JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN
JENNIFER
Belle II
Bundesministerium für Bildung und Forschung
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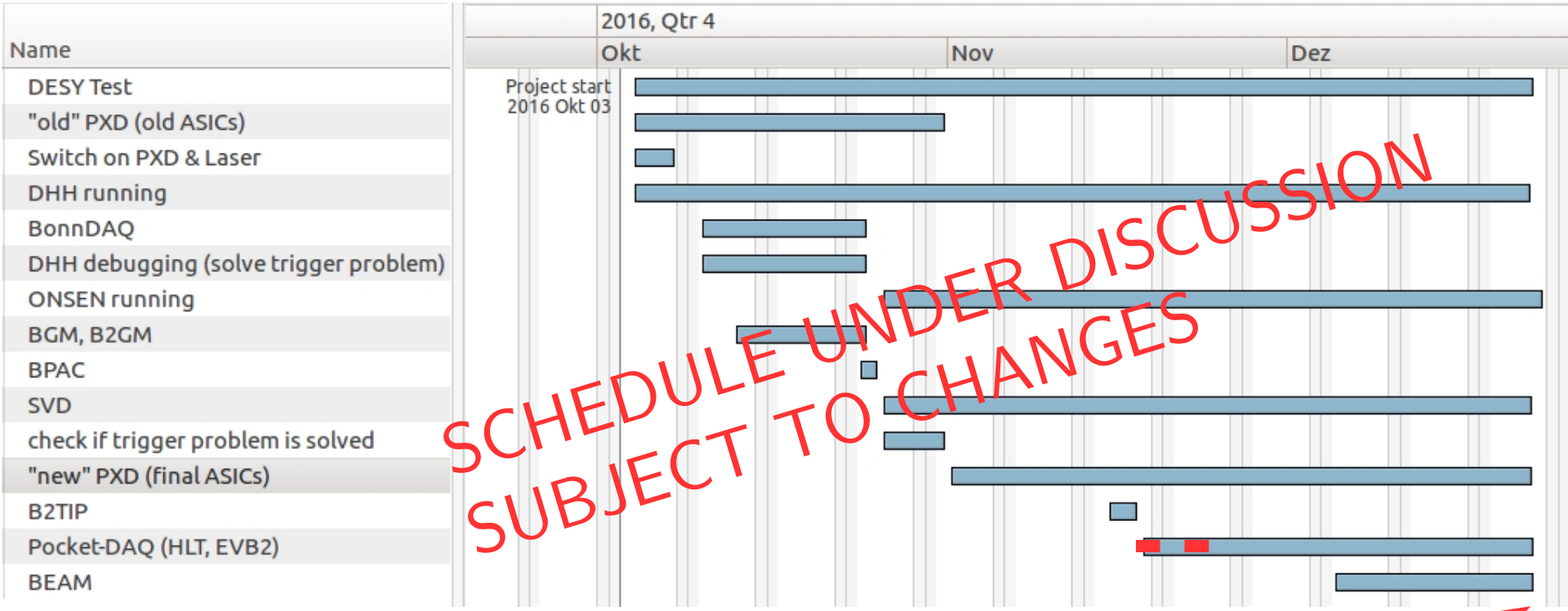
DAQ Integration Topics

DESY testbeam 12/2016, phase II (cabling), cosmic ray test @ KEK, „permanent“ setup, news from Novosibirsk

Sören Lange

10th VXD Workshop, Santander, September 14–16, 2016

Preliminary DAQ ScheduleDESY Test 12/2016
(input from DHH, SVD, ONSEN, KEK DAQ Group)



here stop 24.12.

01/2017 omitted, as not clear, if beam available

Basic dates, DAQ @ DESY 12/2016

04.10. (TUE) after german holiday	PXD module (old ASICs) and laser switched on	DHH + BonnDAQ
		Solve „–1“ trigger number problem
25.10. (TUE), after B2GM and BPAC	SVD arrives	Same DAQ as 04/2016 ?
	ONSEN arrives	
01.11.	New PXD module arrives (new ASICs)	
18.11. (after B2TIP)	Pocket–DAQ arrives	
		Try simplified re–mapping
05.12.	BEAM	

SCHEDULE UNDER DISCUSSION
SUBJECT TO CHANGES

Overall goals: get rid of „workarounds“
30 kHz with „small“ ROIs

PXD DAQ plan & milestones, DESY 12/2016

ONSEN	Same system as in DESY TB 04/2016
	ROI selection with small ROIs simplified re-mapping no change in data format !
	emulate KEK cable setup (LC optical instead of RJ45 copper)
	2 ROI selectors parallel (if 2 DHC connected)
DHH	NEW HARDWARE – optical transmitters DHPT–DHE – DisplayPort DHE–DHPT (7 mm vs. 9 mm ?) – move from VME to ATCA, ATCA carrier boards for DHC
	Test overlapping triggers (send part of data 2x)
	Test 30 kHz (factor 10 higher than 04/2016)
PXD	NEW ASICs DHPT 1.1 → 1.2 DCDB 4.1 (pipeline) → 4.2.x SwitcherBG v1 → v2 (?), depends on bumping
	DHPT clock, 65 Mhz → 76 MHz

Additional goals for testbeam (lower priority)

Check double triggers also for SVD ?
(190 ns double trigger resolution, 5 events pipelined ?)

Test run for PXD cluster-based data format

~~NEW VXDTF2 (if ready)~~, and test anti-crash mechanism on HLT
VXDTF2 will not be ready, see talk by Th. Lück

Compare DATCON and HLT/VXDTF efficiency

And: we should get a 1970‘s style paper protocol book
in 04/2016, many things were not written into the ELOG

„I don‘t have a grid certificate, so I cannot get the DESY account“
„I forgot the forward port number for the ssh tunnel“.
etc. etc.

ONSEN Tests (ongoing)

ONSEN Setup at KEK

Thomas Geßler (KEK, JSPS)

VME crate:
– 1 DHC w/ VME adaptor
– 1 FTSW2
– 1 FTSW3 (unused)
DHC/ONSEN slow control PC

uTCA shelf w/ ONSEN data generator
2-slot ATCA shelf (unused)

14-slot ATCA shelf w/ shelf manager
ONSEN merger: carrier v3.3. + 1 AMC v4
ONSEN selector: carrier v3.3 + 4 AMC v4
→ carriers w PS v1.3 and RTM v1.1
→ all with IPMC and MMC from Mainz
1 spare AMC v4, 3 spare AMC v3
5 spare MMC, 1 spare IPMC

NEW
sent from
Giessen
to KEK
(PXD shelf
is still in
China)

Preparation of DESY 12/2016: ONSEN Tests at KEK

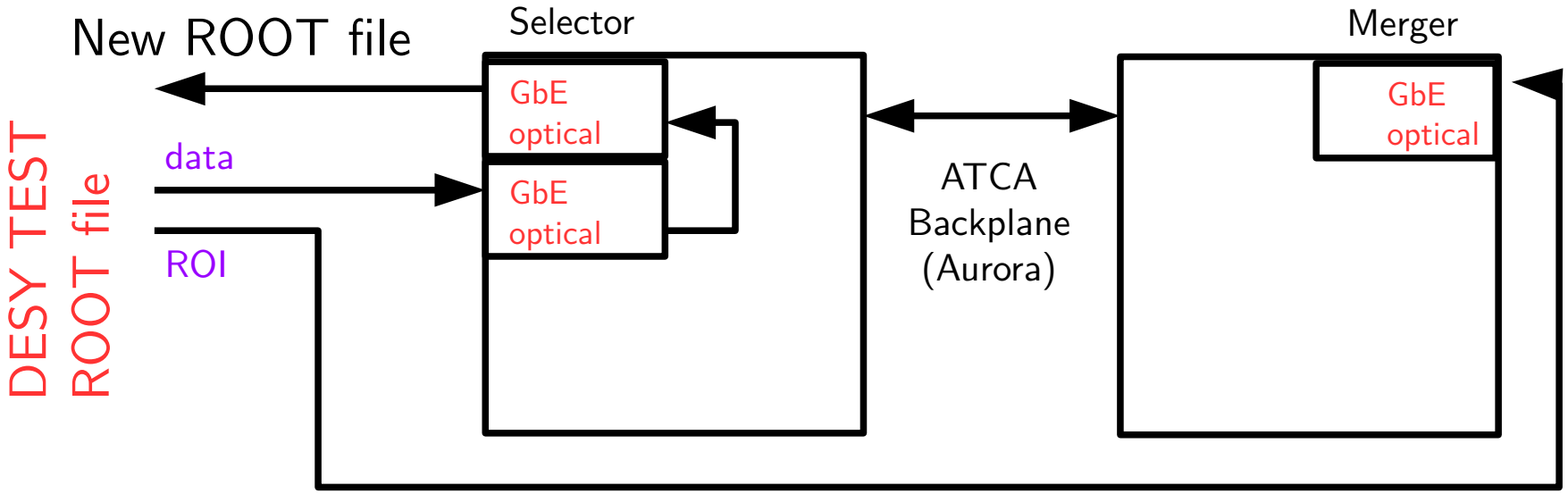
- Significant new ONSEN firmware:
  input data checks/sanitization („data sniffers“)
  – protection against wrong data formats from e.g. DHC
  – new ROI–packet data format (HLT–ONSEN)
- integration tests with DAQ group (planned for this week)
- MERGER now has 8 backplane output channels
  (for ROI distribution),
  but link problems on carrier boards
  (presently link speed reduced to 1.5625 Gbps)
- Improvement of ONSEN auto-programming mechanism/bootloader
- IPMI-related tests w/ Mainz
  (stopped now, no ATMEL programmer)
- JSPS fellowship will end 10/2016
  many planned results not achieved due to lack of hardware
  $\rightarrow$ final report at BPAC

