

# Pixel: Status Report

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On behalf of the Pixel Group

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Mar 30, 2011

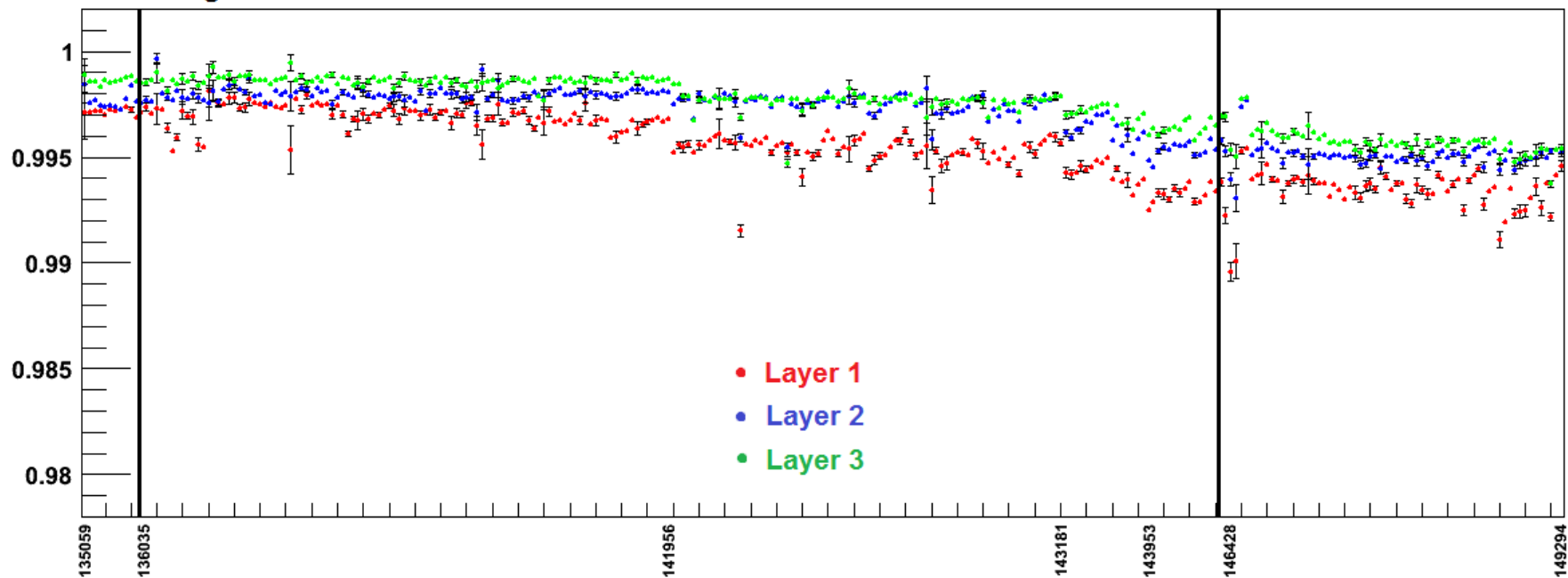
Run Coordination, CMS General  
Meeting

1

Commissioning 10

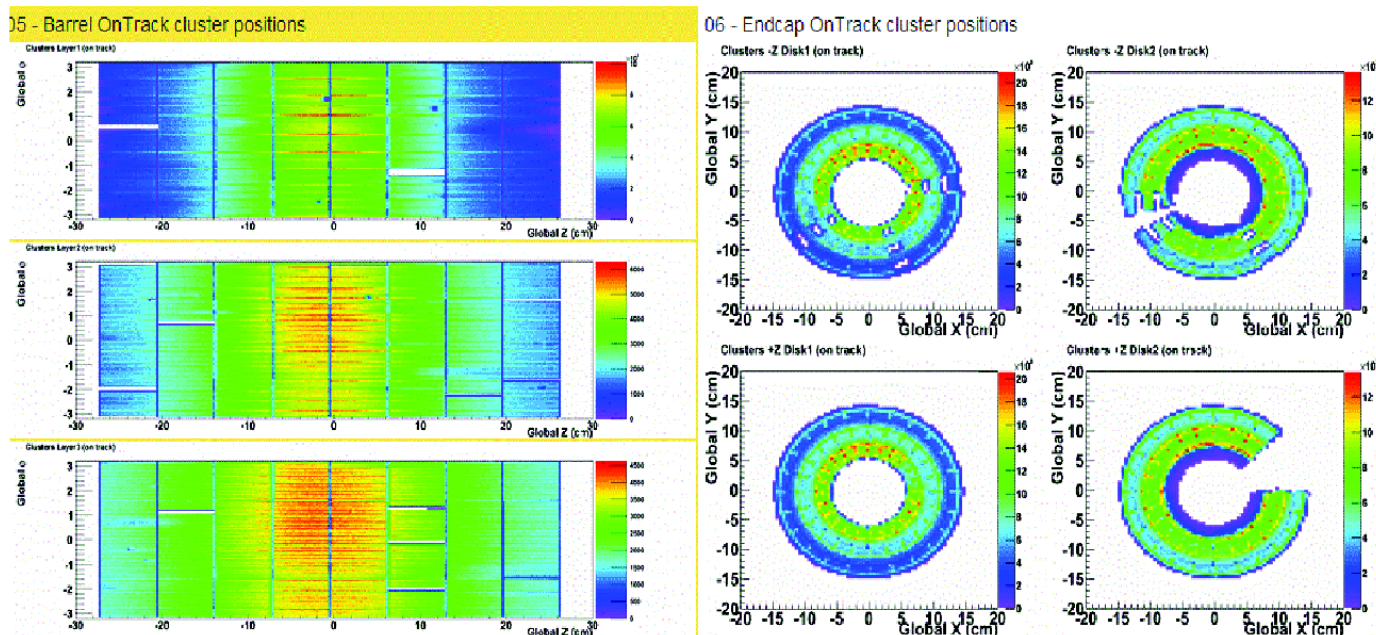
2010A

2010B



- Efficiency decreases with beam intensity
  - Plot excludes known bad modules – as in December ReReco
- Live fraction of the pixels in the end of 2010:
  - Barrel: 98.4%
  - Endcap: 92.8%

- Successful start up in 2011
  - Software updates were performed, some new features introduced
  - Detector needed recalibration in the beginning of February
  - Later participated in cosmic runs
  - Performed timing calibration with the first collisions in March
- No new wholes seen in occupancy in 2011 from DQM:





# Operation at P5



- Activities
  - Data taking whenever there is stable beam
  - Participating in cosmic data taking during interfills
  - Developments and testing in playtime and technical stop
- Pixel crew additional to central shifters
  - Primary contact is the Detector On-Call (DOC)
    - Always present whenever detector is turned ON from OFF
    - Checks beam conditions at the beginning of every fill
  - On-call experts are available for DCS, DAQ, and DQM
- Highlights of new developments during winter shutdown and in re-commissioning:

- RCMS/XDAQ updates required fixes in online code
- Resync signal sent to all detectors when pixel is in out of sync (e.g. in PKAM events)
  - Central trigger system provides automatic software resync with  $\sim 1$  Hz polling
  - New feature tested recently: fast (firmware) automatic resync in  $\sim 20$  milisec
- Private gap BGO command – comes in one package with fast resync
  - The read-out token is not passed onto the next ROC by some ROCs
  - ROC reset signal is sent to the pixels through the TTC by central trigger system upon request from pixel FEDs when „broken token” is detected
  - Requires new firmware in both trigger system and pixel FEDs
  - Trigger system has been tested, more test are needed on the pixel FEDs

- Two-step BPix turn on to Standby – new feature deployed in DCS, before it was done semi-manually
  - ROCs get reduced analog voltage in first step
  - DAQ configures the ROCs
  - Full analog voltage applied
  
- Automatic HV turn-on for post-fill cosmics data taking
  - At scheduled RAMP DOWN, pixel can already be ON, no Pixel DOC supervision is required
  - Pixel DOC still has to be present in the beginning of each fill



