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DEPFET

Active Pixel Detector

Belle II

bmb+f - Förderschwerpunkt

Elementarteilchenphysik

Großgeräte der physikalischen Grundlagenforschung

Botho Paschen (University of Bonn)

# PXD9 RESOLUTION AT BEAM TESTS

PXD Workshop

26-29 May 2019

Kloster Seeon

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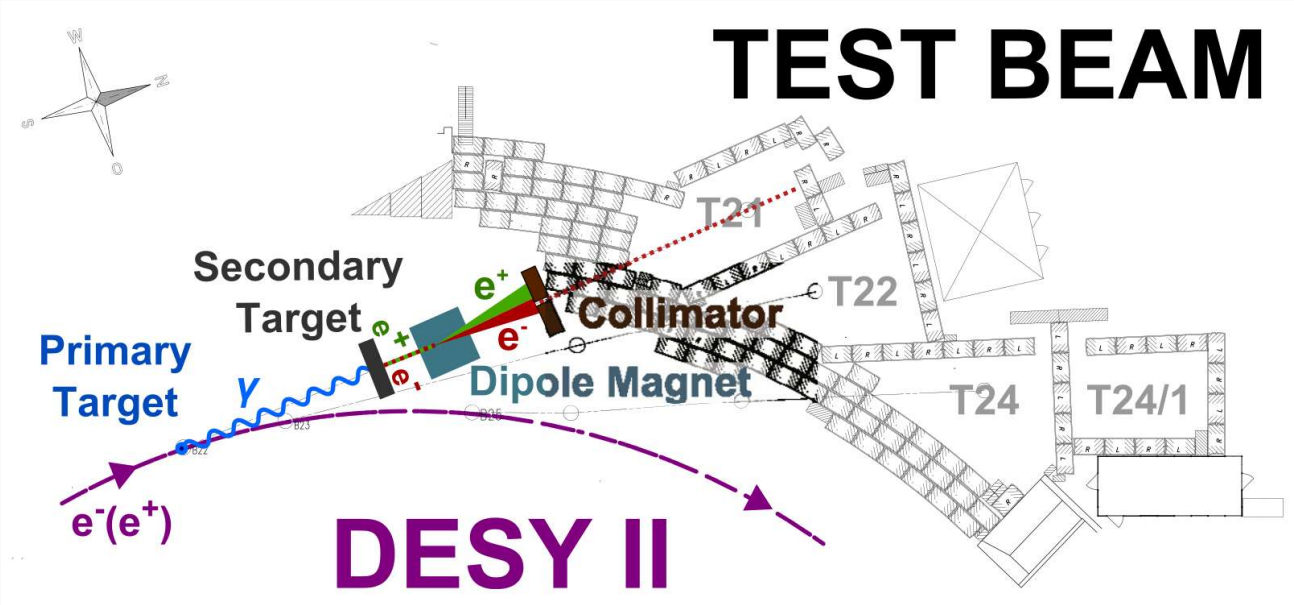
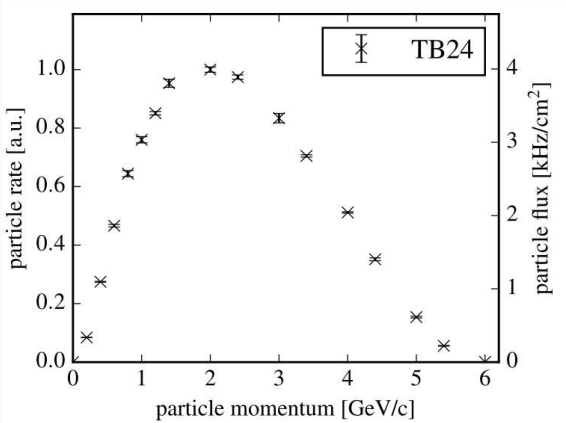
# PXD9 BEAM TESTS

- Two beam test periods at DESY test beam
  - November 2018
  - April 2019
- 5 DUTs
  - W11_OF2
  - W40_IF (GOE guinnea pig)
  - W05_OB1
  - W05_OB1 (irradiated to 21 Mrad)
  - W37_OF1 (phase 2 module)