Thomas Geßler (KEK, JSPS)

Preparation of new DESY test: Onsen tests at Giessen

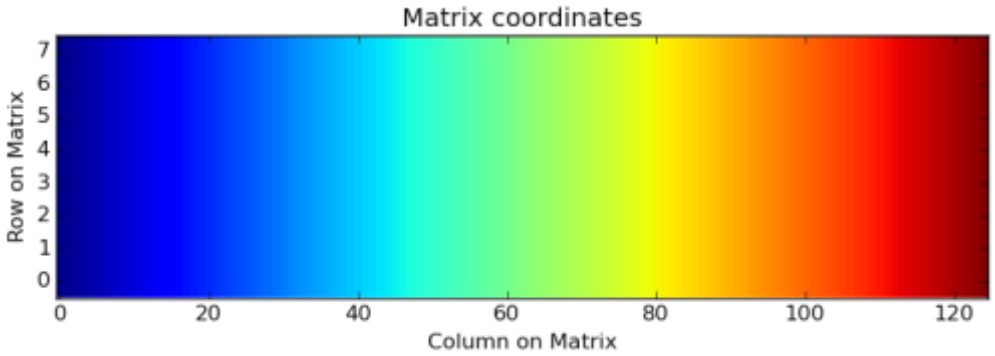
Klemens Lautenbach

- Test system: online re-processing of DESY data with small ROIs (debugROIs were written into the data stream)
- See talk by Klemens
- Tests will continue in September/October

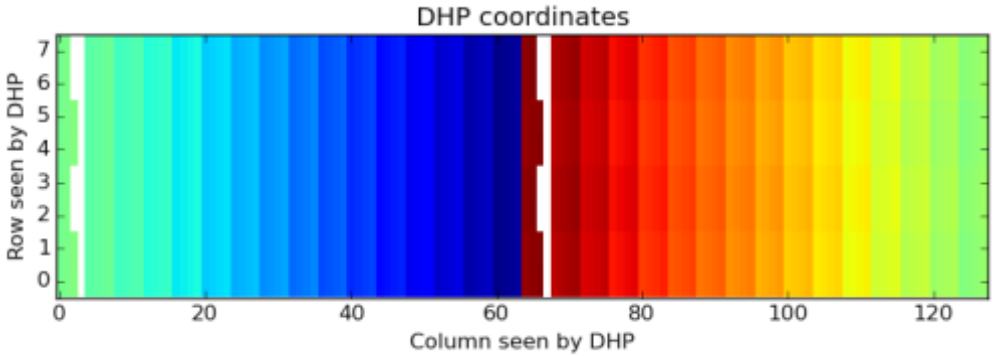


RE–MAPPING

PXD re-mapping



Hybrid–4,5, EMCM
DESY 2014

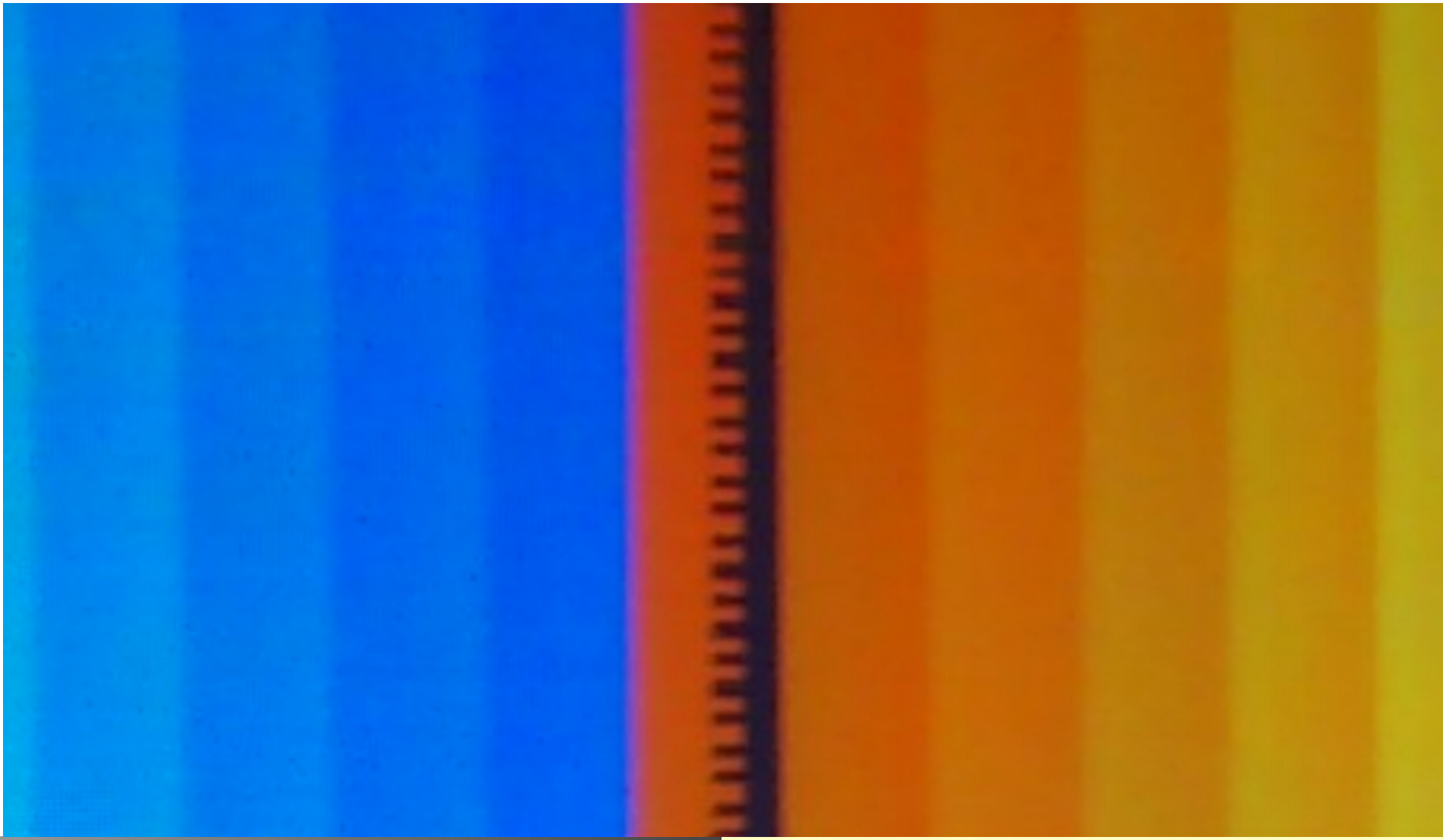


PXD9
DESY 2014

- mirrored per 4 columns
- then mirrored per 64 columns
- 250 vs. 256 pixels
- different for PXD layer 1 and layer 2

see talk by Florian Lütticke
Seeon 2016

Re-mapping: there is one column alternating in DHP ID row-by-row



PXD re-mapping: reminder

- DESY 04/2016:
  - workaround on HLT
    ROIs have minimum size of 4 x 62 (1 gate and 1 DHP IP)
    „large“ ROIs
    in the „golden“ run # 279 w/ online ROI selection
  - all other runs have debugROIs
    „small“ ROIs
    these can be smaller than 4 x 62,
    and were written into the data
    → used by Klemens in online „re-processing“ @ Giessen