# Running cold

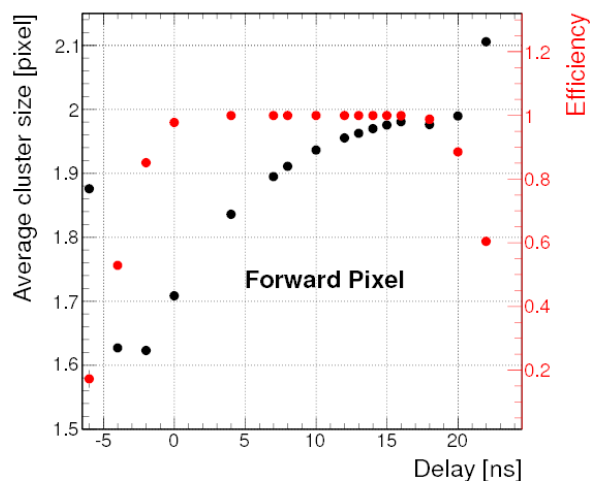
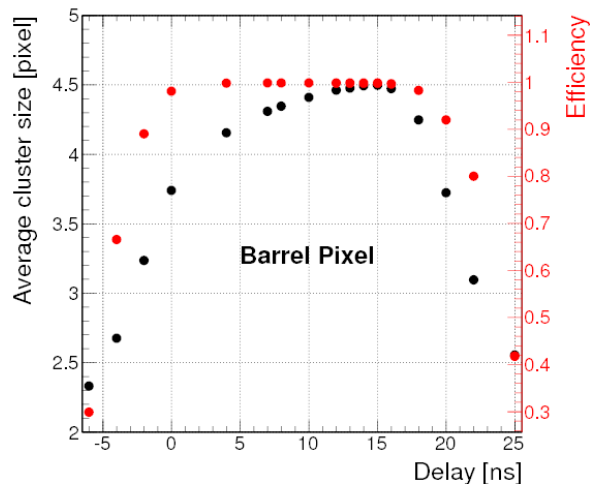


- Normal operational temperature of the pixel detector is 7.4 Celsius
- Leakage current increased as expected after acquiring  $\sim 50 \text{ pb}^{-1}$  – can be reduced by running colder
- Attempted to run at -10 Celsius from mid-January
  - Temperature and humidity were continuously monitored
  - Recalibration of the detector
- An increase in relative humidity interlocked in correlation with magnet ramping up in mid-February
  - Cause is being investigated – no interlock on too high dew point
  - Experts trying to find lowest temperature feasible to run with

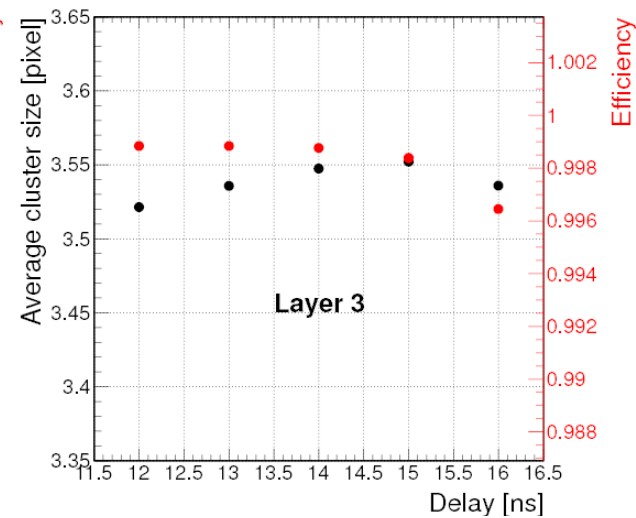
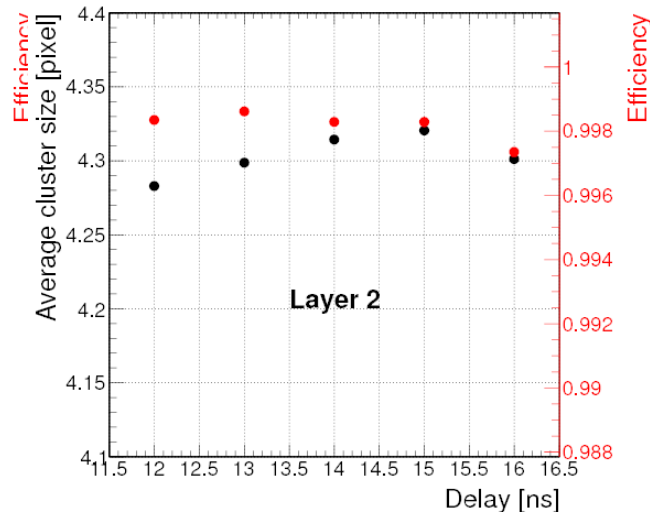
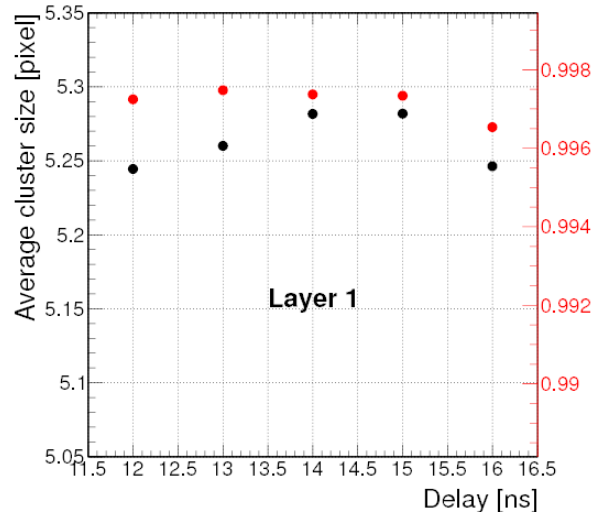
- It was already hinted by the cosmics data that the Pixel detector was off w.r.t most of CMS
  - Detected muons were off in time
  - Pixel BX counter value was shifted
- Pixels were realigned with LHC collisions in the first fill of 2011
- Timing strategy:
  - First performed WBC scan to find right bunch crossing (at points WBC=155, 156, 157) with online DQM
    - Bunch crossing had to be adjusted by one
  - Second a coarse delay took place with lower statistics mostly at 2 ns steps
  - Last a fine delay with improved statistics and 1 ns steps in interval containing most optimal region (around 14 ns)
- Calculate hit efficiency and average cluster size offline in order to determine optimal timing settings



