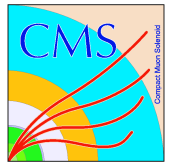


Status of CSC Alignment

Jim Pivarski

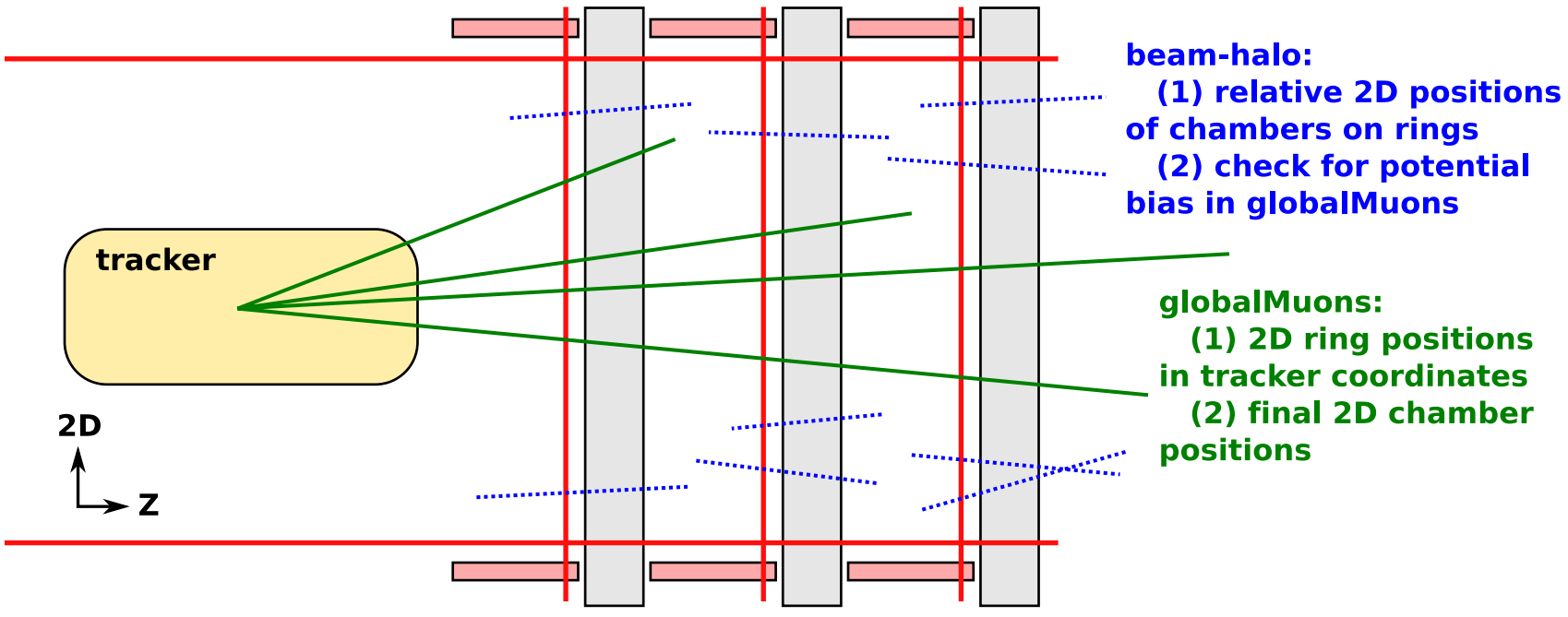
Texas A&M University

15 March, 2010

How CSC alignment fits together

for (1) short-term and (2) long-term ($\gtrsim$20 pb^{-1})

hardware alignment system:
(1) check system with 2D positions of monitored chambers
(1 & 2) provide all Z positions and angles



Outline for this talk

- Status of hardware alignment
- Beam-halo and CSC overlaps
- Next steps, simulated in MC
- Infrastructure development

- Usable datasets in CRAFT-09 and 2010
  - CRAFT-09: can cross-check with cosmics
  - 2010: can cross-check with beam-halo
  - producing initial set of alignment constants for 2010

Straight line monitors

- Fits-by-hand show better agreement with photogrammetry
  - used to debug COCOA models
- DCOPS measure $r\phi$ and z equally; tracks only measure $r\phi$ well

Transfer lines and z-bars

- Internal closure checks are in good agreement
- Also checking with fits-by-hand

Straight line monitors

R-φ Hand Fit Residuals (offsets) for SLM Lines
ME+/-2,3, B = 0

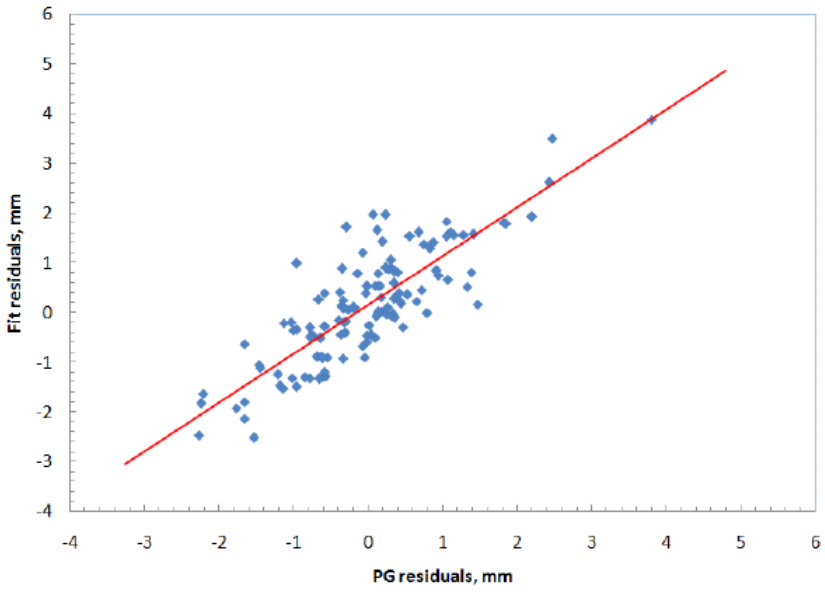
Agreement between hand fit and PG data is about of 0.5 mm

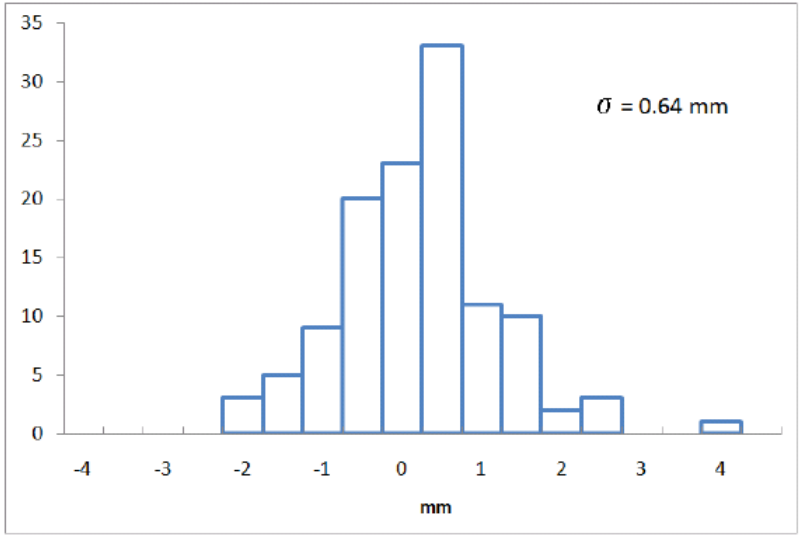
PG data is good enough to validate COCOA fit.