- DESY 12/2016, decision by ONSEN and DHH groups:
  simplified re-mapping, proposed by Florian Lütticke (Bonn)
  (in firmware on DHE or Onsen)
  DATA FORMAT WILL NOT CHANGE

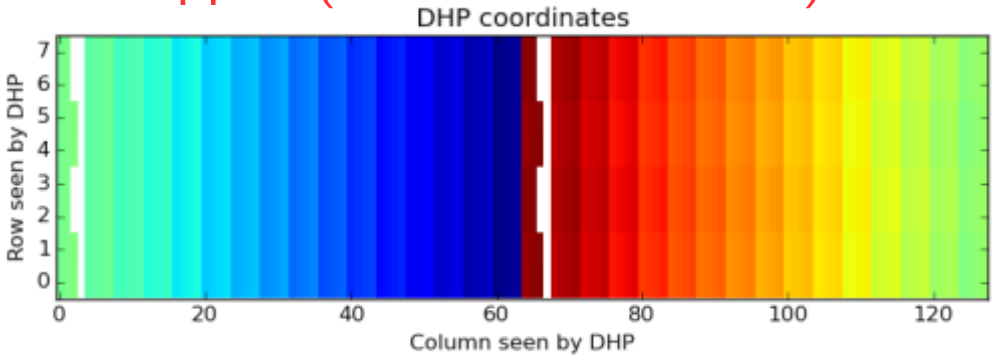
Simplified re-mapping
Proposed by Florian Lütticke (Bonn)

DHP = 1,3
[row, 64*dhp + col_in_dhp]
->
[row ^ 0x2, 64*dhp + (((col_in_dhp ^ 0x3c) + ((row & 2)>>1)%64))]

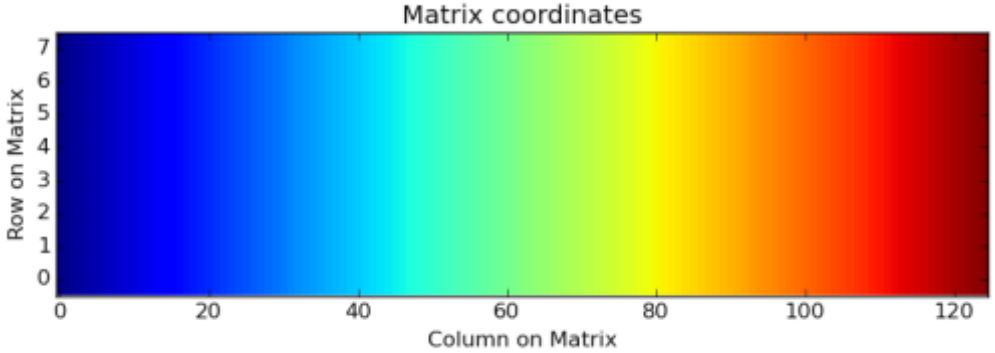
DHP = 2,4
[row, 64*dhp + col_in_dhp]
->
[row, 64*dhp + col_in_dhp ^ 0x3c]

no change of DHP_ID required
no LUT (lookup table) in BRAM required
Could be implemented on DHE or ONSEN
→ we prefer ONSEN (to have control)

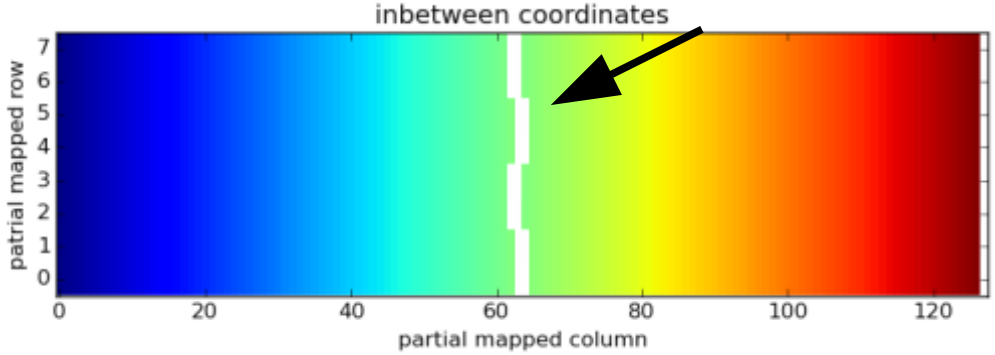
unremapped (as it comes in data)



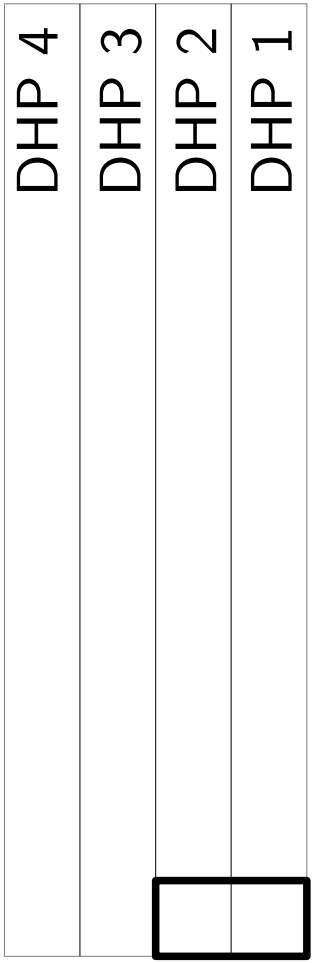
full remapping



simplified remapping



price to pay:
missing areas



Florian Lütticke (Bonn)

What about PXD CLUSTER FORMAT?

- clustering can be done offline even with hit-based format
  only one motivation for online: „cluster rescue“
  slow pions with high dE/dx, not creating a ROI
  → is probably a future project anyway
- why cluster-based format is „easier“ for DHC and re-mapping ?
  DHC data streams are ordered according to DHP ID
  re-mapping implies (sometimes) calculating new DHP ID
  → DHC needs to strip data, re–capsulate, etc.
  → very difficult in hit–based format
  → cluster-based data format writes new headers anyway
  here new DHP ID can simply be added
- will increase data size (no compression, same hits, only re-ordered)
  - more headers (1 per cluster, not 1 per DHP ID)
  - worst case: 1-pixel clusters, factor 2 more data
- re-mapping „breaks“ clusters
  1 cluster with 2 different DHP ID will split into 2 clusters
  → needs offline „cluster recombination“ (not existing yet)
- Proposal: short DHE clustering test run with ONSEN bypass
  at end of beamtime (for checking basf2 unpacker etc.)

„PERMANENT“ SETUP

- DESY HERA west hall (just next to ex–HERA-B)

- 2 stages
  - 2 PXD + 4 SVD system
    begin: after testbeam (01/2017?)
    end: maybe 06/2017
  - PXD half-shell commissioning
    (PXD schedule B2GM 06/2016
    → PXD ready by 07/2017,
    ship to KEK by 11/2017)
    begin: 07/2017
    end: 10/2017