# DESY TESTBEAM

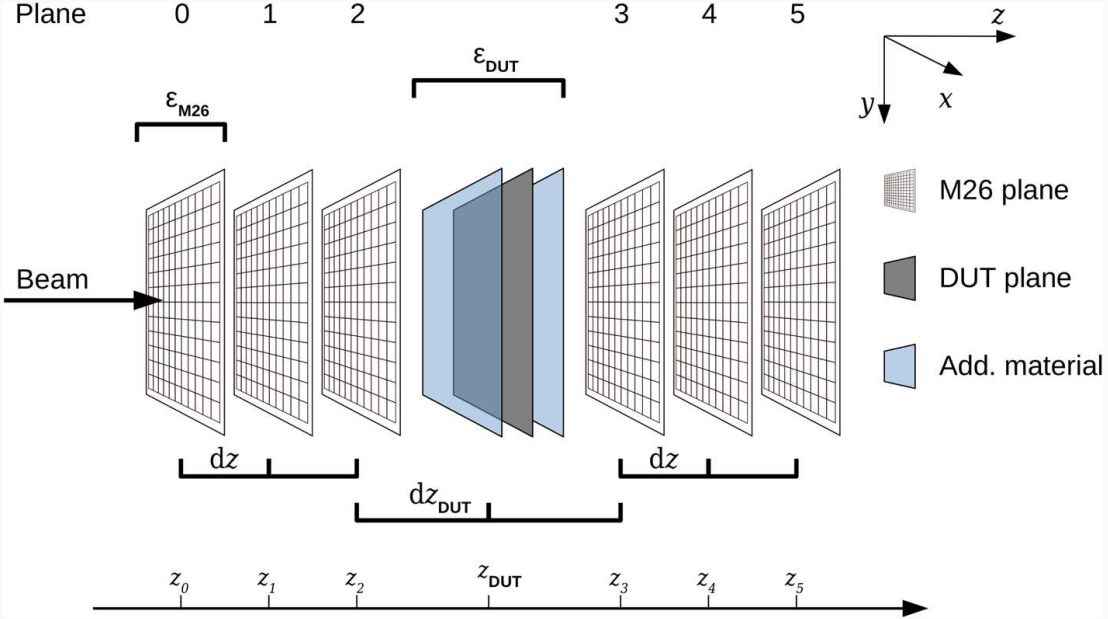



- Electron beam
- Energy range 1-6 GeV




from https://doi.org/10.1016/j.nima.2018.11.133

# BEAM TELESCOPE

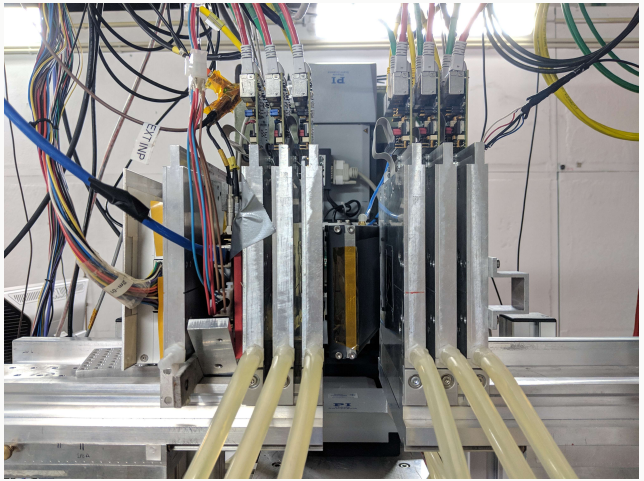


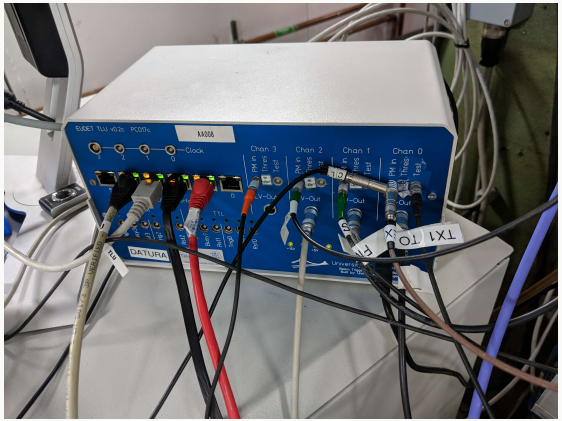

from https://doi.org/10.1140/epjti/s40485-016-0033-2

- Principle:
  - Good tracking with beam telescope
  - 6 M26 Mimosa planes with 18.4 µm x 18.4 µm pixel size
  - Adjustable geometry
  - Trigger signal from FEI4 plane with 25 ns readout
    + scintillators
    (via Trigger Logic Unit)

