



Approved Plots for Pixel Efficiency and Timing in 7 TeV Runs

Viktor Veszpremi
ATOMKI, Debrecen

Bad or otherwise excluded areas in BPix

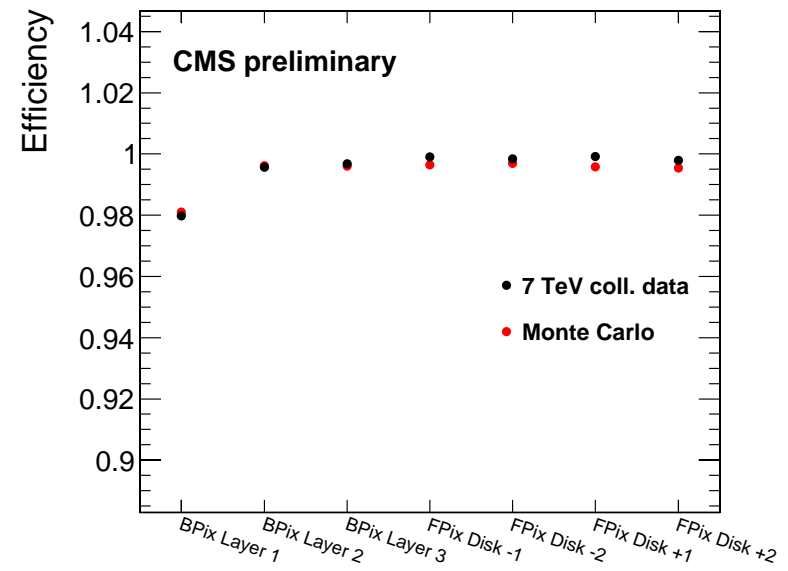
- 11384 functional ROCs (98.8%)
- Bad modules:
 - BPix_BmO_SEC1_LYR1_LDR1H_MOD1 ROC8 - not excluded
 - BPix_BmI_SEC3_LYR1_LDR4F_MOD4_ROC8-15 - new, not excluded
 - BPix_BpI_SEC8_LYR1_LDR9F_MOD2
 - BPix_BmO_SEC4_LYR2_LDR8F_MOD4 (TBM-A is bad)
 - BPix_BmO_SEC7_LYR2_LDR14F_MOD4
 - BPix_BmI_SEC3_LYR2_LDR5F_MOD3
 - BPix_BpO_SEC1_LYR2_LDR1H_MOD4
 - BPix_BpO_SEC4_LYR2_LDR8F_MOD1 TBM-A
 - BPix_BpO_SEC7_LYR2_LDR13F_MOD3 TBM-B
 - BPix_BpO_SEC8_LYR2_LDR16H_MOD4
 - BPix_BmI_SEC2_LYR3_LDR4F_MOD3
 - BPix_BpI_SEC5_LYR3_LDR12F_MOD2
 - BPix_BpI_SEC8_LYR3_LDR22H_MOD4
- Fiducial region selected, avoid module edges

Bad or otherwise excluded areas in FPix

- 4164 functional ROCs (96.4%)
- Bad modules excluded:
 - FPix_BmO_D1_BLD9_PNL2
 - FPix_BmO_D2_BLD7_PNL1
 - FPix_BmO_D2_BLD8
 - FPix_BmO_D2_BLD9_PNL1
 - FPix_BmI_D1_BLD6_PNL1 - new
 - FPix_BmI_D1_BLD11_PNL2
 - Occasionally FPix_BmI_D2_BLD10_PNL1, not officially bad, but excluded from efficiency calculation
- Fiducial region selected
 - Drop hits at module edges
 - Excludes outermost and innermost modules on 4 module panels
- Modules at large pseudo-rapidity are excluded due to tracking