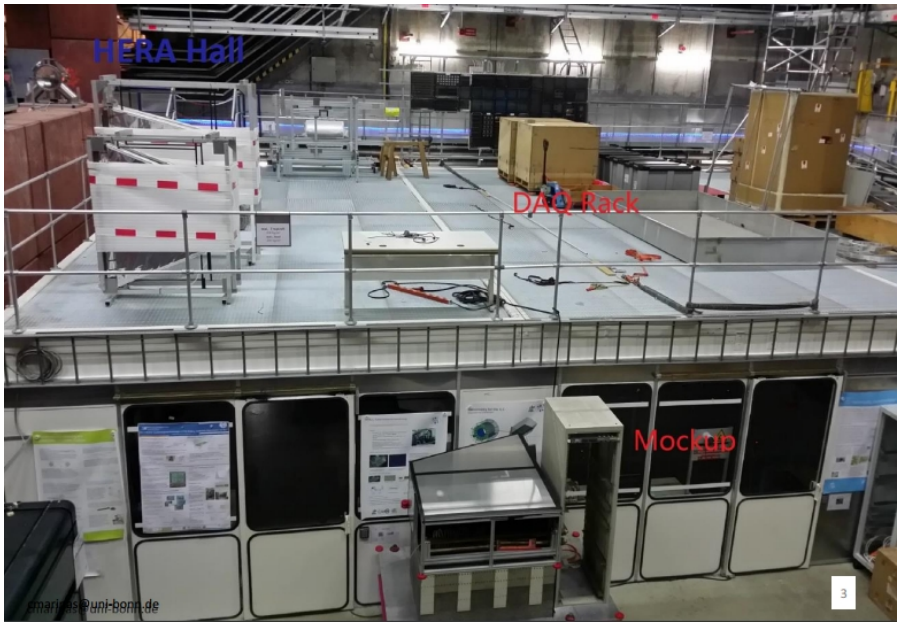


Foto: C. Marinas

- is a problem
  - not sufficient ONSEN hardware to support multiple test sites
    at Giessen, DESY, KEK (≥1.05.2017), MPI (pre-cosmic ?), ...
  - custom requires that <u>all</u> ONSEN hardware arriving will be shipped again to Japan („closed box“ with identical inside)
    → nothing can remain in Germany

Phase 2, cables

- ONSEN/DATCON are in EHUT 1F, Rack A5 & A6
- All phase 3 cables will be installed even before phase 2
- All KEK fibres will be installed by a japanese company, kindly coordinated by Katsuro Nakamura–san
- Fibres: multi–mode, duplex, 50 um core, OM3 → color „aqua“, not orange! halogene free, flammability grade IEC 60332–1

Negociation w/ company already ongoing, basis is Katsuro–san‘s specification v2.1
New, changed DHH position has only minor impact (anyway DHH patch cables required!)

		paid by
ONSEN–EVB2	optical	KEK (already existing)
HLT–ONSEN	optical	KEK (already existing)
DHC–ONSEN all LC–RJ45 converters 50% of QFSP converters for DHC	optical	Giessen
SVD–DATCON	optical	Bonn (?), maybe KEK ?
SC	optical	(spare of DHC-ONSEN)
BonnDAQ	Copper (CAT6, RJ45)	KEK (FY2016 funds!)

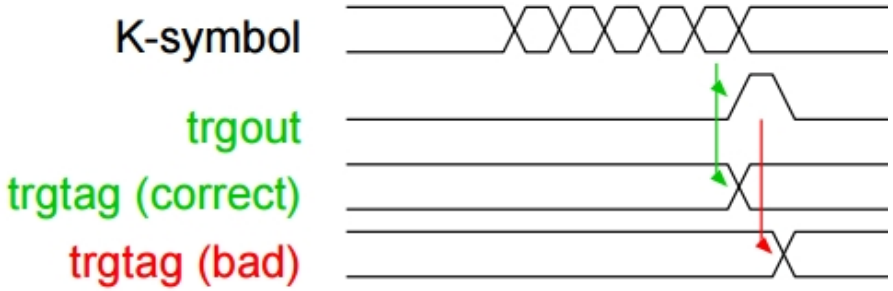
Phase 2, other topics

- Injection trigger → not prepared yet
  (it means: GDL bit with previously discussed timing constraints)
  Iwasaki-san promised to spend some work on it
  phase I → all BEAST I detectors were untriggered
- Integration of BEAST II into DAQ not clear yet (Itoh–san)
  PXD, SVD are triggered → record by DAQ
  FANGS, CLAWS, PLUME are untriggered → record by EPICS
  → two different data streams
  should be matched later by timestamps
  similar to VXD and telescope in DESY TB (which used FTSW→TLU interface for providing the timestamps)

NEWS FROM NOVOSIBIRSK TRIGGER/DAQ WORKSHOP

NEWS FROM NOVOSIBIRSK

- FTSW
  - Nakao–san confirmed that „–1“ trigger offset problem should be solved w/ firmware b2tt-0.48 (2016.06.29)
  - requires verification, but maybe not possible before 12/2017 @ DESY? (not possible at KEK, as only DHC dummy data generator available)



- EVB2
  - Info from Yamagata–san: switch for EVB2 must be purchased in FY2016 (KEK funds)
    <u>32 cables w/ 21.8 MB/s (each cable) is present default solution</u>
    1 cable w/ 10GbE w/ 700 MB/s is future solution
    final decision would require test with 8 Onsen carrier boards
    ($\rightarrow$ not available yet, as hardware still in China)
  - Interesting news: ONSEN is not the main sender into EVB2

	Input data rate into EVB2
EVB1	$\leq$2000 MB/s (SVD and ARICH are $\geq$50%)
HLT	2000 MB/s
ONSEN	700 MB/s (worst case, 3% PXD occupancy)

NEWS FROM NOVOSIBIRSK – DQM and ALARMS

- New basf2 DAQ error counters will be part of DQM
- DQM needs decoding/unpacking of data
  → can only be behind EVB2 (e.g. express–reco)
- There are 2 DQM:
  1.) basf2–DQM, e.g. on EVB2, express-reco, after unpacker
  2.) EPICS–DQM
  can only run after basf2-DQM
  needs a sending mechanism from EVB2 to EPICS
  will show s.th. 1-2 min after basf2–DQM
- Alarm in EPICS–DQM ?
  Proposal by Michael/Klemens: EPICS-IOC directly on EVB2 ?
  discussed in Novosibirsk:
  preference by DAQ-group is alarm mechanism by Konno-san
  (already prepared for basf2)
  → EPICS will get alarm by NSM2–EPICS bridge, Nakao-san volunteered
- Q: Can error counters be send to EPICS, too?
  argument by Nakao–san:
  why we need error counters 2x? (in basf2, and 1–2 min later in EPICS)

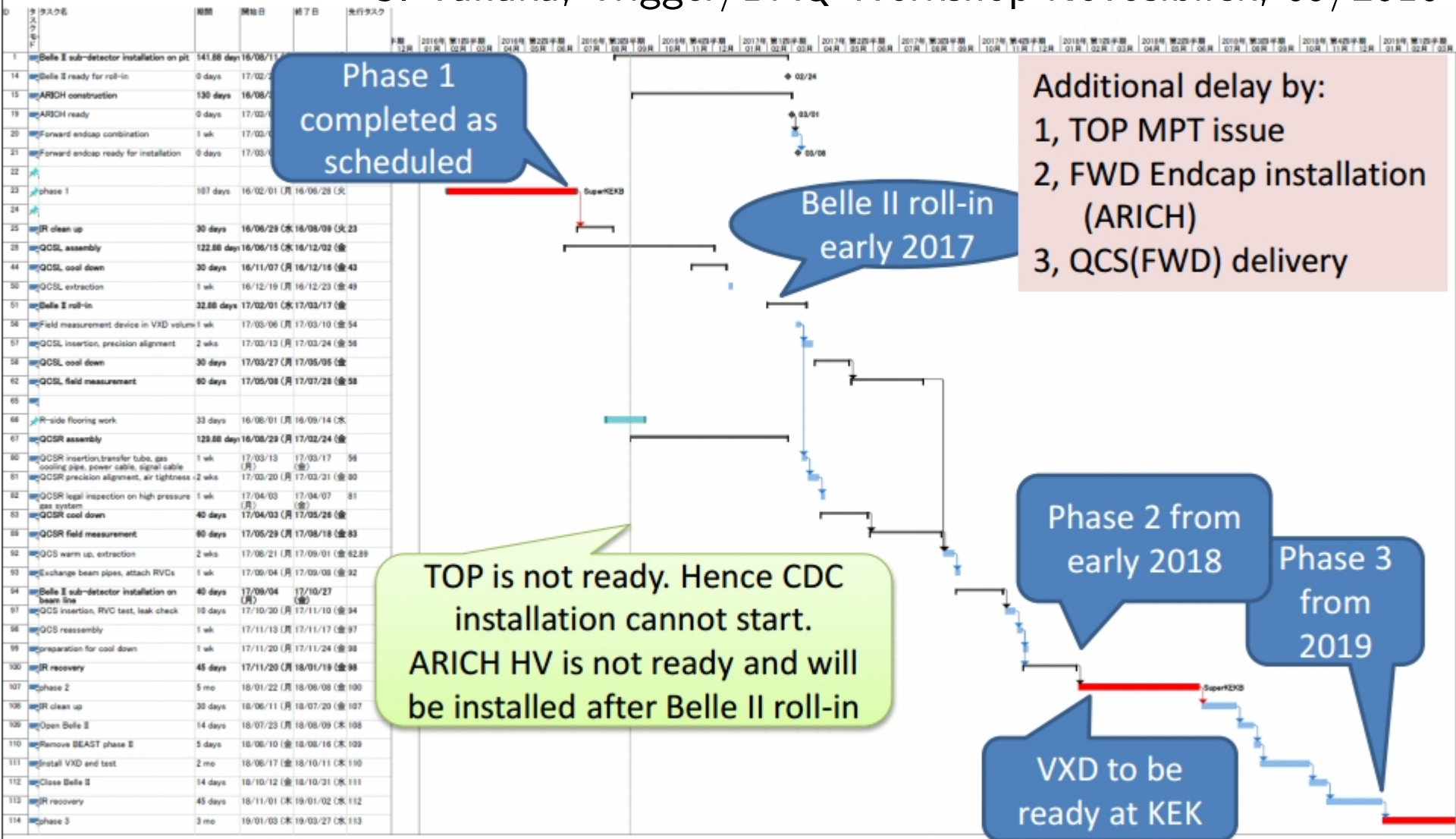
NEWS FROM NOVOSIBIRSK and follow-up: DESY 12/2016 vs. global DAQ schedule

