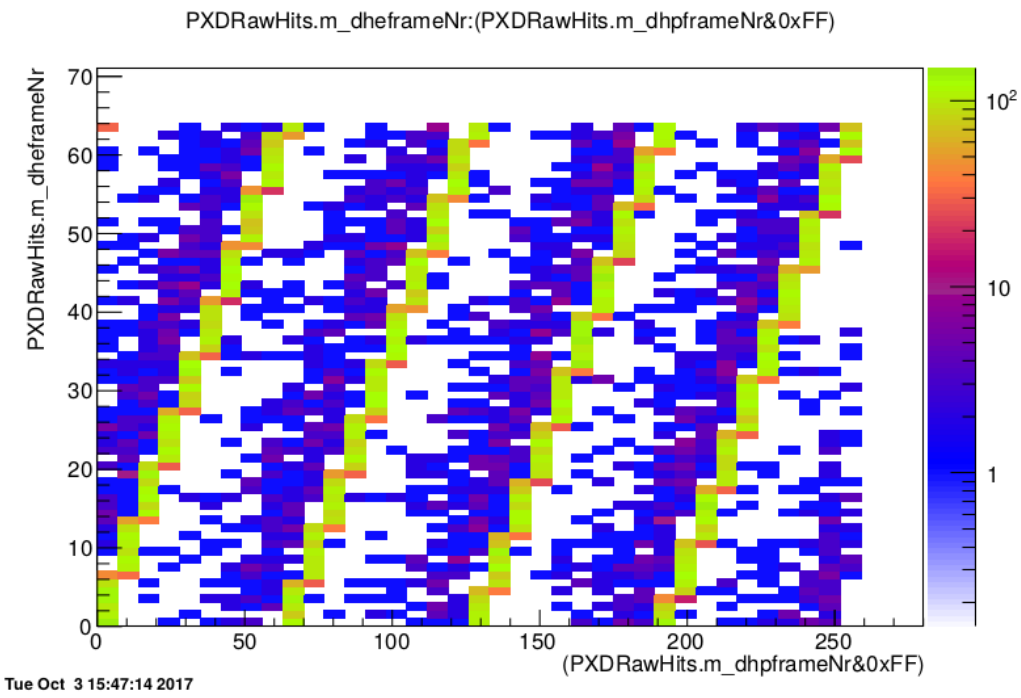
Header Fields 2

- DHE frame number vs DHP frame number
  - Expected: DHE frame number matches lowest 6 bits of DHP numbers (+1)
    - Correlation
  - Seen: Quiet some entries outside diagonal

events without frame nr problems



events with frame nr problems, log-z



Looking at Raw Data


```
Read Frame Len:       16  ... Frametyp: 1A3FE9A9 3 DHH_START Trigger $E9A9  (ID 23) StartRow $336, Frame $17
00005F36 4219E9A5
Read Frame Len:       12  ... Frametyp: 6A31E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A1010433: (ID $0,1), Frame $0433 $33
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A1030433: (ID $0,3), Frame $0433 $33
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A103043A: (ID $0,3), Frame $043A $3A
Read Frame Len:       12  ... Frametyp: 6A32E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A102043B: (ID $0,2), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A103043B: (ID $0,3), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A30E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A100043B: (ID $0,0), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A31E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A101043B: (ID $0,1), Frame $043B $3B
Read Frame Len:       16  ... Frametyp: 2230E9A9 4 DHH_END   Trigger $E9A9  (ID 23)
00480000 00000000
```

- Data structure correct, DHP frames inside DHE frame.
- Trigger Nr and DHE ID correct for all frames.
  - DHE Id in DHP frame not set (know problem; redundant information)
- Four DHPs (0-3) connected an read out (Chip ID)

Looking at Raw Data – cont.


```
Read Frame Len:       16  ... Frametyp: 1A3FE9A9 3 DHH_START Trigger $E9A9  (ID 23) StartRow $336, Frame $17
00005F36 4219E9A5
Read Frame Len:       12  ... Frametyp: 6A31E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A1010433: (ID $0,1), Frame $0433 $33
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A1030433: (ID $0,3), Frame $0433 $33
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A103043A: (ID $0,3), Frame $043A $3A
Read Frame Len:       12  ... Frametyp: 6A32E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A102043B: (ID $0,2), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A33E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A103043B: (ID $0,3), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A30E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A100043B: (ID $0,0), Frame $043B $3B
Read Frame Len:       12  ... Frametyp: 6A31E9A9 D ONSEN DHP Processed Trigger $E9A9  (ID 23)
A101043B: (ID $0,1), Frame $043B $3B
Read Frame Len:       16  ... Frametyp: 2230E9A9 4 DHH_END   Trigger $E9A9  (ID 23)
00480000 00000000
```