Oleg Prokofiev

Straight line monitors

Correlation and Resolution



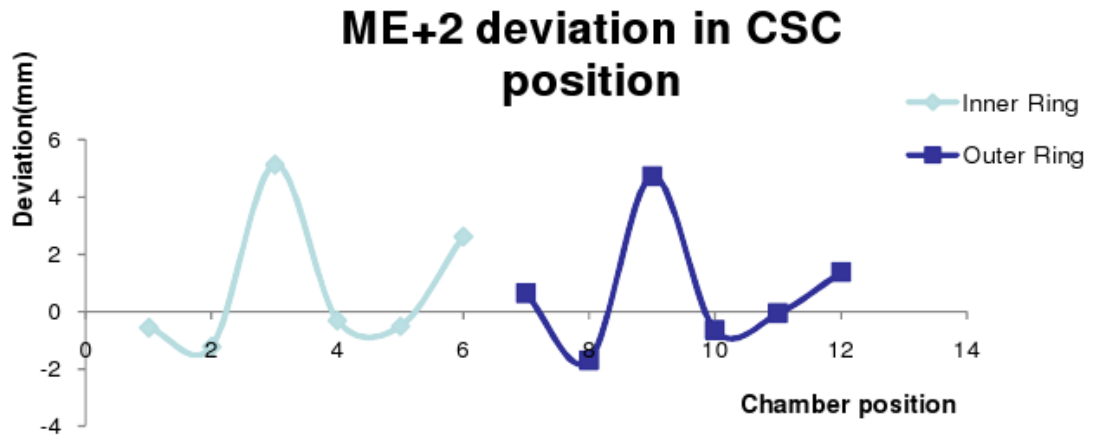


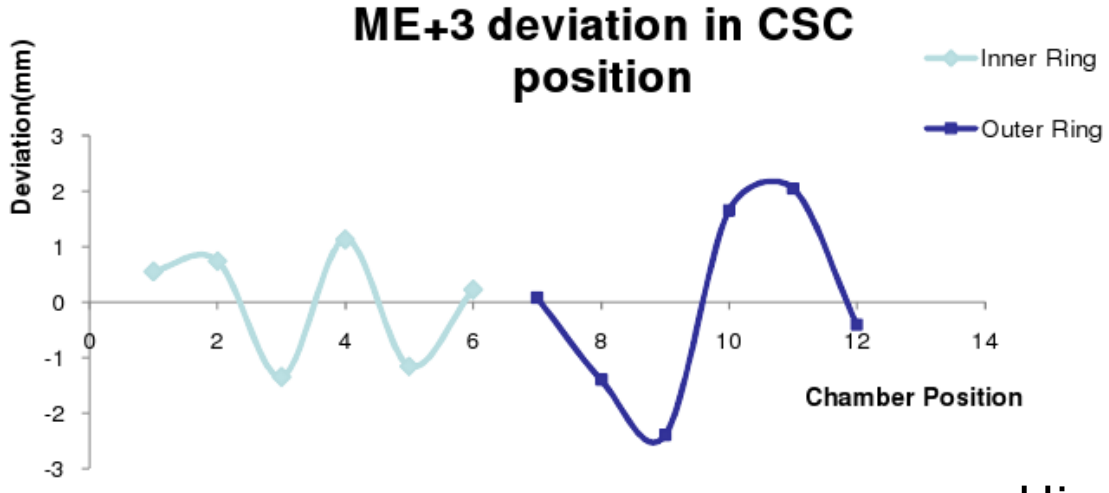
Oleg Prokofiev

- Accounting for $\sigma_{PG} = 300$ μm, DCOPS accuracy is 500 μm
- We know that the hardware is producing good data and that the photogrammetry (2007) is still relevant

Straight line monitors

- Workflow complete; needs to incorporate updates from transfer lines and corrections to COCOA model