- Info from Itoh-san
  japanese colleagues can stay ~3 weeks
  (~2 weeks per person, individual)
  constraints: work at KEK and budget
- presently strong preference (Email by Itoh–san, 13.09.2016)
  – arrive 1 week before beam (~28.11.), connect pocket-DAQ
  – then stay 1–2 weeks into the beamtime for 30 kHz test
- if not final ASICs
  → beamtime loses important conditio–sine-qua-non before it starts
  → in such a case
  <u>(only) remote support from DAQ group</u>

COSMIC DATA TAKING

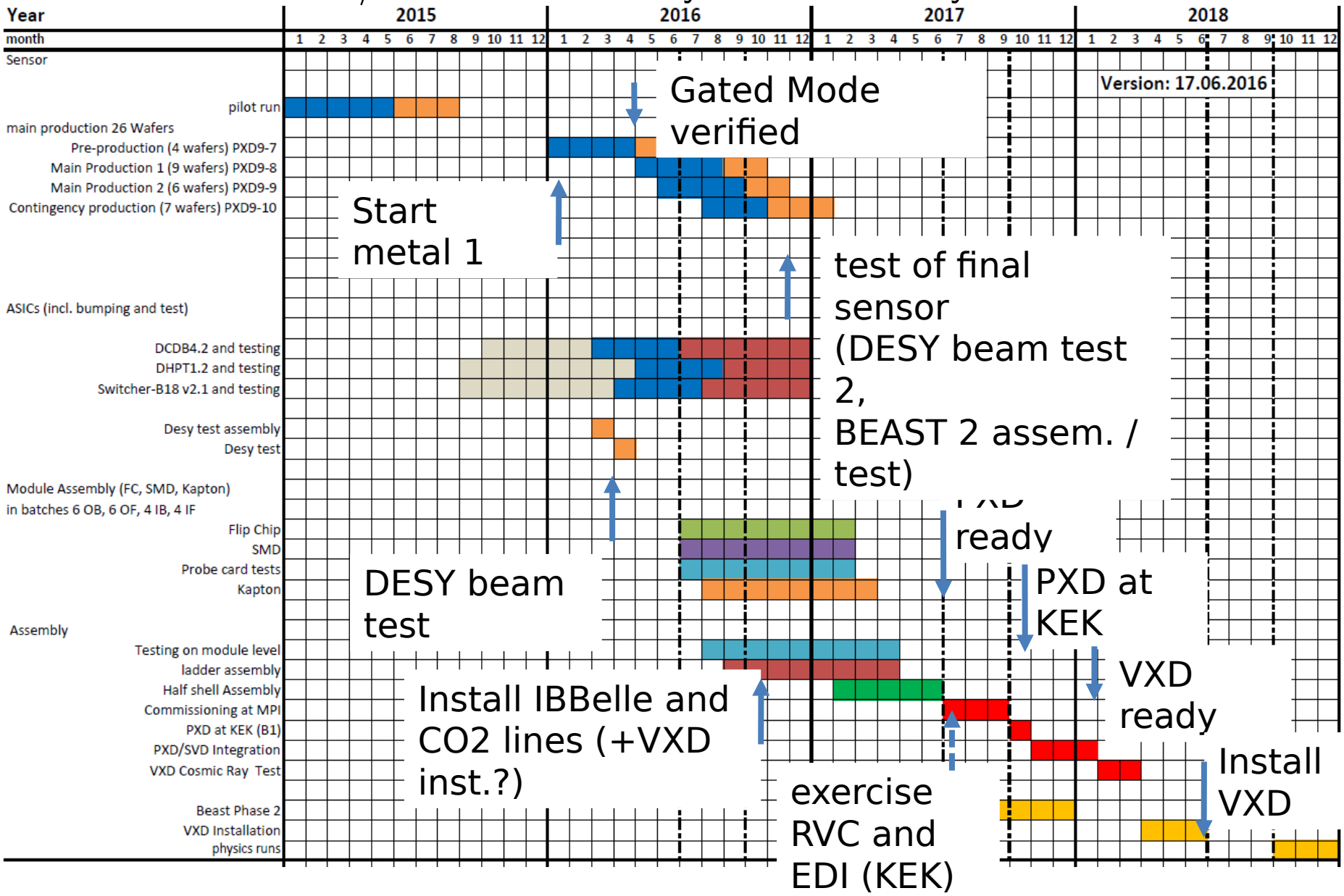
Schedule (possibly, but it will be decided in next B2GM)

S. Tanaka, Trigger/DAQ Workshop Novosibirsk, 09/2016



PXD - Schedule and Milestones (updated)

Version 06/2016 – not clear yet, if shifted by +3 months



VXD cosmic data taking

- According to new, preliminary schedule
  02–06/2018
  → now 5 months parallel w/ phase II
  (JENNIFER secondments, but remember: 2018 is last year)
- VXD will be installed at Tsukuba B4,
  ONSEN and DATCON will be at EHUT F1
- for ONSEN, a 2-slot shelf (for phase 2)
  and a 14–slot shelf (for cosmics) operated at same time
- Not decided yet:
  - where to put DHE/DHC for cosmic run?
    maybe two additional 14-slot ATCA shelfs at B4, near VXD?
    (one for BW, one for FW)
    other TUM shelfs will probably already be installed (top of Belle)
  - we need 32 optical additional fibres temporarily from B4 to EHUT F1
    (maybe L~20 m)
    can we use the cheaper, orange fibres here?

RESULTS FOR BPAC

Results DESY testbeam 04/2016 for BPAC

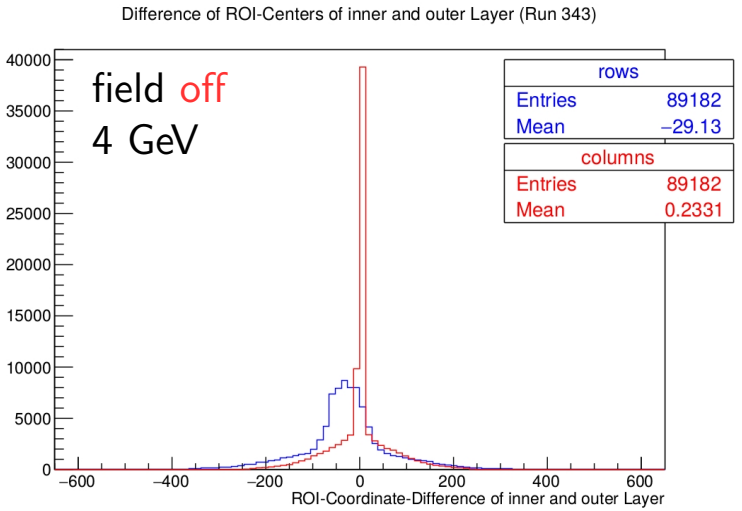
3 kHz full DAQ chain
→ factor 30 higher than 2014