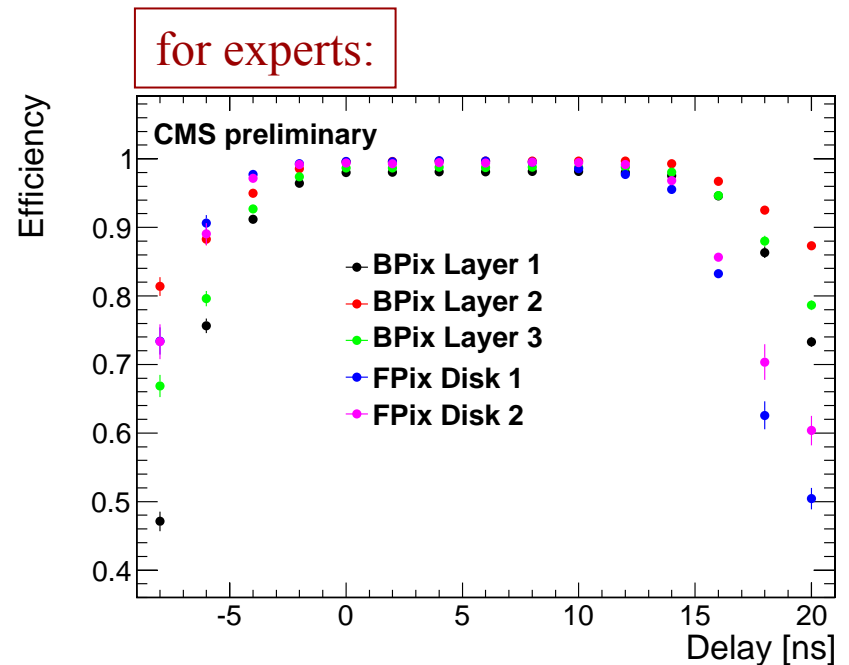
Layer efficiency in BPix and FPix

- RecHit efficiency: $N_{\text{hits found}} / N_{\text{hits expected}}$ computed in the fiducial regions
- Layer 1 eff. underestimated by $\sim 1.5\%$ due to tracks originating outside Layer 1 (secondaries)
- Event selection: ≥ 1 vertex where $|z| < 15$ cm, $|\rho| < 2.0$ cm, $N_{\text{dof}} > 4$
- Track selection
 - Seeded from the Pixels, valid hits always required on „other” layers
 - $P_T > 0.9$ GeV, $N_{\text{strip hits}} > 10$, track consistent with vertex, where $|dz| < 1.0$ cm and $|d_0| < 0.5$ cm



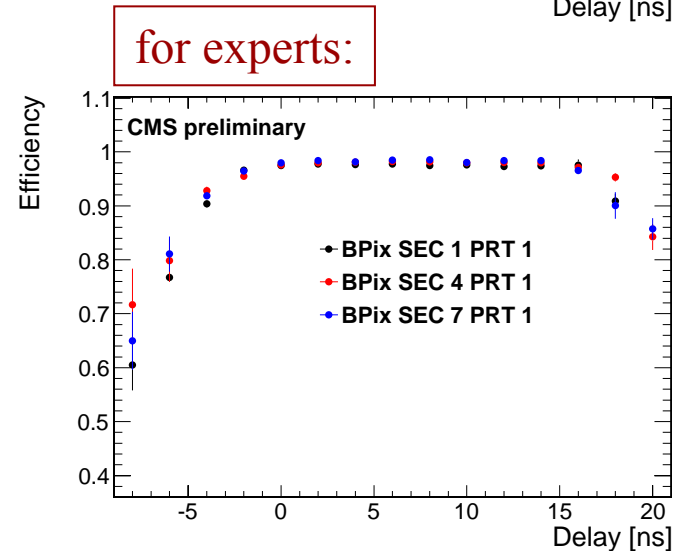
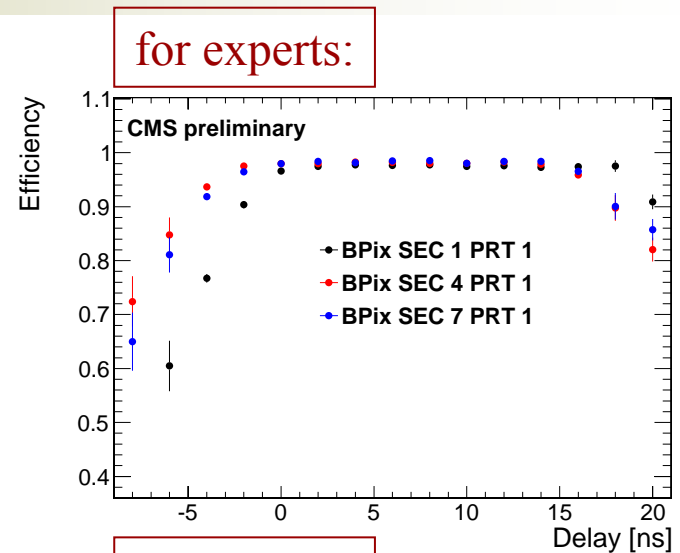
Clock Phase Scan