# Coarse delay

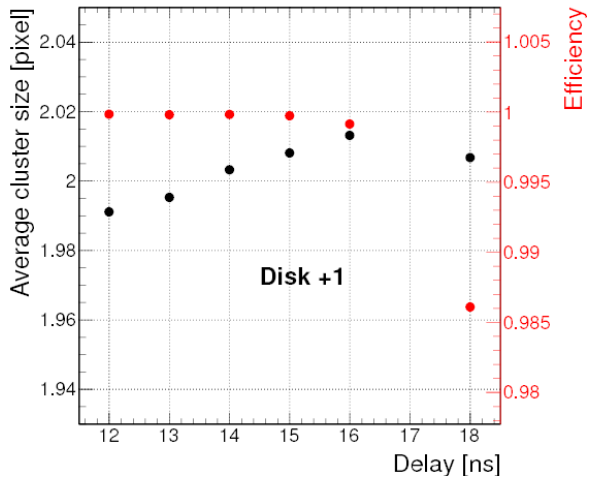


- Efficiency requires a hit of any kind near a track
  - Tolerant to cluster quality
  - Has a 15 ns long plateau
- Cluster size is maximized at later phase w.r.t LHC collisions
  - Clusters are on-track (see last slide for results with general clusters)
- Best setting towards the end of the efficiency plateau (larger clusters, more pixels read out)
  - Must leave room for internal misalignment
  - Currently using 12 ns

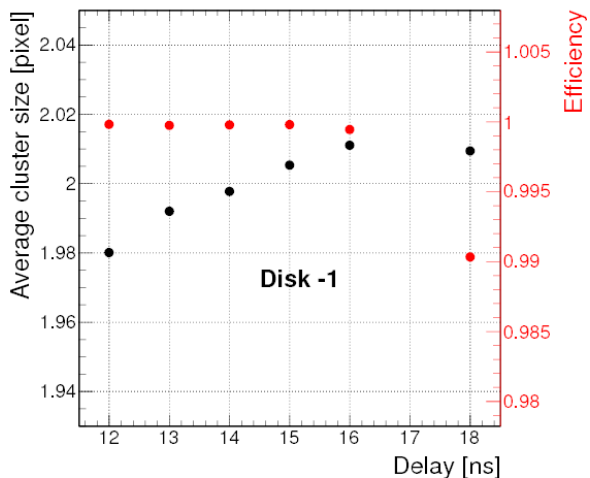
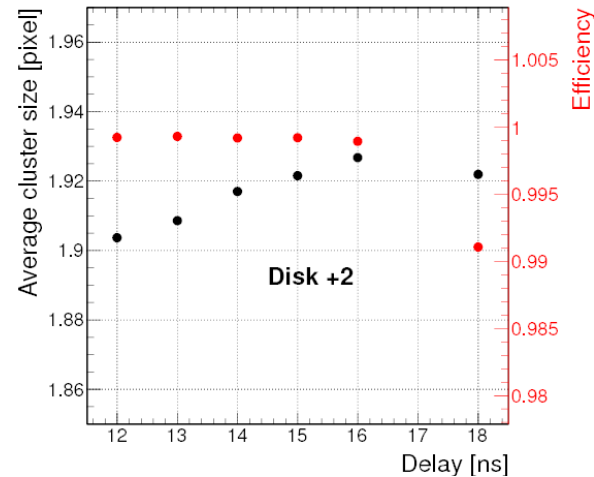