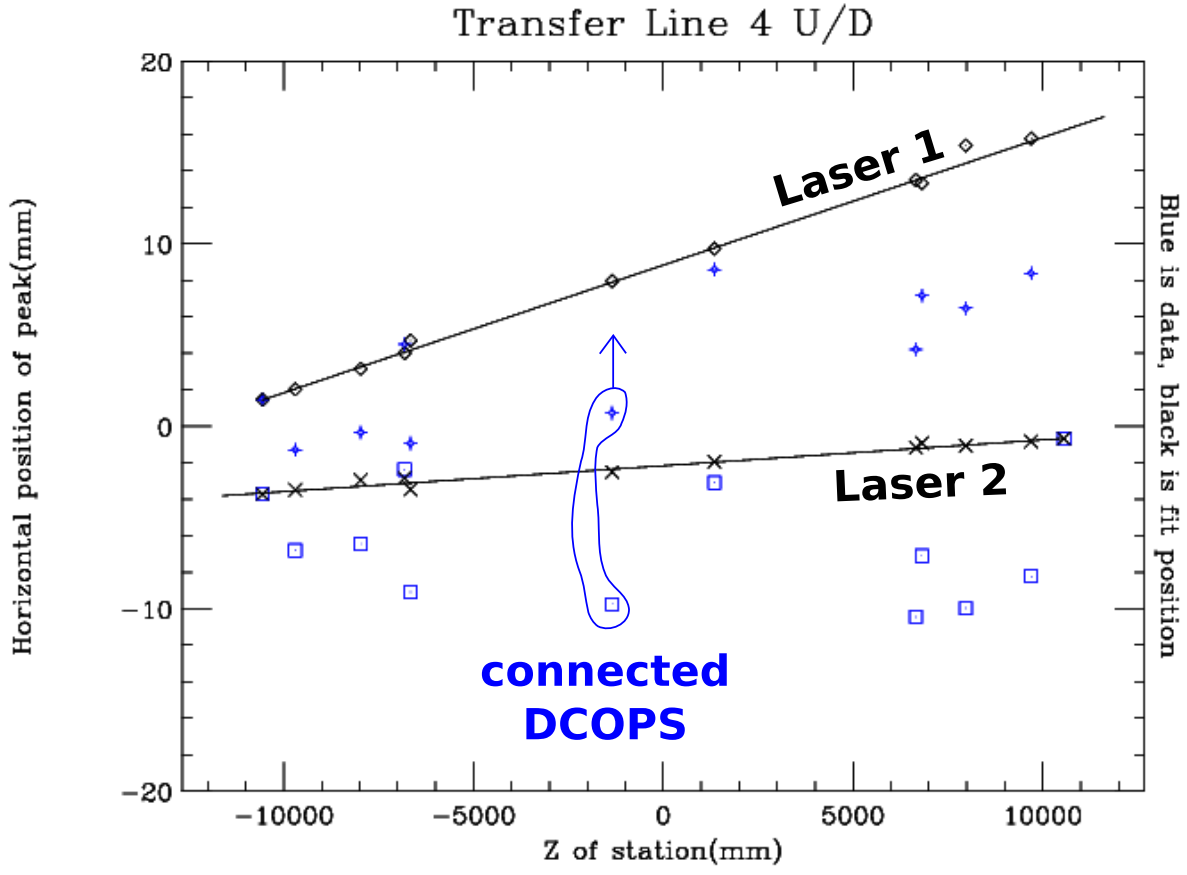




Himali Kalakhety

Transfer line analysis

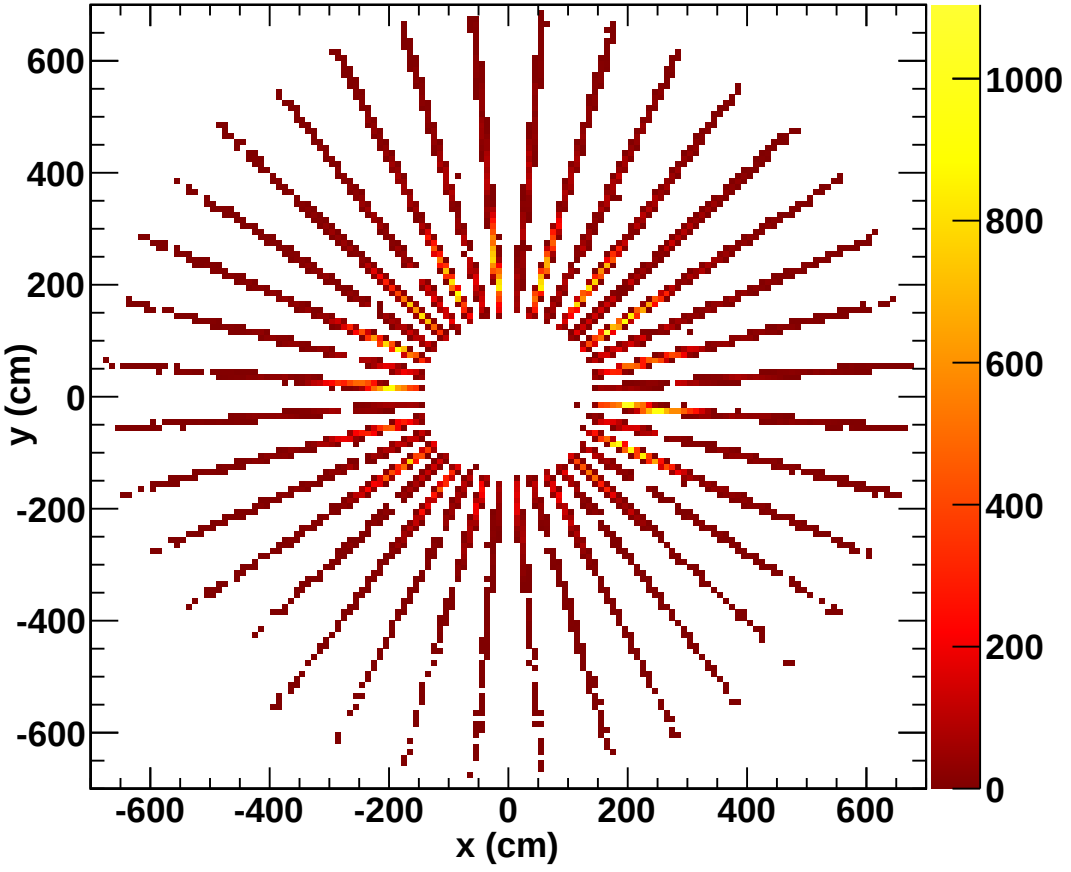
- Two laser measurements in each station agree
- Checking closure test from endpoint photogrammetry
- Also testing COCOA fits against by-hand fits (by-hand fit below)

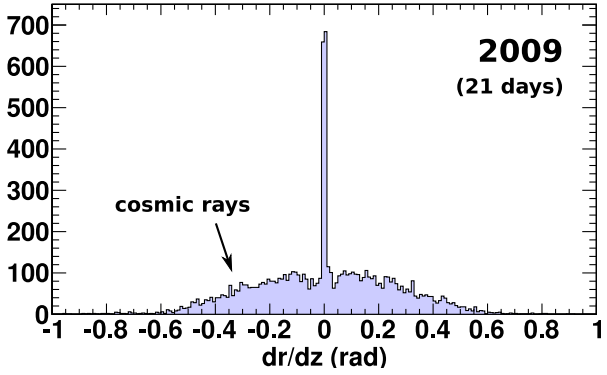


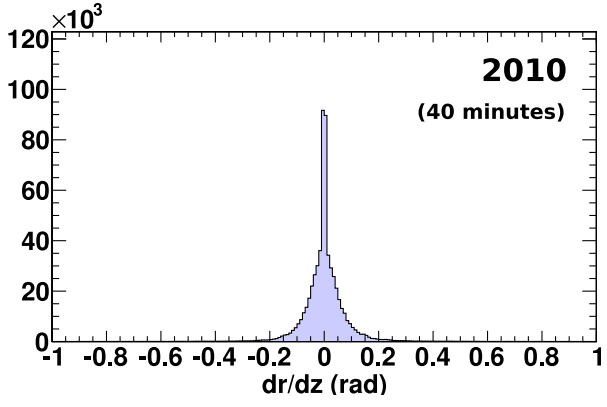
Jim Bellinger

Beam-halo data!

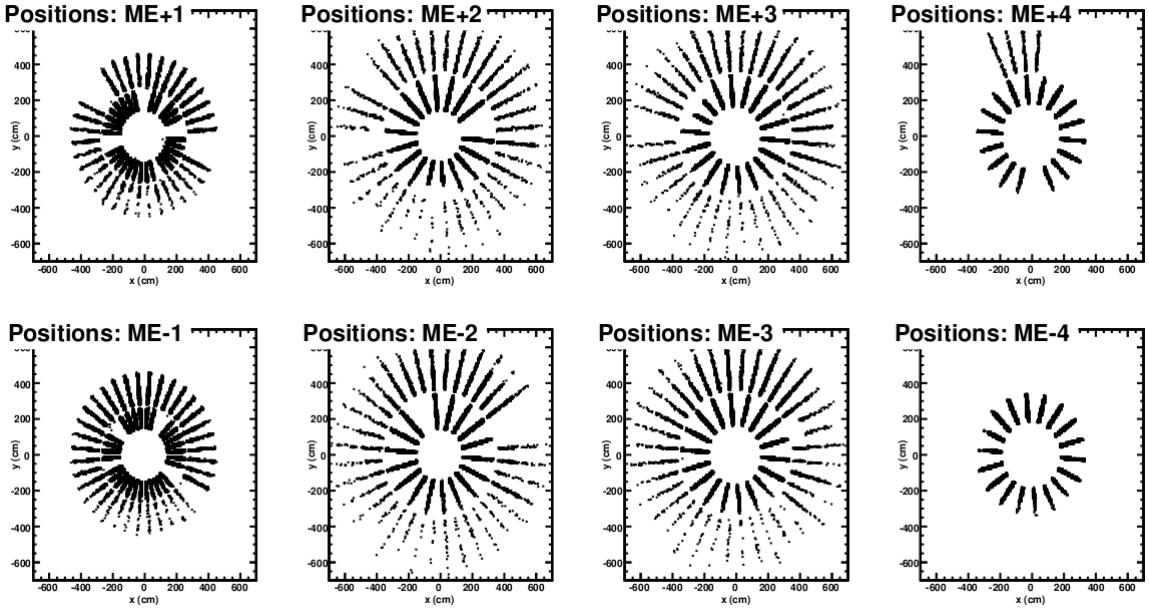
- About 1 million events in 40 minutes
- Distribution of beam-halo used in CSC-Overlaps alignment