- Efficiency versus the relative phase between the LHC clock and the pixel clock
- Calculated as earlier, but
 - tracks are seeded from the strip detector
 - no valid hits required on „other” layers explicitly
- Right phase essential for data taking
 - hits recorded within a single LHC clock cycle are read out



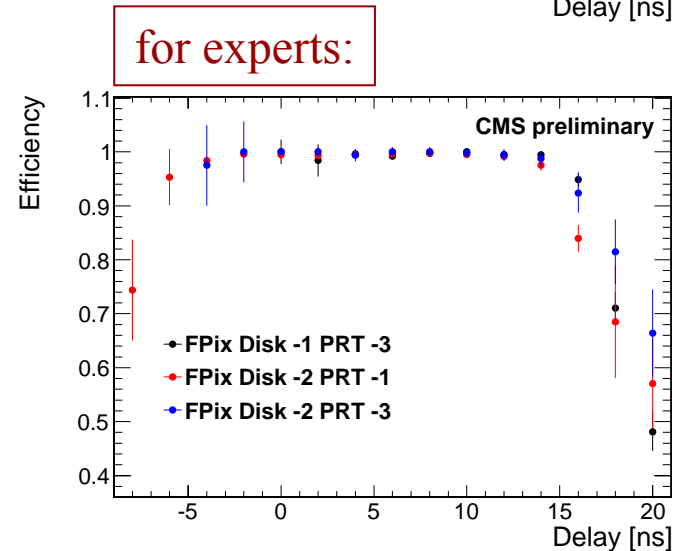
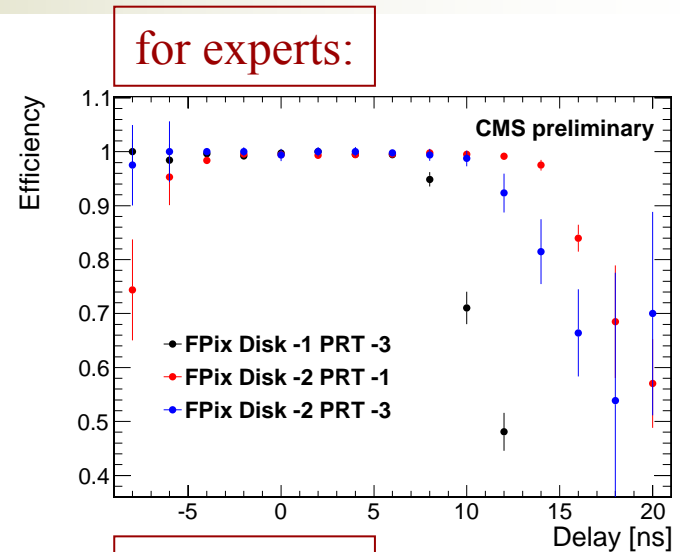
Clock Phase Scan: BPix

- Read-out groups were not in phase due to hardware differences
- Upper plot: largest misalignment in BPix was ~ 3 ns
- Lower plot: efficiency curve after shifting read-out groups into right phase
 - New points are calculated, did not perform another scan