- ~13 ns works for each layer
- Layers are internally aligned
  - More natural division is by read-out groups or modules
  - Offline analysis on checking internal alignment is ongoing
  - This year more statistics is available

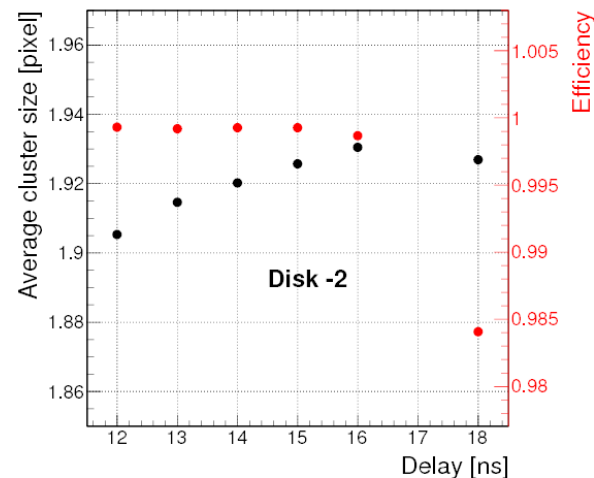
# Fine delay in FPix



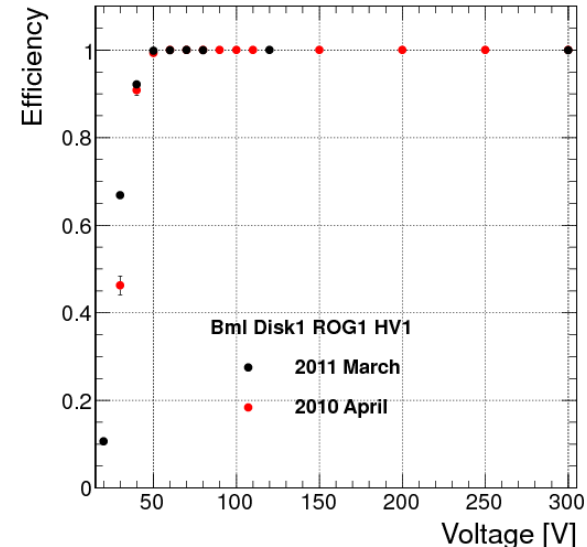
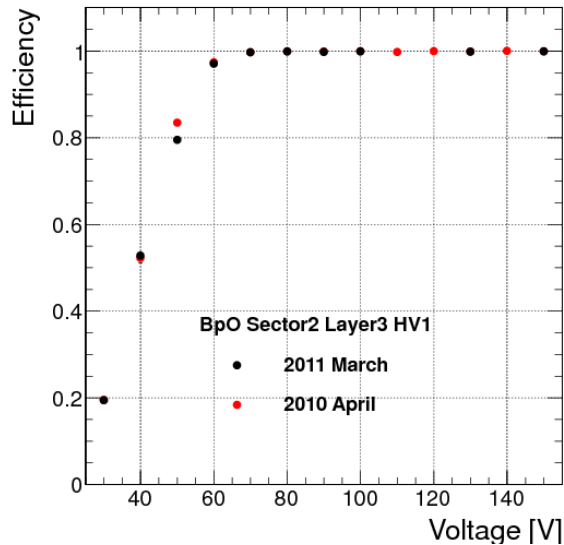
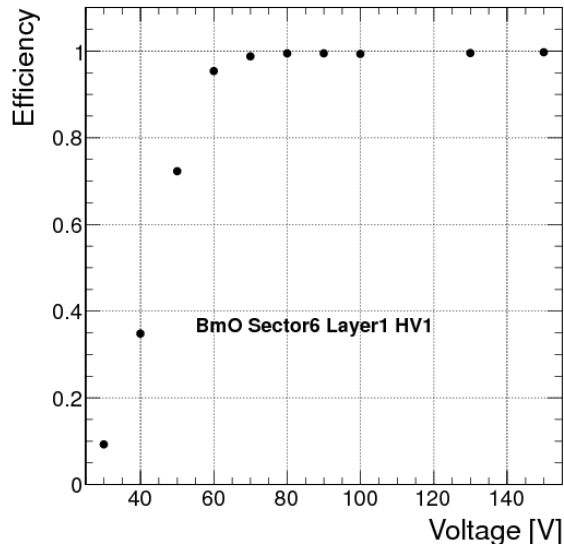
1 ns shift  
w.r.t BPix