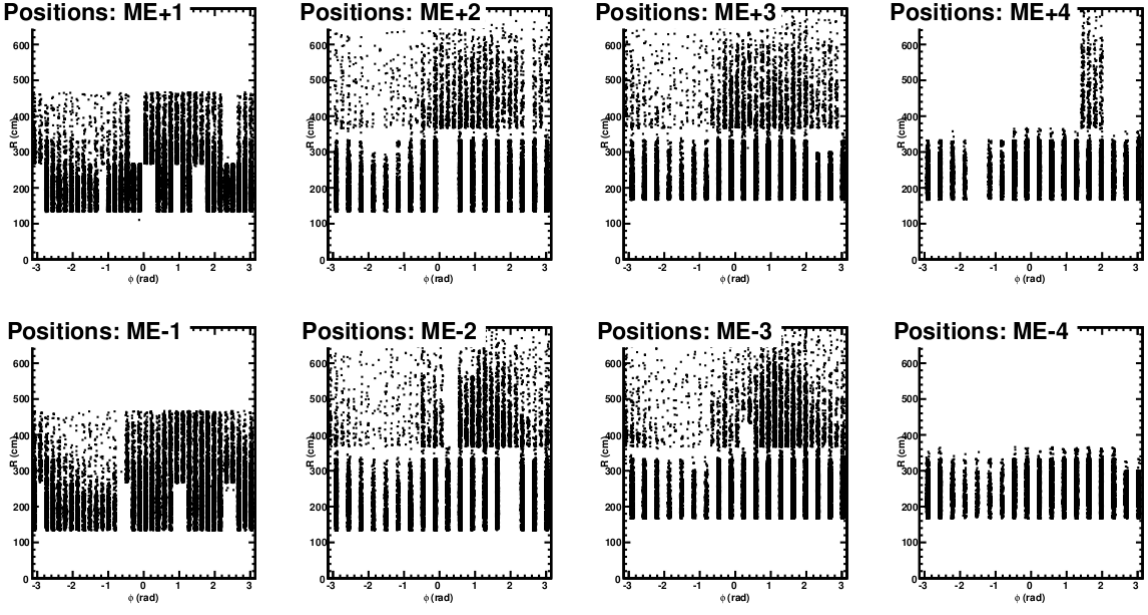


In more detail...