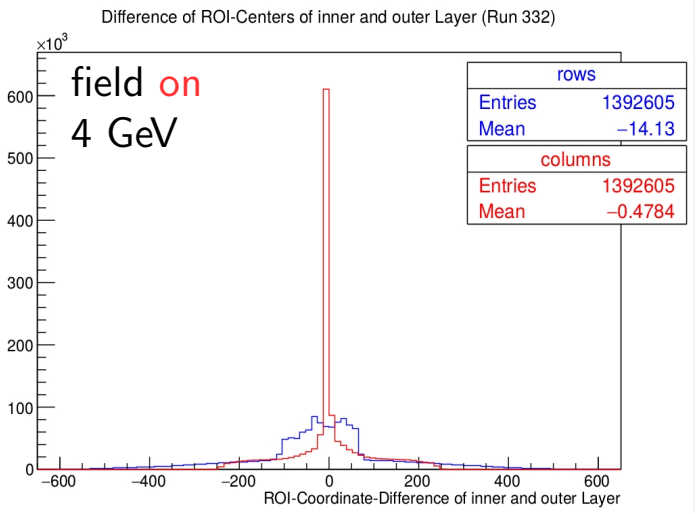
„Golden“ run # 279
1.15 M events w/ online ROI selectionn
no error, but „large“ ROI size
(w/o re–mapping)

2 PXD layers
→ correlations between
ROI(layer 1) and ROI(layer 2)

secondary target
→ multiple ROIs per 1 layer (~5 %)

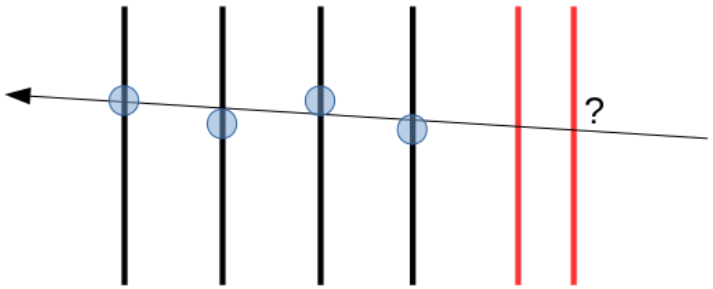
18.9 M events (of total 101.1 M)
w/ high quality
(but „–1“ PXD/SVD trigger offset)

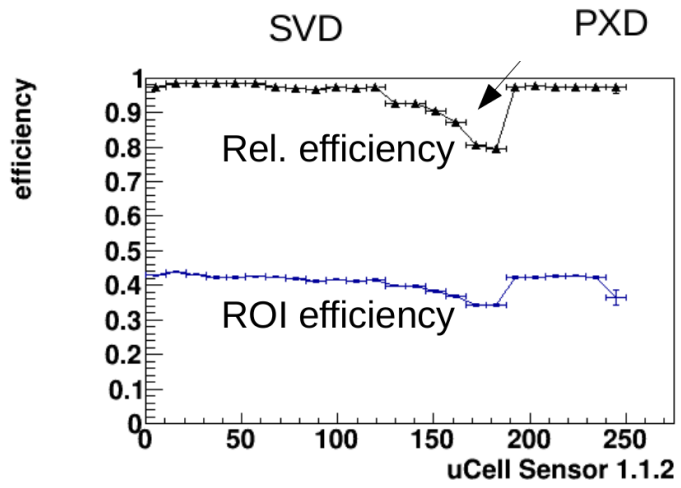




Efficiency problem was solved

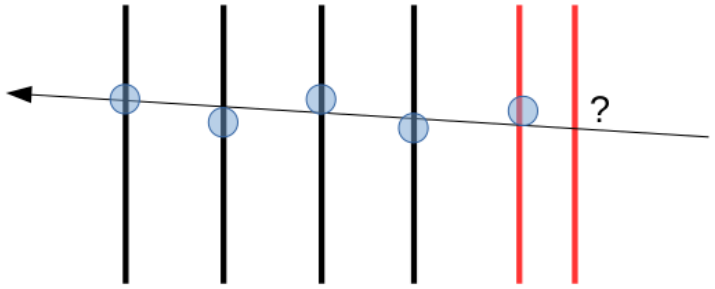
ROI efficiency
(better: hit matching efficiency)