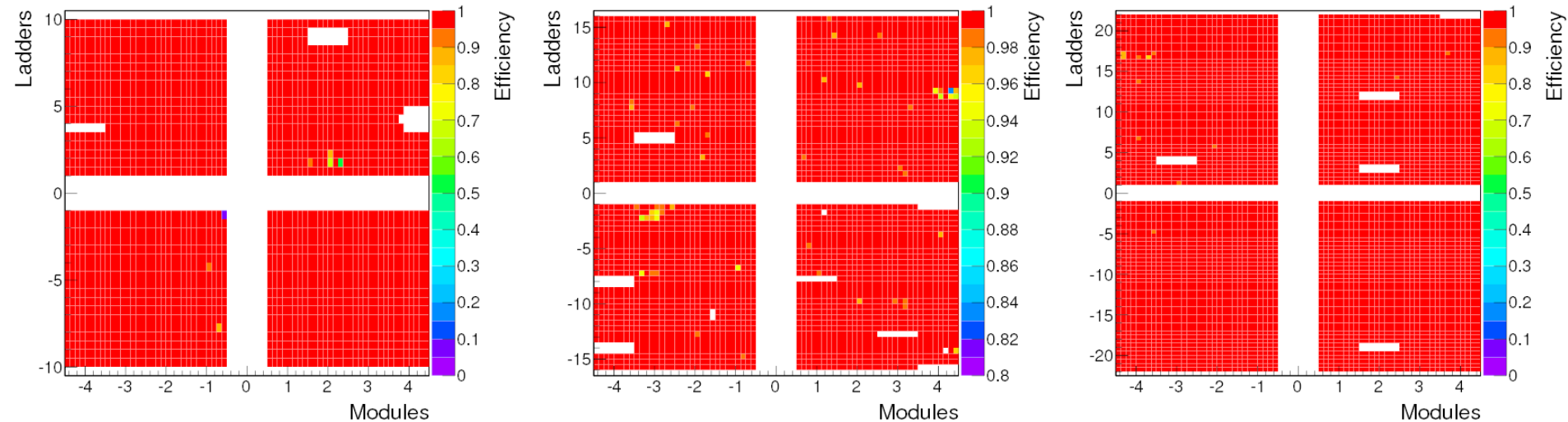
Safe setting  
around 14 ns



- Efficiency consistent with early 2010 conditions ( $>99.7\%$  for all layers)
  - Required readjustment of clock implies half a clock cycle shift of the entire pixel detector
- Determine best setting
  - Expect a  $\sim 1$  ns shift in these plots along the delay axis due to recent changes in the TTC system
  - Should choose safe location to allow room for small misalignment
- New setting will be used for a fill
  - Small improvement in cluster / pixel size
  - It will be totally transparent, will not affect efficiency
  - After offline validation, new settings will be made final

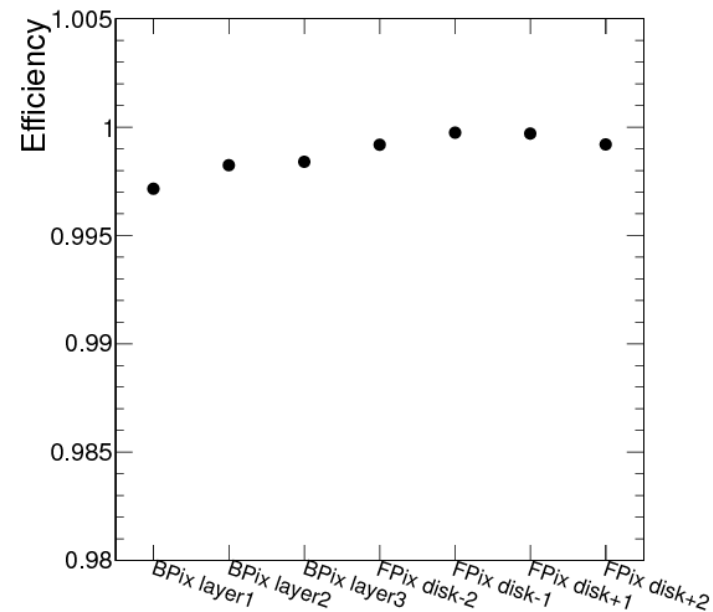


- HV scan performed in April 2010 and March 2011
- Modules selected
  - Fpix\_BmI\_D1\_ROG1\_HV1 (three blades),
  - Bpix\_BpO\_SEC2\_LYR3\_HV1 (8 modules),
  - Bpix\_BmO\_SEC6\_LYR1-2\_HV1 (4 modules) – added in 2011
- Results are very compatible