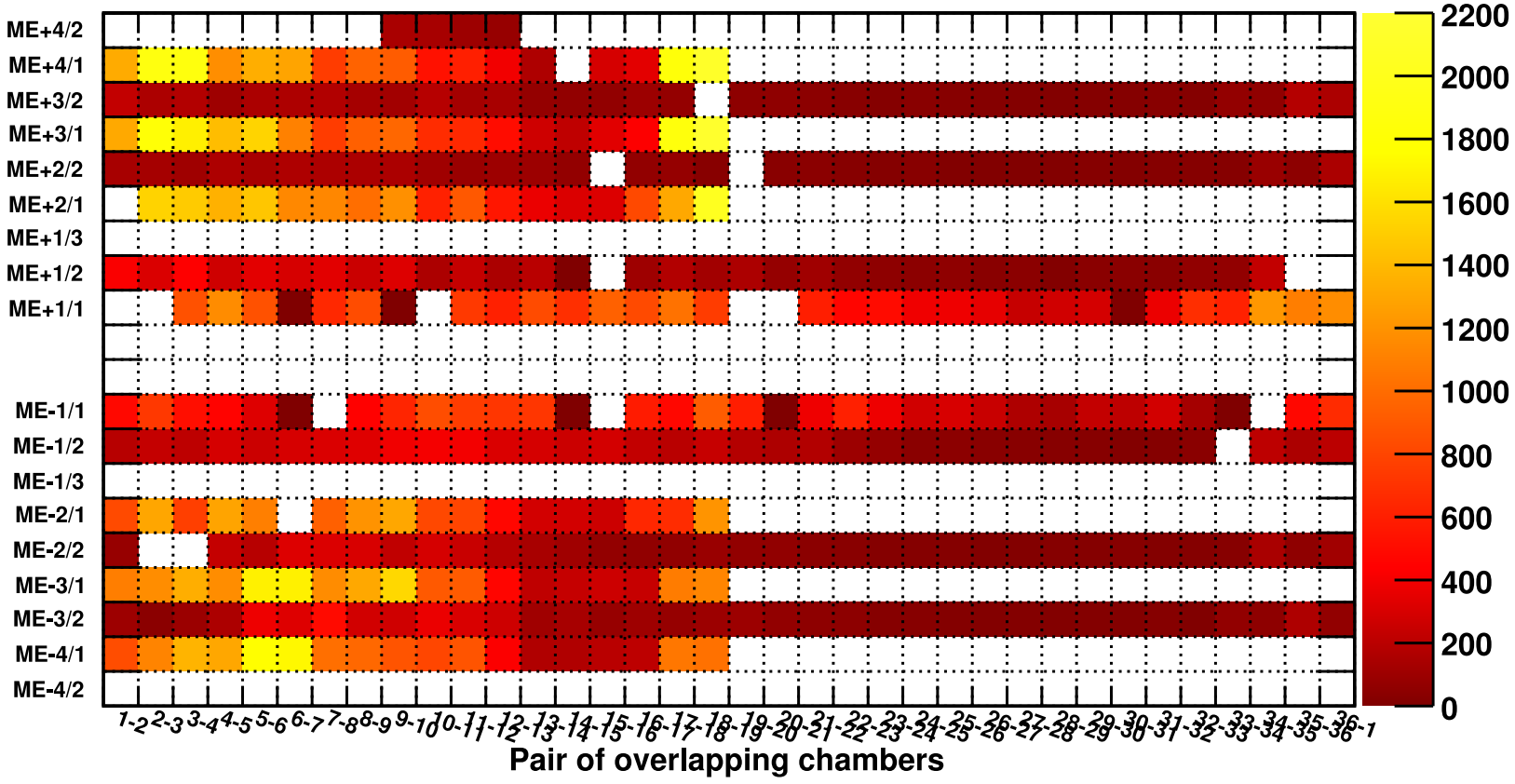


- Divided up by station
- Some overlaps are missing

- R vs. ϕ
- Innermost radius set by track-reconstruction requirements

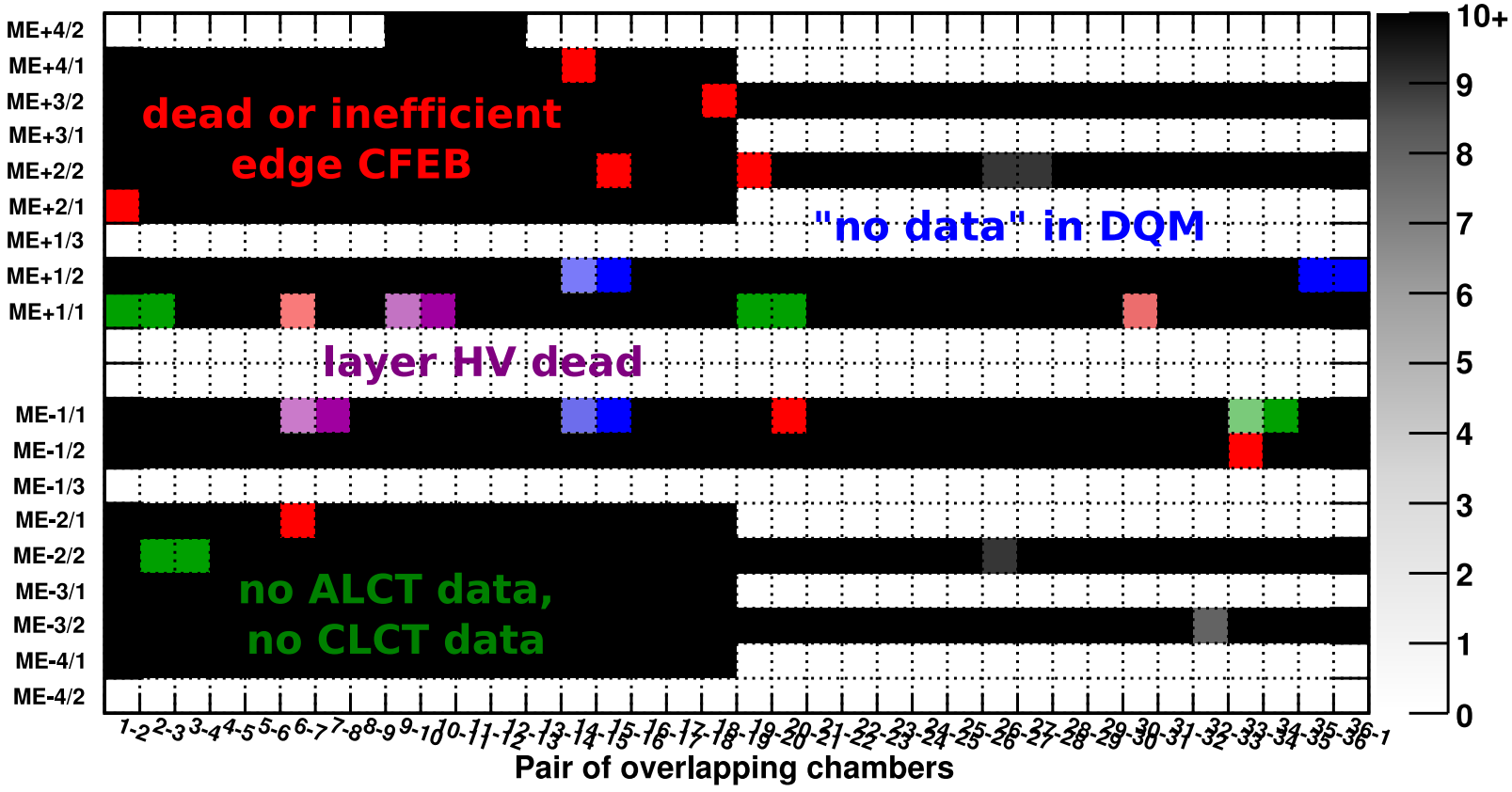


Missing overlaps



- 4 complete rings, 6 "almost complete" rings, out of 15
  - "almost": only one gap, which we can fill by *assuming* closure

Missing overlaps

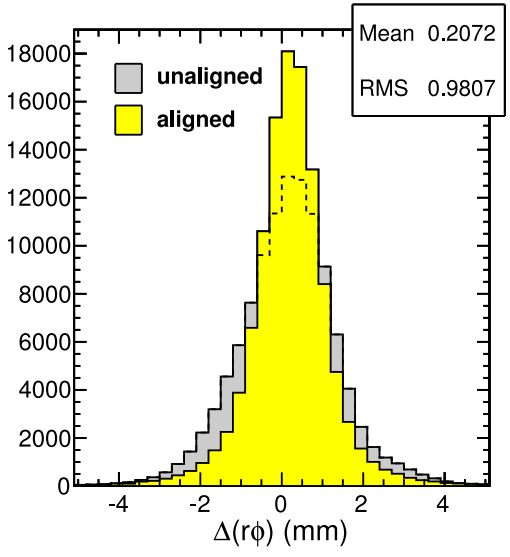


- 4 complete rings, 6 "almost complete" rings, out of 15
  - "almost": only one gap, which we can fill by *assuming* closure
- Most of the problems are edge CFEBs (1 or 5)