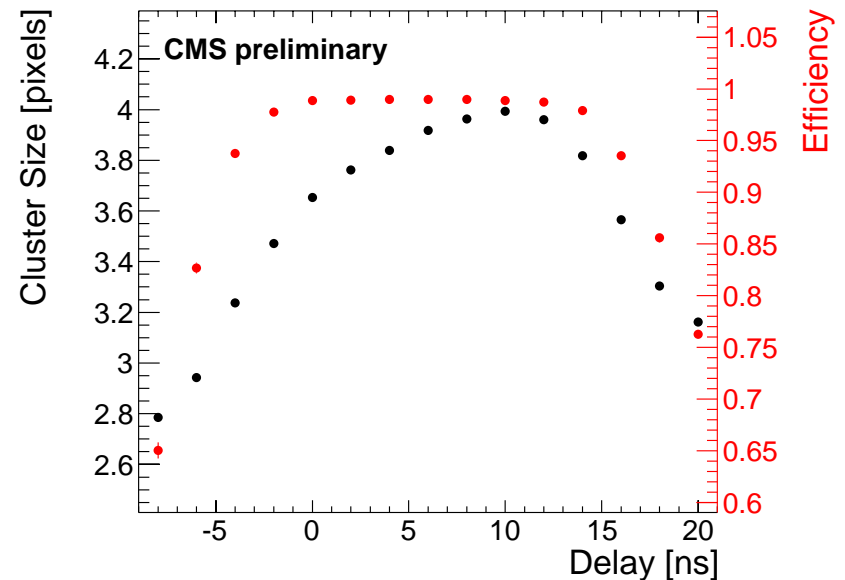
Clock Phase Scan: FPix

- Read-out groups were not in phase due to hardware differences
- Upper plot: largest misalignment in FPix was ~ 8 ns
- Lower plot: efficiency curve after shifting read-out groups into right phase
 - New points are calculated, did not perform another scan



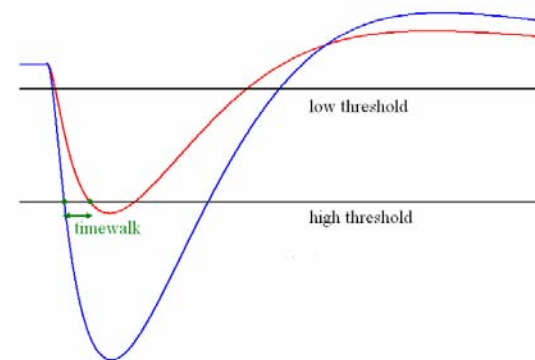
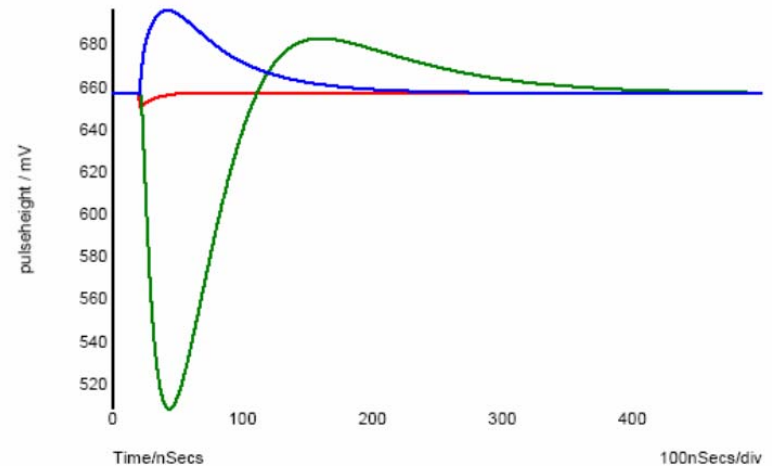
Efficiency and Average Cluster Size

- Average cluster size in the pixel detector
 - Clusters with charge >12 ke
- Quantity independent of tracking
- Each read-out groups are aligned such that maximum average cluster size is at 10 ns
- Operating point for clock phase chosen at 10 ns
 - Optimizing for track resolution needs more data