# BEAM TEST SETUP

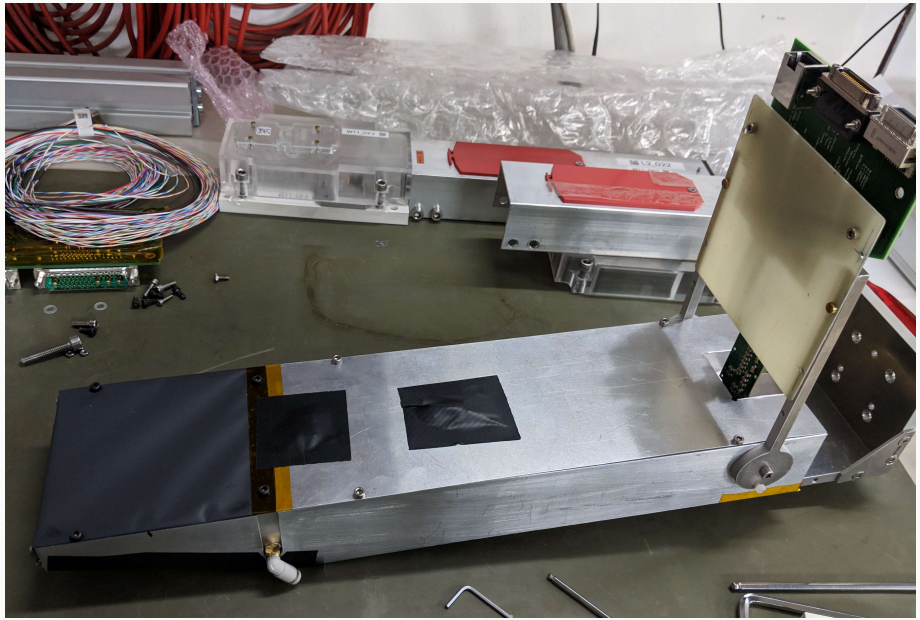
- Beam telescope and DUT
  - 6 Mimosa planes
  - FEI4 timing reference
  - PXD 9
- DAQ hardware
  - Telescope hardware (DESY)
  - Standard PXD lab setup
- Trigger distribution unit
  - Input FEI4 + scintillators
  - Output to all pixel chips