Closure consistency check

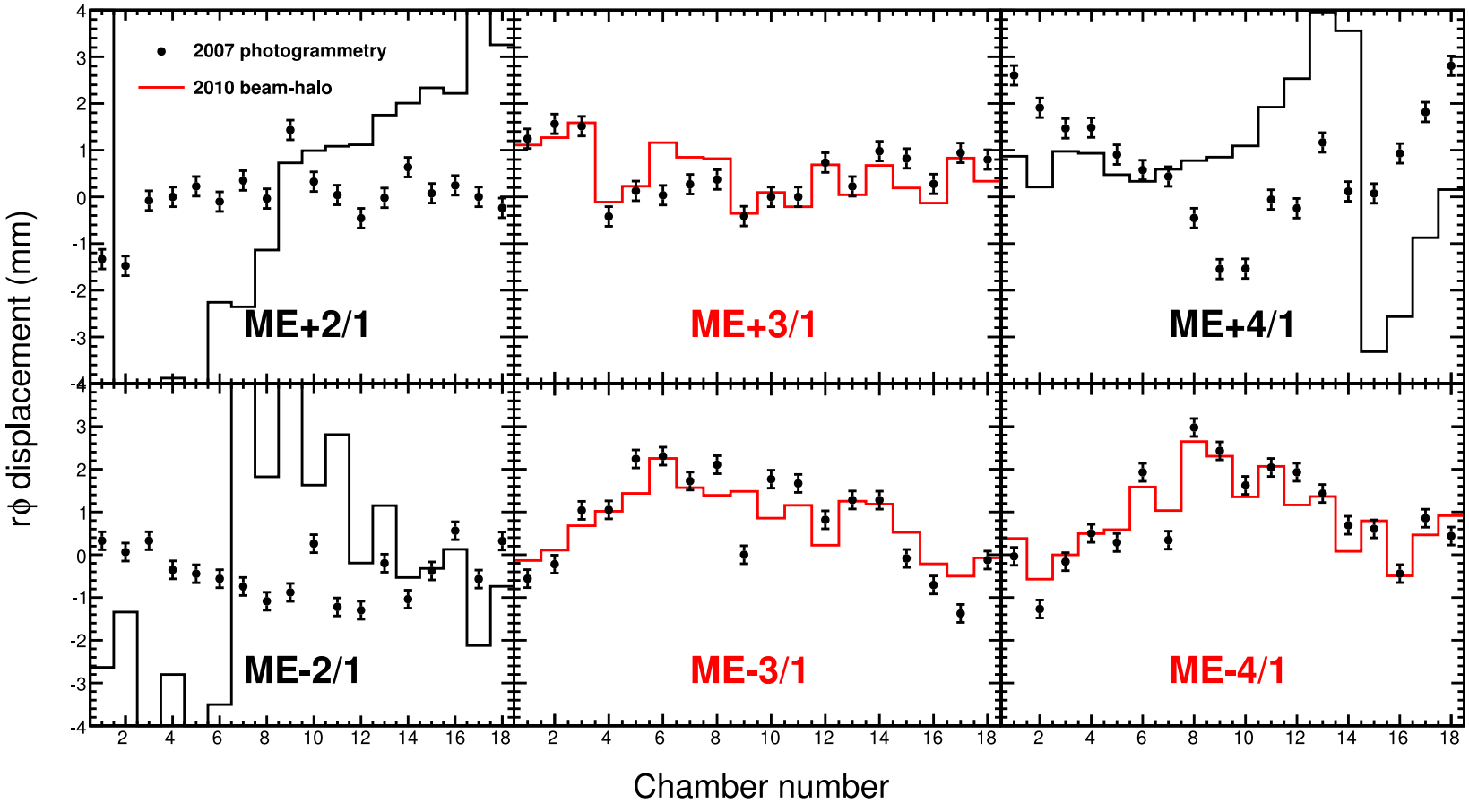
- Closure per chamber $= \frac{1}{N}\sum_{i}^{N} \Delta(r\phi)_i - \Delta(r\phi)_{i+1}$ $\quad N = 18$ or 36
  - independent of alignment
  - can only be computed for complete rings
  - non-zero value interferes with alignment of incomplete rings

	2008	2010
ME+3/1		$+298 \pm 9$ μm
ME−2/1	-40 ± 23 μm	
ME−3/1	-20 ± 28 μm	$+486 \pm 9$ μm
ME−3/2		$+572 \pm 27$ μm
ME−4/1		$+440 \pm 10$ μm



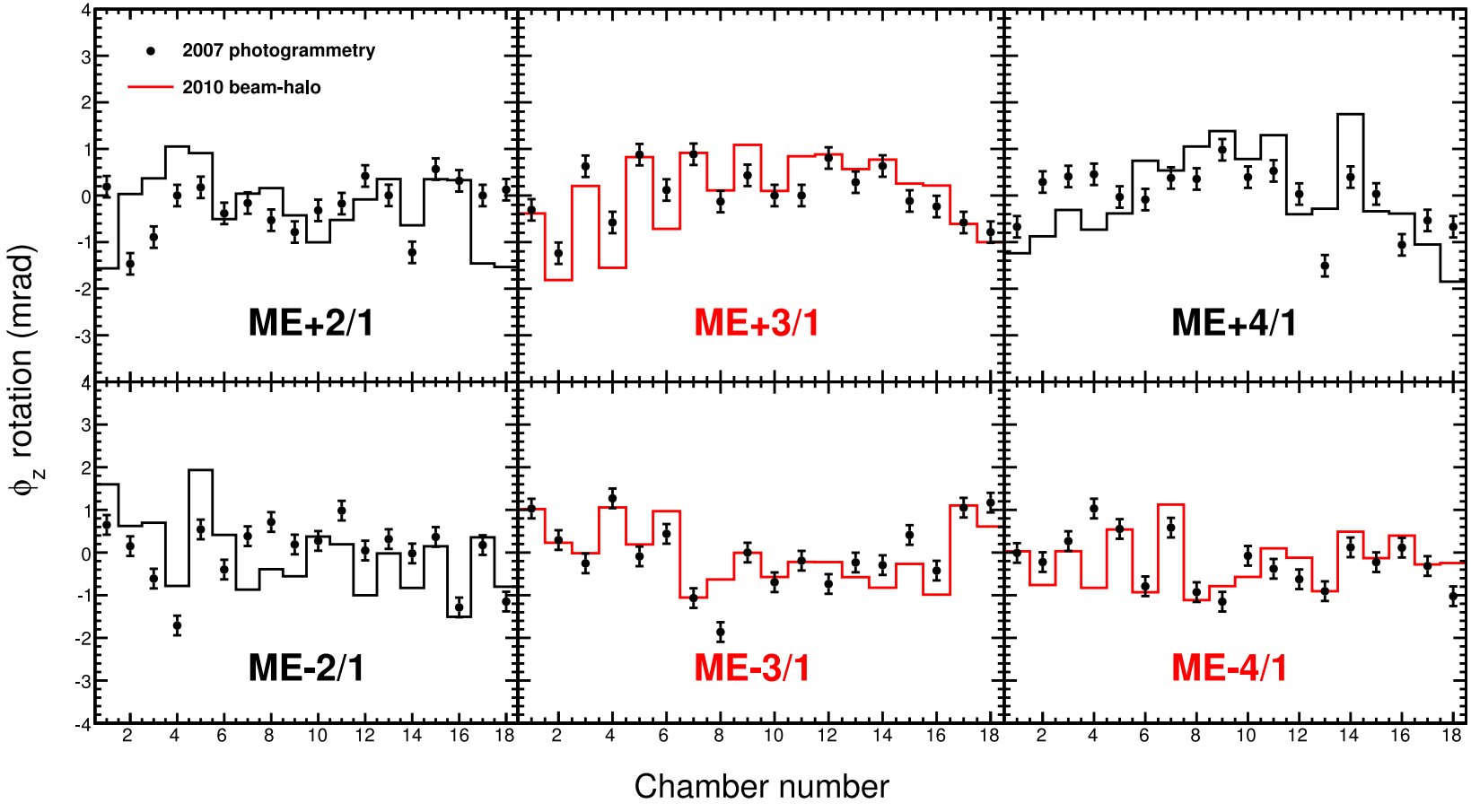
- In 2008, an 800 μm effect was caused by a $\sim$10 μm error in strip width; this new effect is smaller

Inner ring results



- Complete rings in red are more reliable
- Incomplete rings have 500 μm $\times$ 17 $=$ 8 mm errors at the location of the gap that is filled-in by assuming zero closure