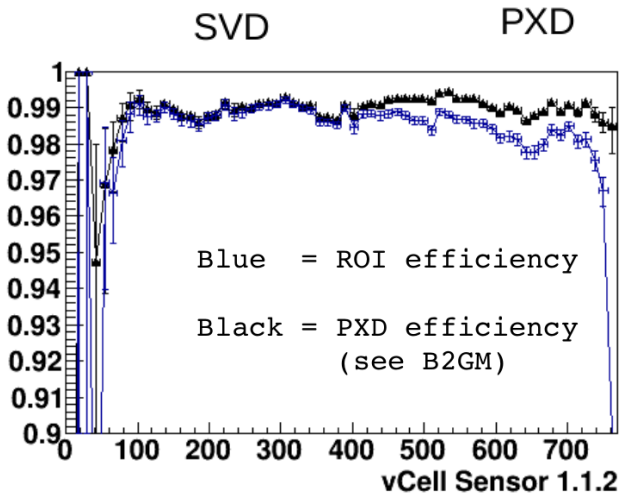




Benjamin Schwenker, B2GM 06/2016

Relative efficiency



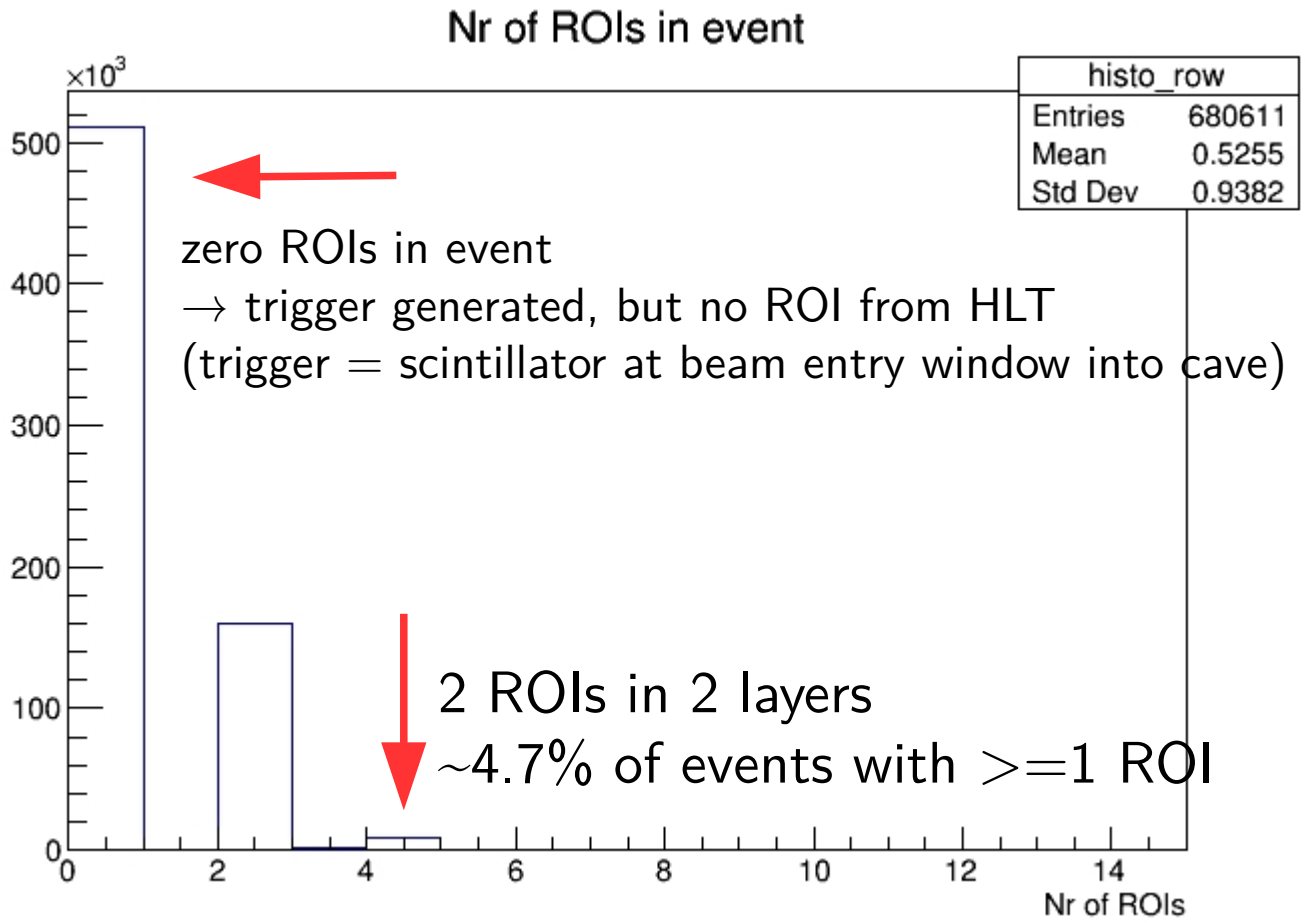


Björn Spruck, TB analysis meeting, 12.07.16

Problem was: „–1“ PXD/SVD trigger offset correction was applied **2x**

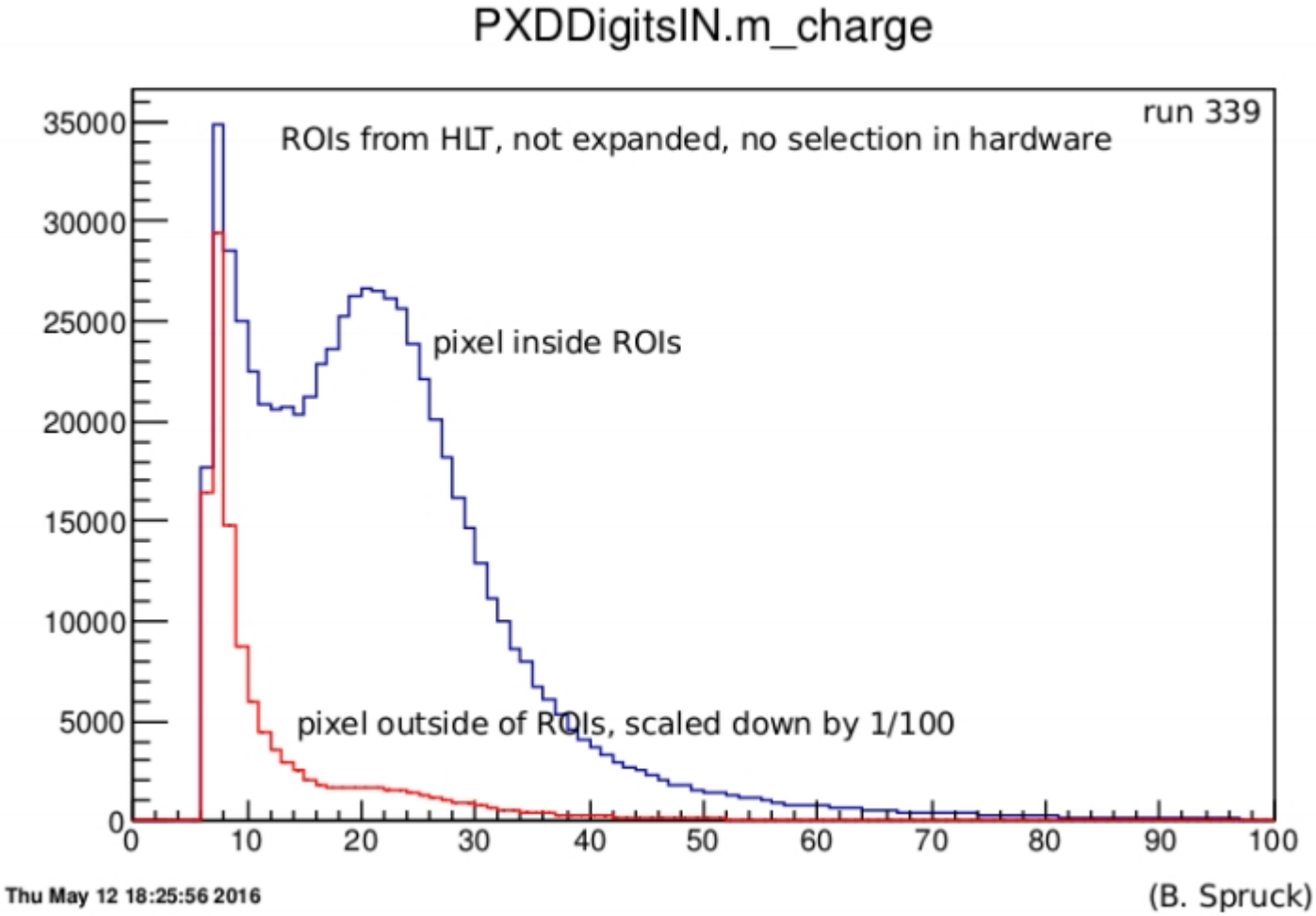
Multiple ROIs per 1 PXD layer

5 mm Pb target to generate secondaries (run 339)



Björn Spruck

ROI offline study with secondary target
(run 339, selection was not performed online, but ROIs were stored offline)



Reduction in run # 339
(w/ multiple ROIs per event and per layer)

680.611 events
6.420.183 pixel hits
373.548 ROIs
365.278 pixel hits inside ROIs

} REDUCTION FACTOR 17.6

(preliminary, for BPAC)

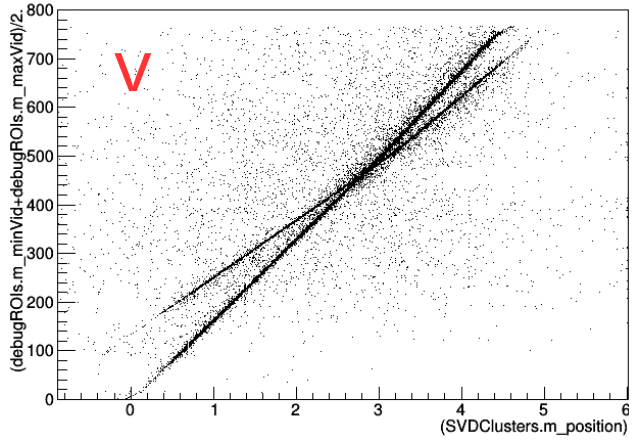
Contains a factor 1.8
(there are events with zero ROIs, but HLT „yes“)

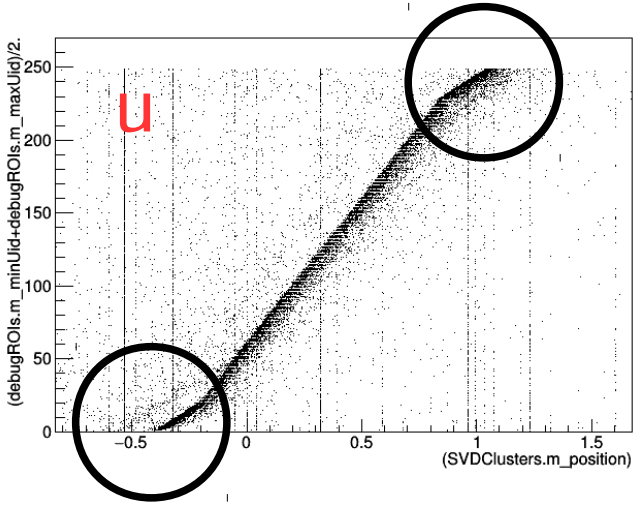
Must be compared to requirement factor $\geq$30
(factor $\geq$3 on HLT x factor $\geq$10 on Onsen)

Correlations in run # 279 („golden“ run, online ROI selection)