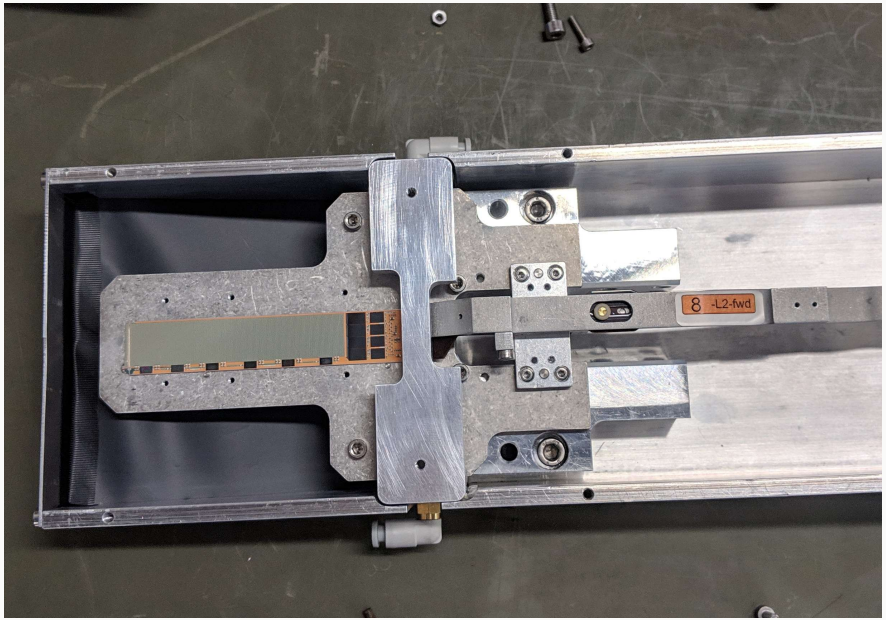




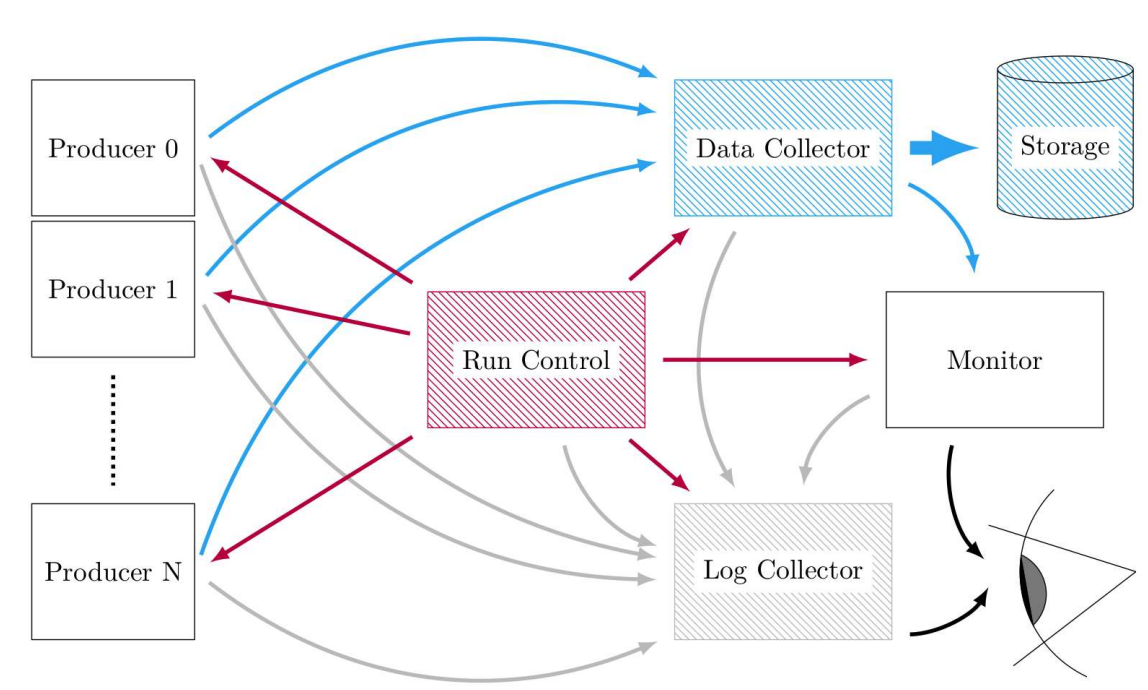
# BEAM TEST SETUP

- Special mechanics necessary





# DAQ SOFTWARE




from http://dx.doi.org/10.3204/DESY-THESIS-2016-010

- EUDAQ framework
  - https://github.com/eudaq/eudaq
  - General testbeam DAQ framework
  - All detectors DAQs are integrated
- PXD9
  - DHH
  - LocalDAQ „DEPFET producer“

# ISSUES

- Synchronization losses between detectors
  - Misunderstanding of Triggers
  - DAQ problems of components
- PXD9 link instabilities
  - Very severe, but reason unknown

- Many checks developed for life monitoring and data analysis

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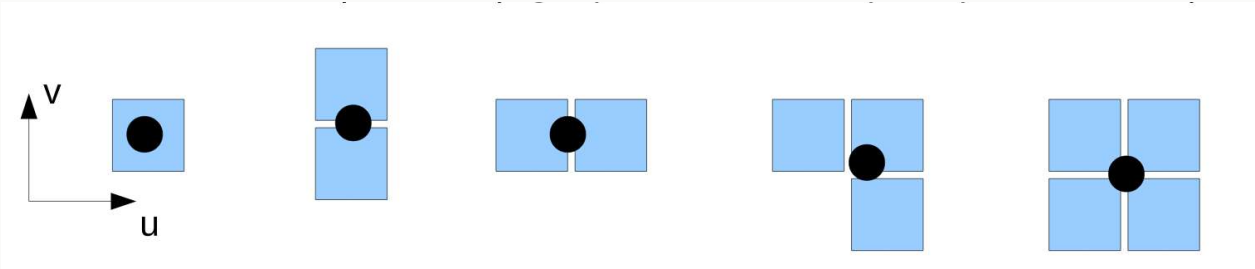
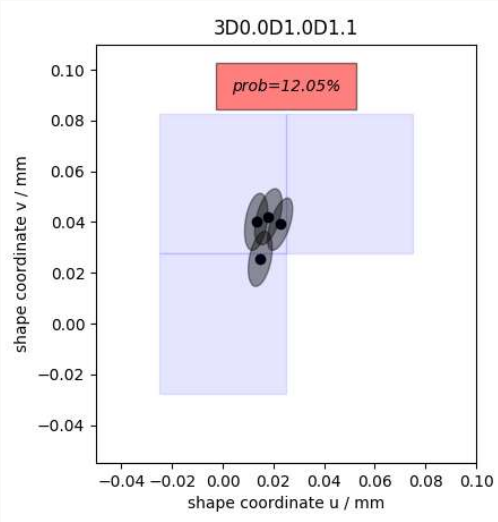
# DATA ANALYSIS TOOLS

- TBSW framework by Benjamin
  - https://bitbucket.org/BenjaminSchwenker/tbsw/src/master/
  - General testbeam beam test analysis framework
  - All detectors data formats are integrated
- Tasks
  - Raw data conversion
  - Detector alignment
  - Track finding
  - > Evaluation of Efficiencies etc.