Inner ring results



- Complete rings in red are more reliable
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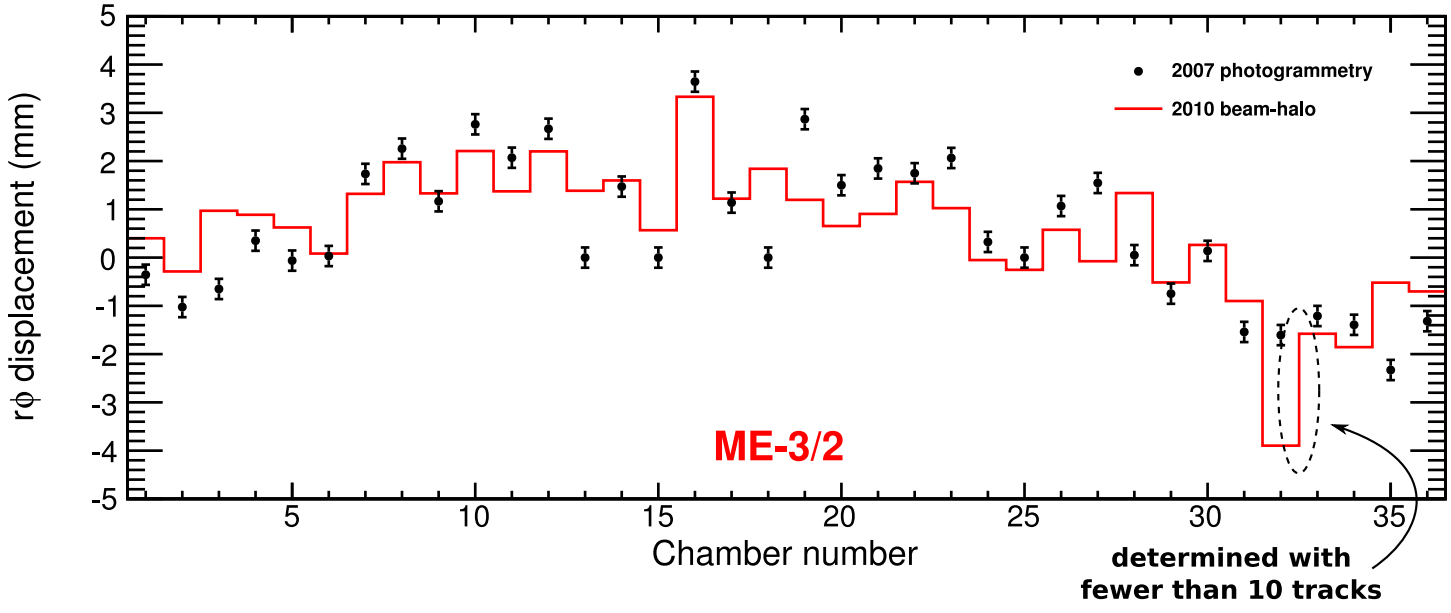
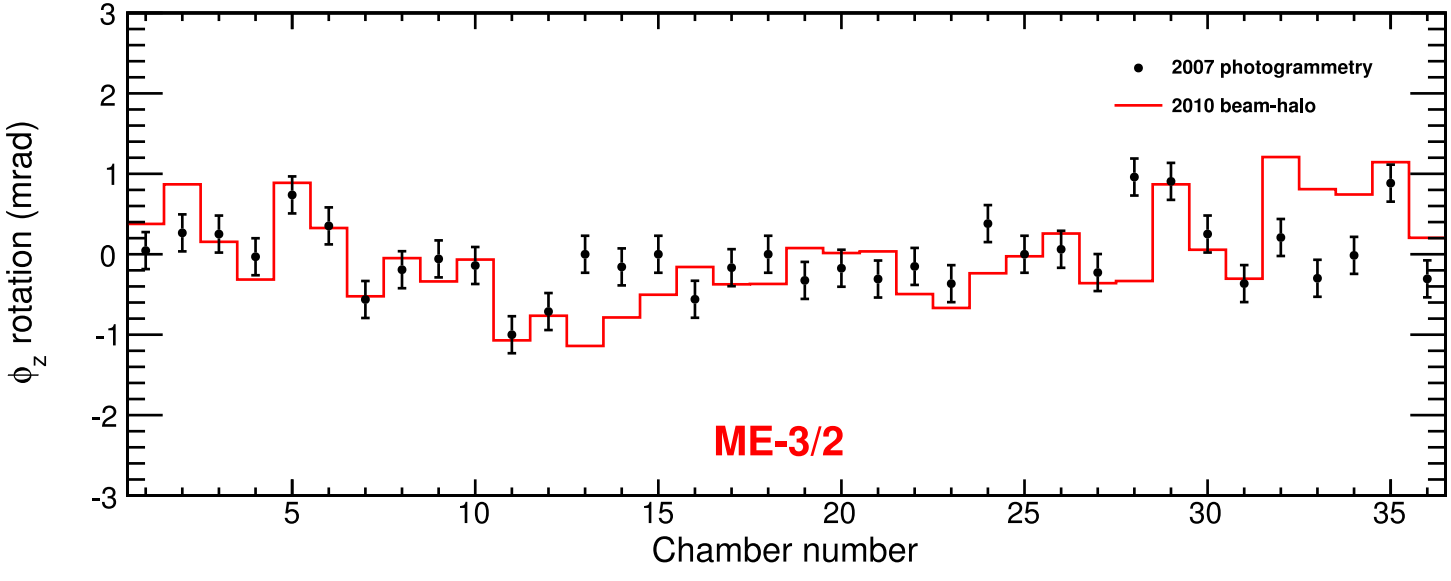
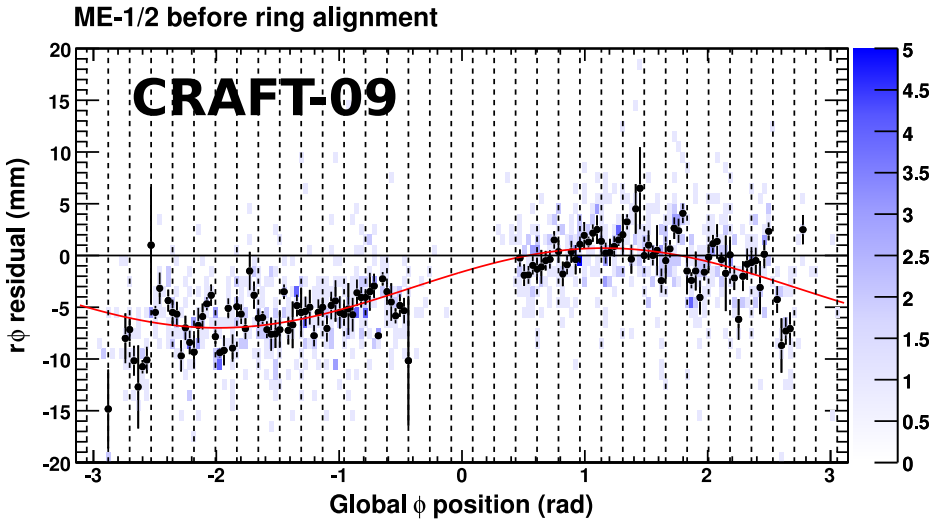
First complete outer-ring