- ROC efficiencies for Layer 1, 2, and 3
- Used current default delay setting of 12 ns
- Known bad modules or ROCs are excluded from calculation (white)
  - List is being compiled
  - Offline characterization of these ROCs is ongoing

- New developments are introduced or ready to be tested
  - Automatic resync 50 times faster – smaller dead time
  - ROC reset by private gap mechanism
  - Automatic HV turn-on – less human time
- Realignment with collisions was quick and successful
  - A smaller optimization in cluster size is yet to come
  - Final settings will be validated in a fill in a transparent way
- Pixel detector is in a good shape, its efficiency is close to last year
  - All calibration scans were finished with 2 bunches, all data since then have been taken at full efficiency



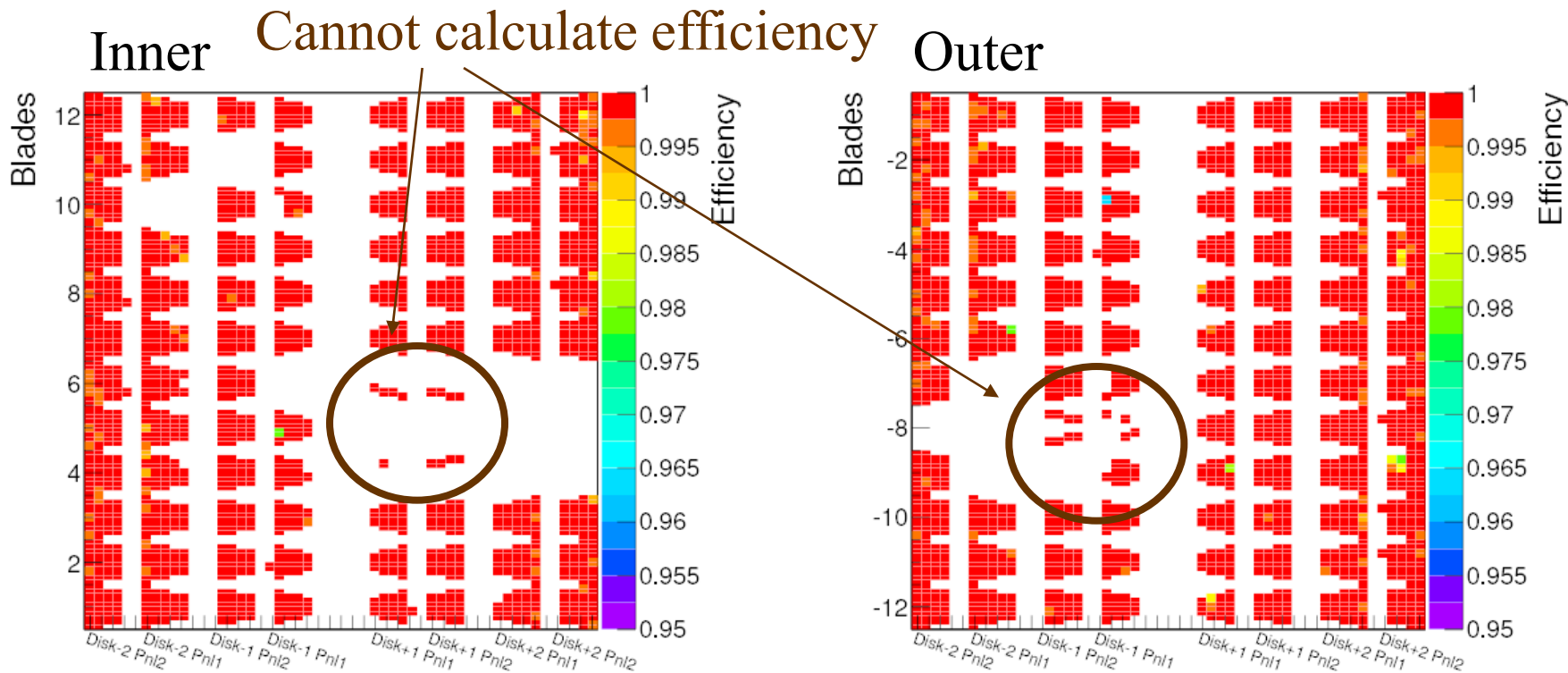
Efficiency in pixel layers



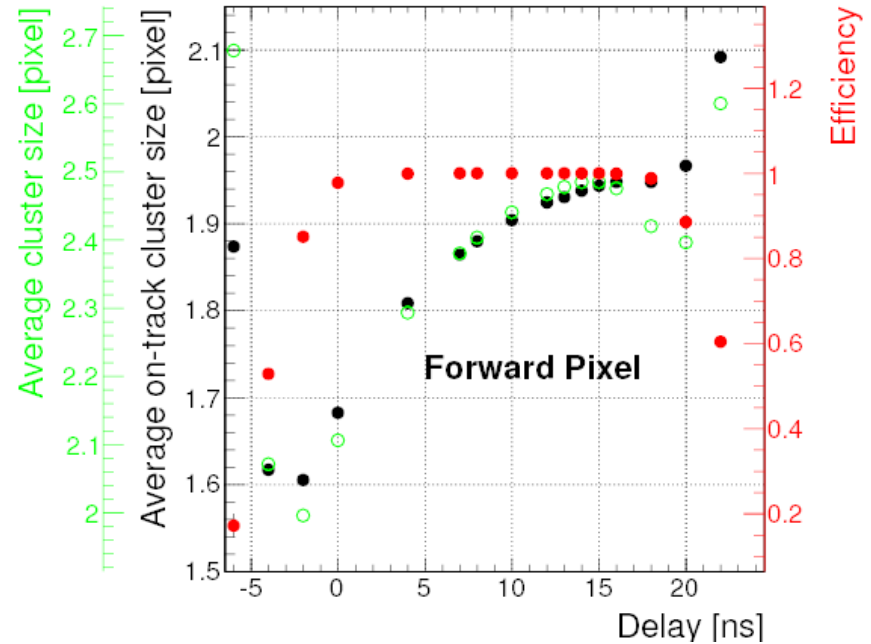
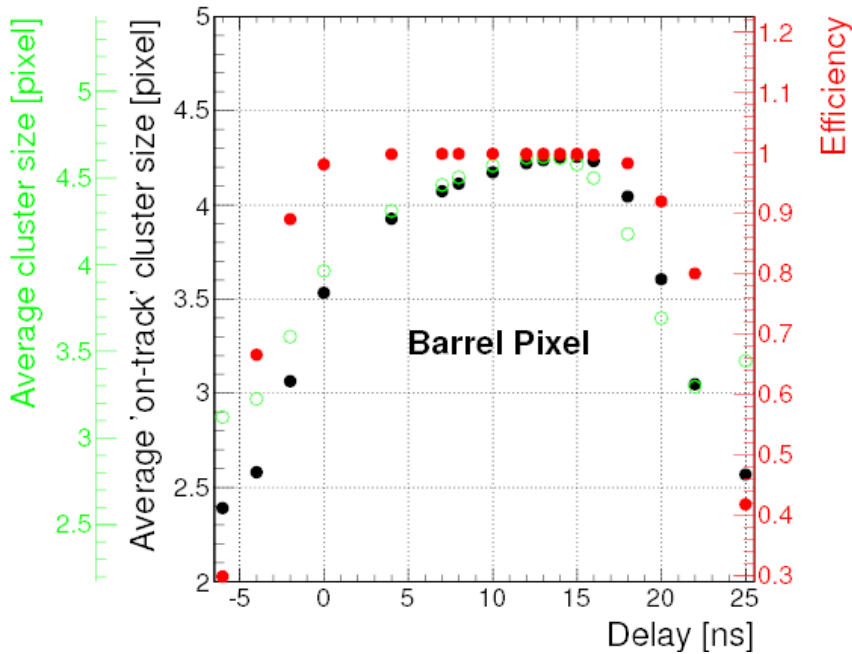
# Addendum







- ROC efficiency in Endcap disks with 12 ns delay settings
- Efficiency is not tested in regions where only two pixel tracking layers work



- Average cluster size for all clusters and on-track clusters give very similar predictions for best timing