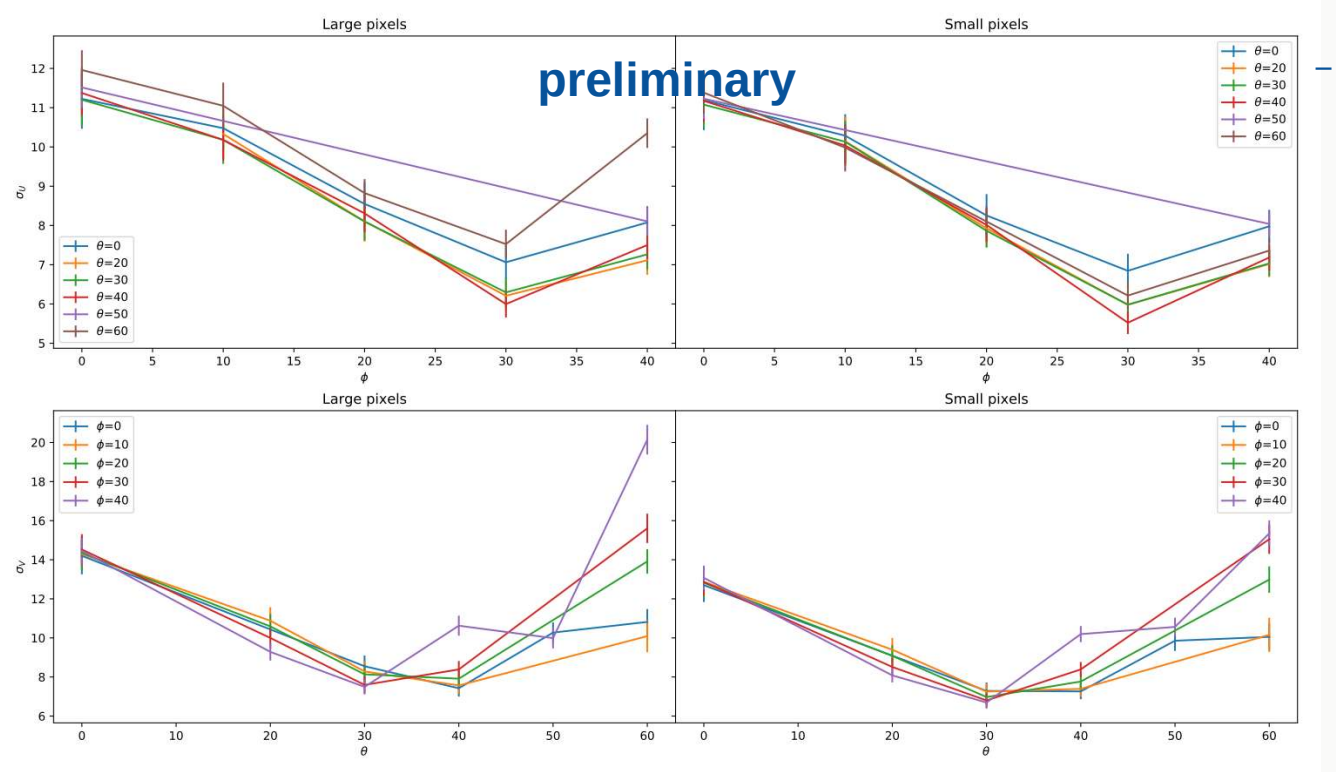
# ANGLE MEASUREMENTS

- Benjamin @ Ringberg 2017 „New results on PXD spatial resolution and calibration from beam data“ (https://indico.mpp.mpg.de/event/5220/session/24/contribution/65)
- Understand PXD response to check digitizer for Belle MC
- Cluster shape tracking approach as opposed to center of gravity (COG)
  - Train database to get from cluster shape
    - Hit position
    - Hit uncertainty



# RESOLUTION OF PXD9




- Large data set
  - W40_IF module
    - Small pixels: 55x50
    - Large pixels: 60x50
  - Angular scan in phi and theta
  - Preliminary results with expected resolutions and dependences
  - More to come soon
    - Comparison COG
    - Region details