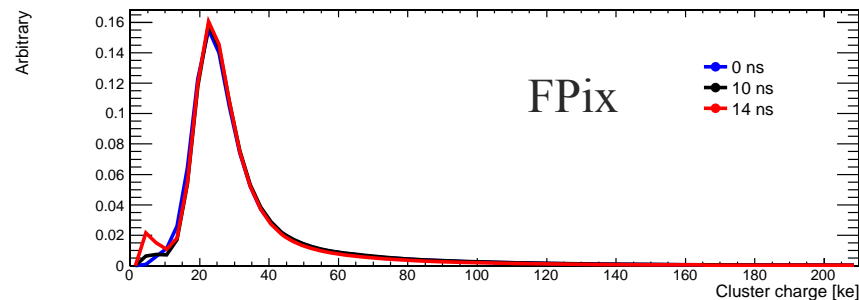
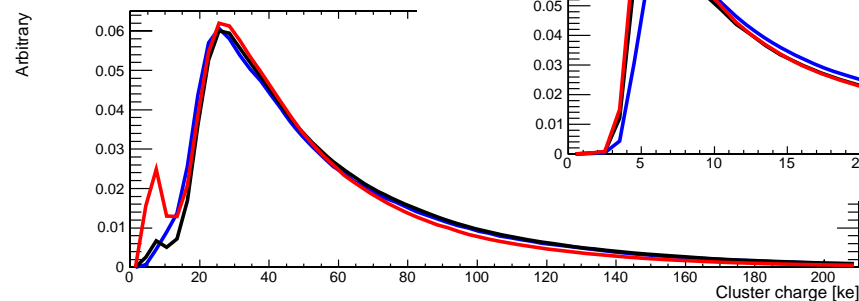
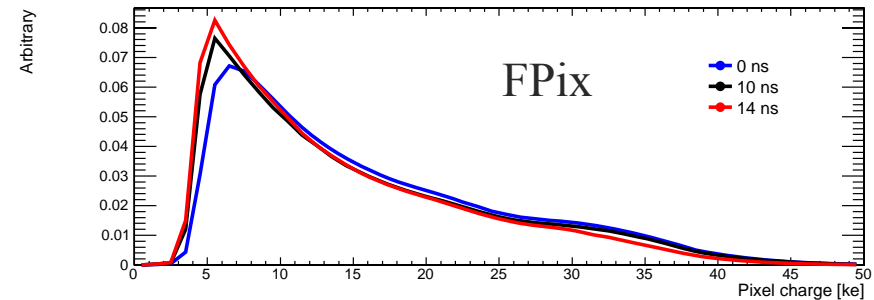
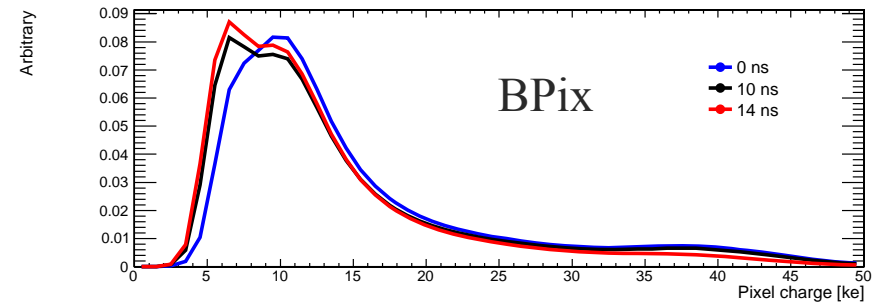
Timewalk

- Upper plot shows signal of a hit (red), after the pre-amplifier (blue) and after the shaper (green)
- Lower plot: signal of two pulses of different charge deposits
- High threshold of triggering read-out is reached at different times
- Lower limit on threshold is imposed by noise, internal cross-talk between pixels