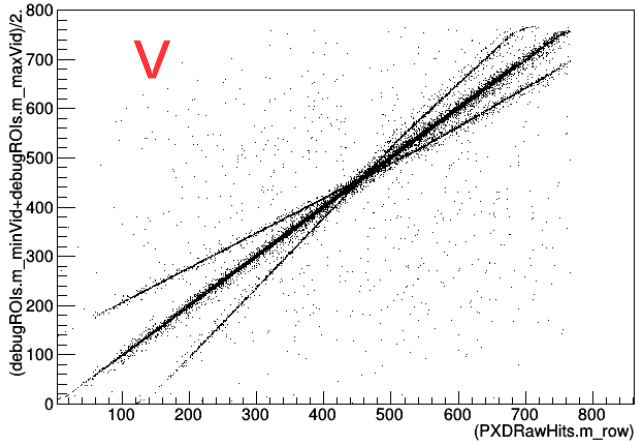
NEW RESULT

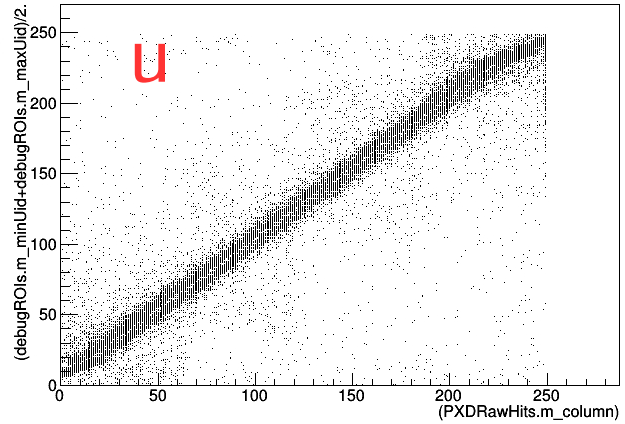
ROIs vs. SVD clusters



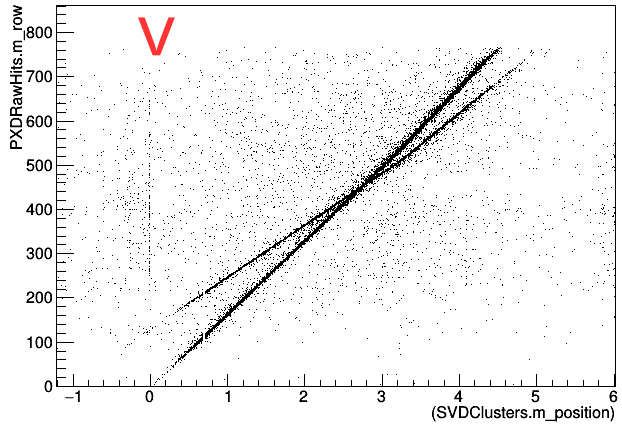


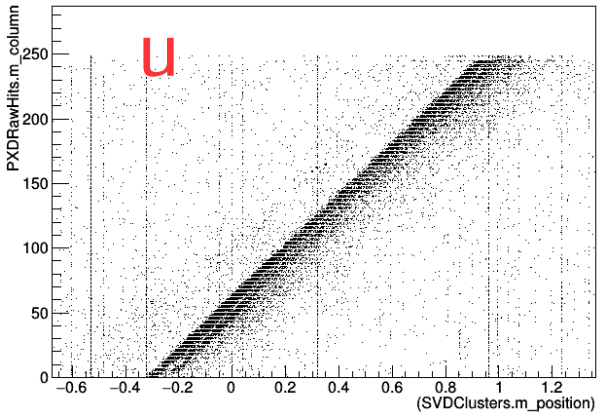
ROIs vs. PXD hits





PXD hits vs. SVD clusters



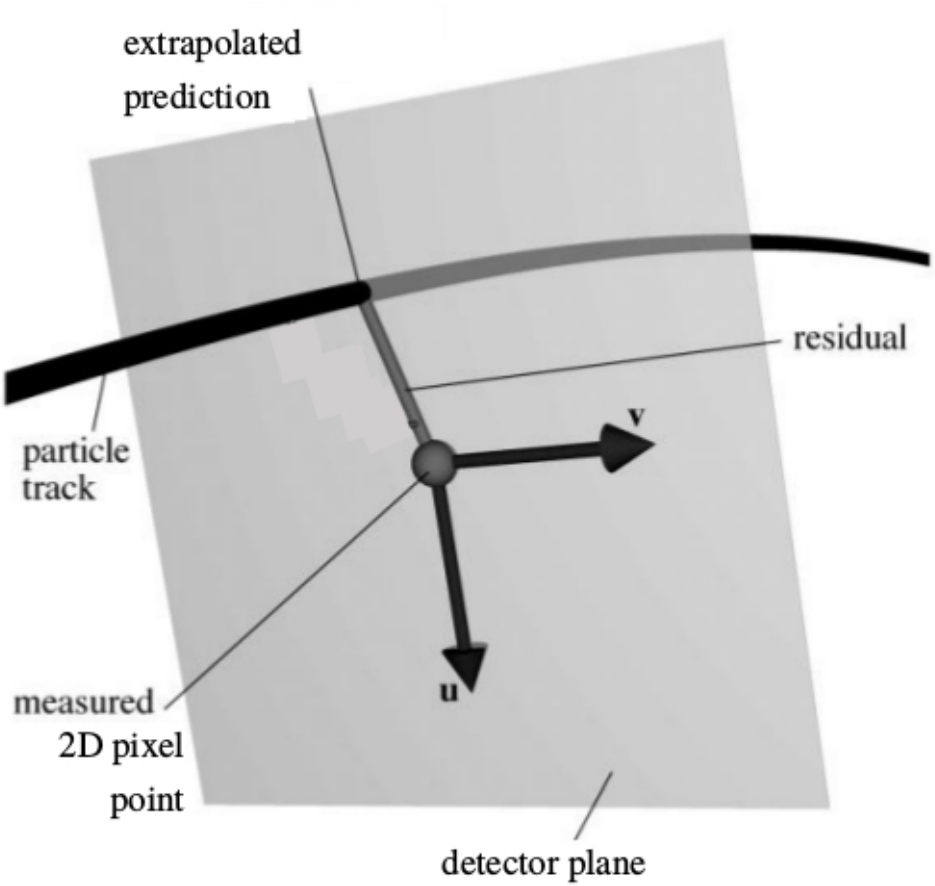


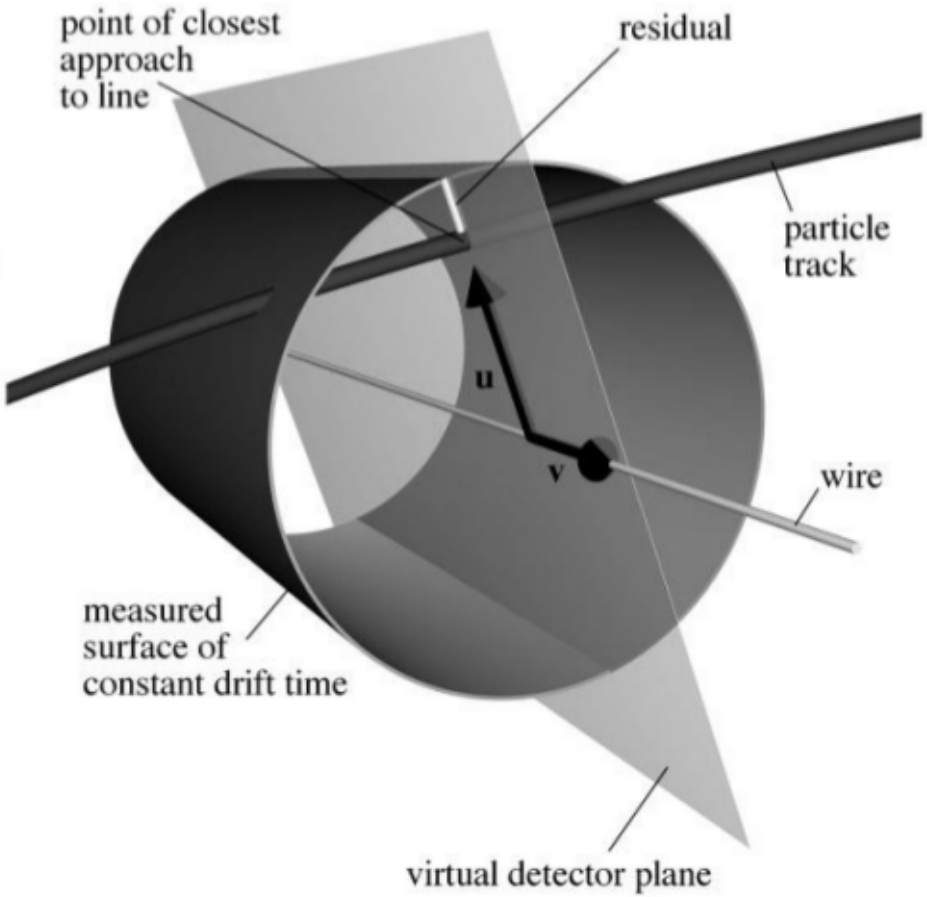
All ROIs are „debugROIs“ (= small ROIs, as they should be)

„edge effects“ (preliminary idea: VXDTF sector maps?)

BACKUP

Definition of u,v





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NEW error detection in basf2 unpacker