Possible problems:

- We see 1, 2 (as expected) and 3 frames per DHP
- The DHP frame numbers are not consecutive!
- The DHE frame number doesnt match DHP frame number

Suggestions

- Without redundant information, its hard to do low level checks offline
- Header field need to be filled to allow for versatile checks (e.g. dependencies on trigger offset)
- Don’t suppress empty frames. We do not care about a few extra bytes at the moment.
    - More important to be sure that we are sure no frame is dropped by whatever reason. If there is a reason to drop a frame, set error bits!
- Set designated error bits if anything is suspicious in an event, such that we can flag it for analysis.
- When we finally can read out sensor data @KEK, check data immediately for these troubles

And we see it before ONSEN, too …

```
Header Found.
Event Nr of Frames: 22
Read Frame Len:      20  ... Frametyp: 5823006F B CON_START Trigger $006F  (DHC ID 1)

Read Frame Len:      16  ... Frametyp: 182F006F 3 DHH_START Trigger $006F  (ID 2) StartRow $2CE, Frame $0E
00003ACE 539D26AD
Read Frame Len:     384  ... Frametyp: 2823006F 5 DHP_ZSD Trigger $006F  (ID 2)
A103EF89: (ID $0,3), Frame $EF89 $09
Read Frame Len:     380  ... Frametyp: 2820006F 5 DHP_ZSD Trigger $006F  (ID 2)
A100EF89: (ID $0,0), Frame $EF89 $09
Read Frame Len:     256  ... Frametyp: 2821006F 5 DHP_ZSD Trigger $006F  (ID 2)
A101EF89: (ID $0,1), Frame $EF89 $09
Read Frame Len:     280  ... Frametyp: 2822006F 5 DHP_ZSD Trigger $006F  (ID 2)
A102EF89: (ID $0,2), Frame $EF89 $09
Read Frame Len:    3520  ... Frametyp: 2823006F 5 DHP_ZSD Trigger $006F  (ID 2)
A103EF8A: (ID $0,3), Frame $EF8A $0A
Read Frame Len:    3076  ... Frametyp: 2820006F 5 DHP_ZSD Trigger $006F  (ID 2)
A100EF8A: (ID $0,0), Frame $EF8A $0A
Read Frame Len:    3268  ... Frametyp: 2821006F 5 DHP_ZSD Trigger $006F  (ID 2)
A101EF8A: (ID $0,1), Frame $EF8A $0A
Read Frame Len:    3624  ... Frametyp: 2822006F 5 DHP_ZSD Trigger $006F  (ID 2)
A102EF8A: (ID $0,2), Frame $EF8A $0A
Read Frame Len:      16  ... Frametyp: 2821006F 5 DHP_ZSD Trigger $006F  (ID 2)
A101EF8D: (ID $0,1), Frame $EF8D $0D FrNr ERROR EF8D EF8A
Read Frame Len:     596  ... Frametyp: 2821006F 5 DHP_ZSD Trigger $006F  (ID 2)
A101EF8E: (ID $0,1), Frame $EF8E $0E
Read Frame Len:      16  ... Frametyp: 2820006F 4 DHH_END   Trigger $006F  (ID 2)
1E1C0000 00000000
Read Frame Len:      16  ... Frametyp: 1A2D006F 3 DHH_START Trigger $006F  (ID 22) StartRow $2DB, Frame $18
000062DB 53C09529
Read Frame Len:    1012  ... Frametyp: 2A20006F 5 DHP_ZSD Trigger $006F  (ID 22)
A100F565: (ID $0,0), Frame $F565 $25
Read Frame Len:    1428  ... Frametyp: 2A22006F 5 DHP_ZSD Trigger $006F  (ID 22)
A102F565: (ID $0,2), Frame $F565 $25
```

(pattern generator data?)