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bmb+f - Förderschwerpunkt

Elementarteilchenphysik

Großgeräte der physikalischen Grundlagenforschung

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# STATUS OF DATCON AND HLT ROI CREATION

DEPFET Workshop Seeon, May 2019



**HOUGH TRANSFORMATION** 

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# RESULTS

- Phase 2 (basf2)
- Phase 2 (hardware)



## **ANGULAR RESOLUTION OF DATCON – PHASE 2**

- Distributions of the track parameters found by DATCON
- Hough space for intersection search 64x64 for both Hough spaces
- φ-coverage in Hough space: -37° ... +37°
- θ-coverage in Hough space: 0° ... 180°
- Zickzack-structure caused by discrete Hough space





## **ANGULAR RESOLUTION OF DATCON – PHASE 2**

- Comparison of the reconstructed track parameters with the parameters of the tracks found by the Vertex Detector Track Finder (VXDTF)
- No optimisation of the parameters of the DATCON algorithm
- Angular resolution of about 1° (central region)
- VXDTF found 22999 tracks in this specific run (roughly 1.1M events)
- DATCON in total found more tracks, but only 17633 tracks in events with VXDTF tracks





# RESULTS

- Phase 2 (basf2)
- Phase 2 (hardware)



### **DATCON OPERATION IN PHASE 2**

- Difference of the SVD cluster position reconstructed by DATCON compared to the values of the real SVD clusterizer in number of strips
- Plots for u side
- Up: complete strip range, logarithmic y axis
- Down: central region only, contains about 39% of all strips





### **DATCON OPERATION IN PHASE 2**

- Difference of the SVD cluster position reconstructed by DATCON compared to the values of the real SVD clusterizer in number of strips
- Plots for v side
- Up: complete strip range, logarithmic y axis
- Down: central region only, contains about 48% of all strips





- Angular residuals for phi (left) and theta (right) in rad
- Comparing DATCON track parameter with the VXDTF track parameter





#### **ROI CREATION**



- Phi and theta tracks are extrapolated to PXD as straight lines
- Every possible row/column combination is taken as a valid ROI
- (Many) Unwanted ROIs are created



Difference of the ROI center for DATCON and VXDTF ROIs (u left, v right)





# **STATUS OF FULL DATCON SYSTEM**









**Concentrator** 

- FTB events are not sent out synchronously
- Ring buffer can now store up to 512 events to keep the system running (before 32) and 4096 clusters per link
- Issue found on FTB data
  - > At least FADC and FTB trailer missing
  - Event will never be proccessed in DATCON
  - > Data seem to be overwriten too soon on FTB
  - > Does not help for synchronization of FTB link. Safety measure implemented to not get stuck
- This week on maintenance day, Katsuro-san and Bruno will investigate the problem
  - After checking today, there are strong hints that there really is a FTB problem, investigation will go on the next days







## **CURRENT STATUS**

- Monitoring the number of events waiting in the ring buffers
- Large number of stored events
- Missing events or large current event id difference are properly handled
- Concentrators are all running very stable





#### **CURRENT STATUS**

Tracking on chassis

- One chassis connected to half of the SVD sensors (28 FTBs) on the +x range
- HS spaces:
  - 128 x 64 for Phi: [-PI, PI], 64 x 64 for Theta: [0, PI]
  - Updated HS clusterizer to match HS dimension
- For both sides, track candidates are extrapolated as straight line. ROI only for layer 1
- DATCON sometimes gets stuck, can be recovered during run
- ROI format looks good. On run 1136 , 2.8% of events disappeared most likely because of FTB issue explained previously
- Run with ONSEN planned this week



- Exact same parameters as one chassis approach
- Phi and Theta tracking firmware finished and validated by simulation
- Hardware test ongoing
- Step by step approach (Data mgt + tracking + clust + extrap + Roi + ONSEN)



#### **CURRENT STATUS**

Slow and run control

- All important PVs saved in the archiver
- Added monitoring on concentrator to check buffer occupancy and SVD cluster
- DATCON run control is running nicely

Hardware testing

• Start tests this week with ONSEN

FADC 50 700 600 500 400 300 200 100 0 6 0 B 9 *လ* ကိ number of SVD cluster

• If stable we can optimistically start testing the fully scaled up system by the end of next week



## **STATUS OF BASF2 DEVELOPMENT**



## **UPDATES ON BASF2 DEVELOPMENT**

- Optimised SVD clustering
  - Similar performance as the real SVD clusterizer in basf2
- Fixed bug in extrapolation  $\rightarrow$  smaller residuals
- New way of track fitting
  - Fit tracks as straight lines in conformal space with data obtained from phi HS only
  - Speedup of factor 2
  - Less parameters to optimise
  - More precise values for phi and track radius, plus less tracks and thus less ROI
  - Caveat: Outliers degrade theta estimation, but simple way of outlier removal is implemented under test, looks promising



## **OUTLOOK FOR FURTHER IMPROVEMENTS**

- Optimise all parameters
- Not only fit tracks in conformal space, but also extrapolate to PXD in conformal space

 $\rightarrow$  always straight line extrapolation, no estimation of intersection of a circle with a straight line (for now, tracks are extrapolated as straight lines if R > 50 cm)

 $\rightarrow$  no sqrt (very time consuming on FPGA)

- Use several small HS for different parts of the SVD
  - "Sector map" approach
  - Works for both phi and theta, but many clone tracks
  - Adapt this to new track fit algorithm → should decrease number of tracks and ROIs, and make it more precise



# **OPTIMISATION OF HLT ROIS**



- HLT ROIs might be too small
  - On MC they provide high data reduction factor (DRF) of >100 for current standard values
  - But ROI finding efficiency is below 90% (with my analysis script)
    - → Optimise parameter (eight parameter)
- 1000 MC events
  - Generic Y(4S) + BG overlay (version: updated0918)
  - Full tracking
  - Randomly varying six of eight parameters (maximum sizes for u and v fixed to large values)



#### **ROI FINDING EFFICIENCY VS DATA REDUCTION FACTOR**





#### **ROI FINDING EFFICIENCY VS NUMBER OF ROI**





#### **DRF VS NUMBER OF ROI**





#### **EFFICIENCY VS NUMBER OF ROI AND DRF**

Parameter sweep + Standard values X





# $\begin{array}{l} \textbf{ROI EFFICIENCY VS PT} - \textbf{STANDARD VALUES} \\ \textbf{ROI finding efficiency} \in vs \ \textbf{p}_{\tau} \end{array} \end{array}$





# $\begin{array}{l} \textbf{ROI EFFICIENCY VS PT} - \textbf{OPTIMISED} \\ \textbf{ROI finding efficiency} \in \textbf{vs} \ \textbf{p}_{\tau} \end{array}$



#### **COMPARISON STANDARD (U) – OPTIMISED (D)**

ROI finding efficiency  $\in$  vs  $\phi$ 

ROI finding efficiency  $\in$  vs  $\theta$ 



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- Reasonable results and ROI with phase 2 setup (hardware and basf2)
- Full setup at KEK is there
  - Yet it hast to be tested and prove save operation
  - Test when connected to ONSEN, first in "spectator mode"
  - Don't risk to stop PXD / Belle II operation to not lose beam time
  - Debug SVD / FTB problem together with SVD experts
- Possible upgrades and improvements are developed and tested in basf2
  - Will try to apply them on FPGA in future, but first we want to have a running system
- Standard parameter for HLT ROI creation should be changed to improve ROI finding performance (although ROI and data reduction are not yet applied online)









## **THANK YOU FOR YOUR ATTENTION!**