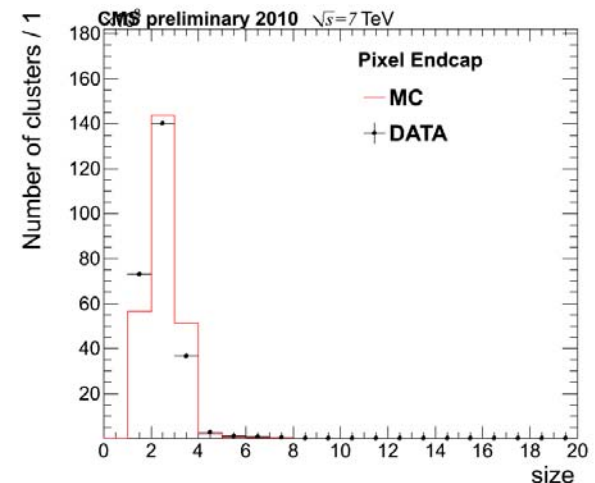
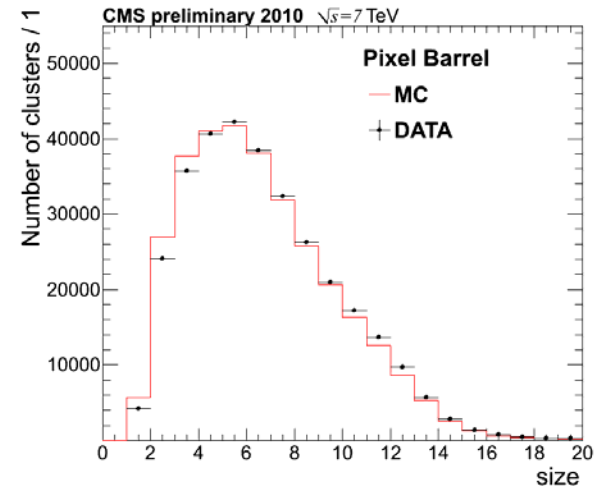
Pixel and Cluster Charge

- Time dependence of the pixel charge – effective threshold goes lower with delay
- Time dependence of cluster charge
- The 12 ke cut drops noise and some single pixel clusters
- Cluster charge in FPix is smaller, would not tolerate cutting on pixel size



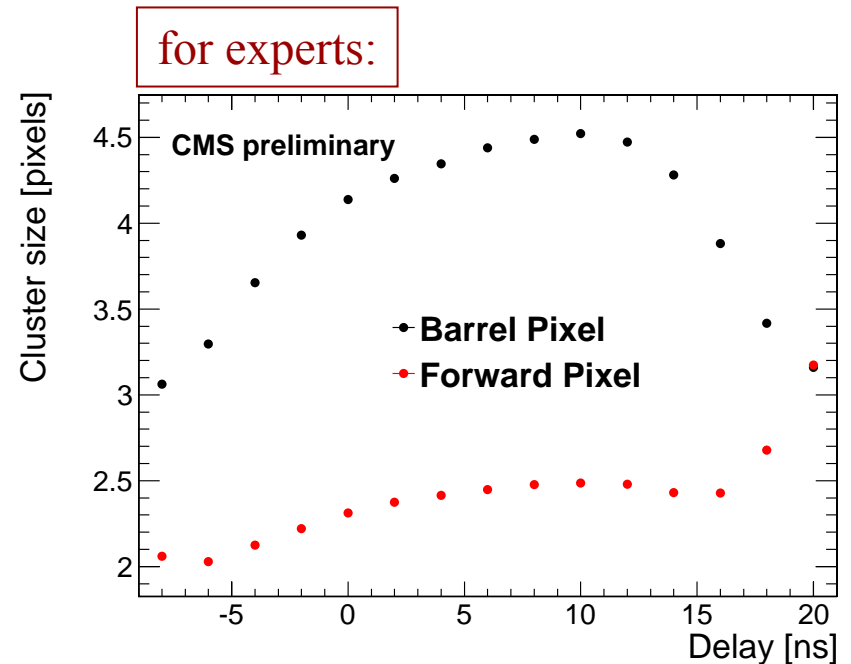
Cluster Size

- Barrel Pixel: large incidence angles in large eta results in larger clusters
 - Average charge per pixel is smaller
- Forward Pixel: all tracks have small incidence angles
 - Average charge per pixel is larger



Cluster Size vs Clock Phase

- Early phase: small pixel hits (e.g. on cluster edges) are not read out
- Late phase: large pixel hits (inside clusters) are not read out
- FPix: at late clock phase, average is biased towards large clusters
 - Smaller clusters comprised of pixels with larger average charge



Average cluster size in BPix and FPix separately

Pixel Timing

- New settings are prepared and tested
 - Did not have time for extensive running, yet, but so far looks good
 - Result was presented in Tracker Week in Elba
- In the near future, planning to take full stores with timing varried around current settings
 - More data will provide opportunity to study tracking performance (resolution of cluster position)