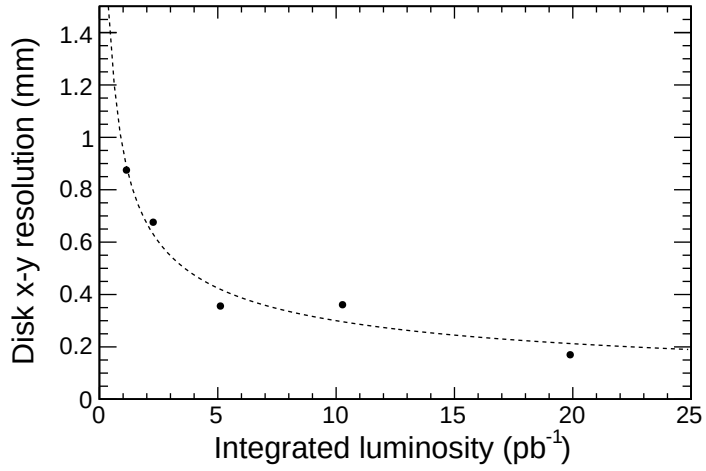


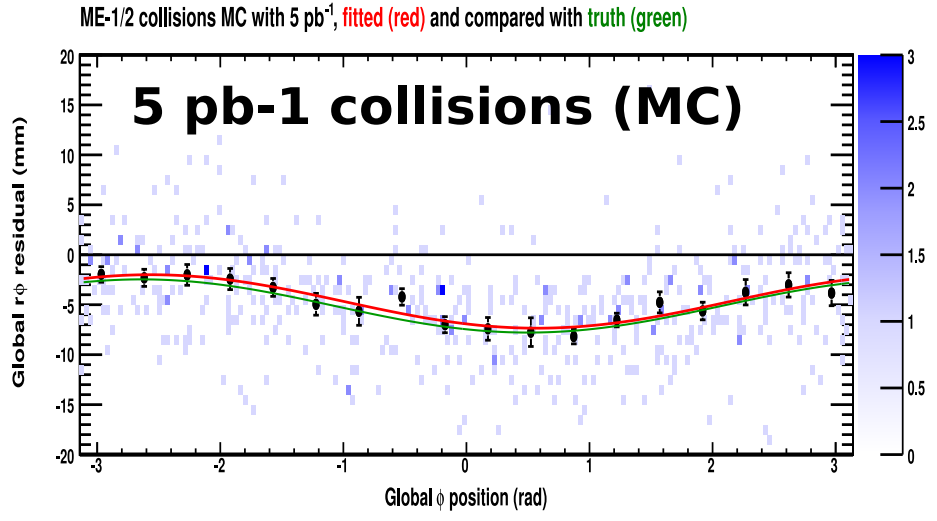


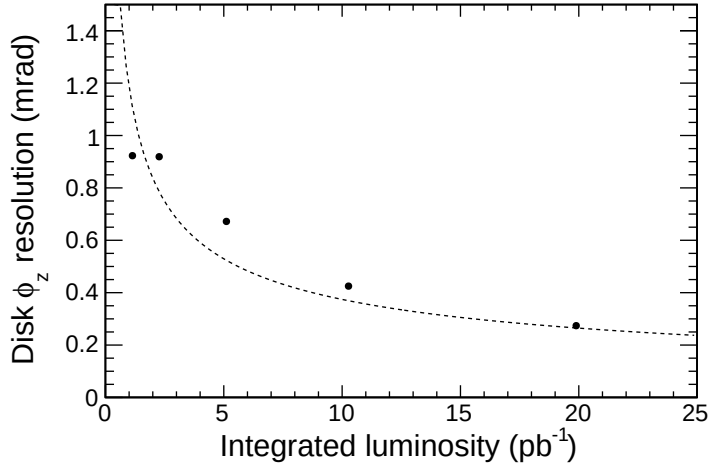
Connecting rings to tracker

- Established technique with cosmics; completes endcap alignment with 400 μm accuracy at 5 pb^{-1} if rings can be aligned internally



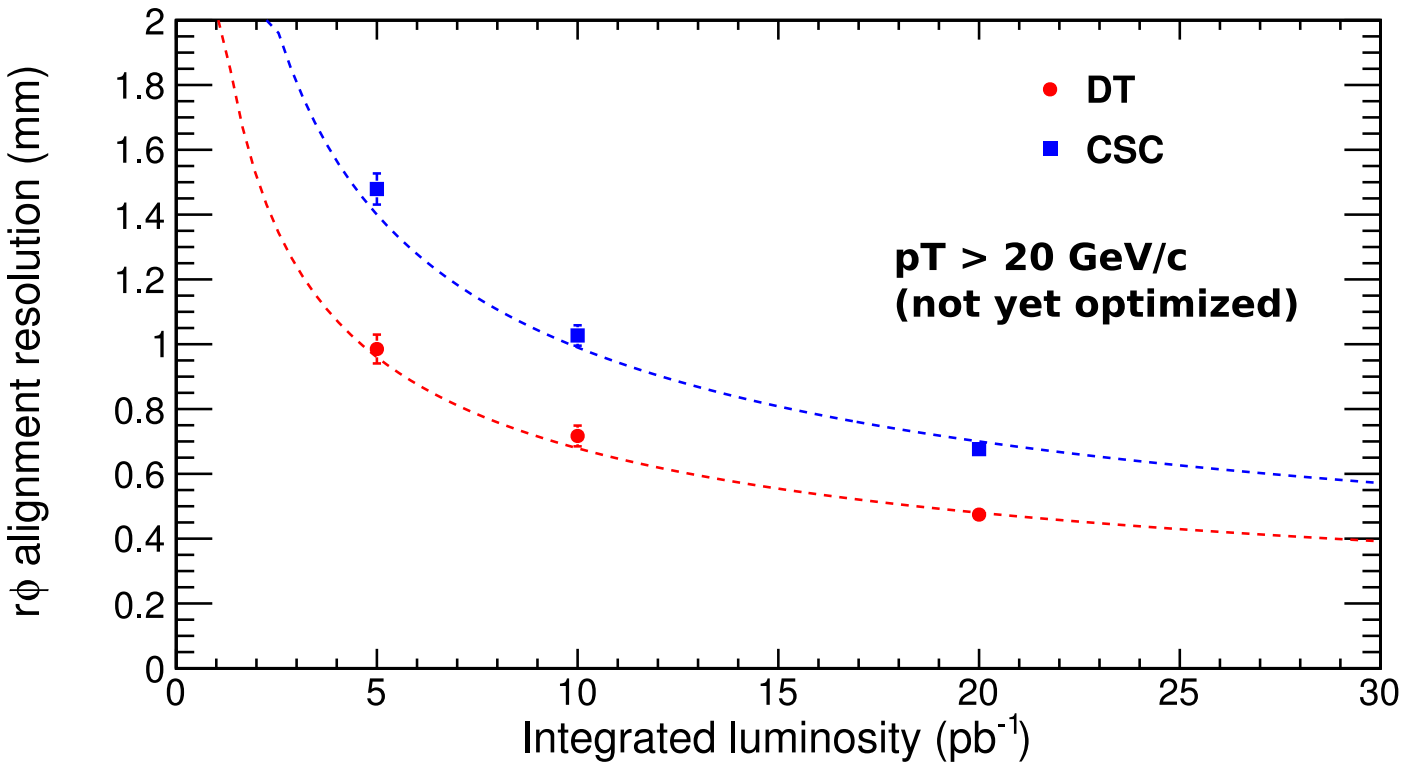






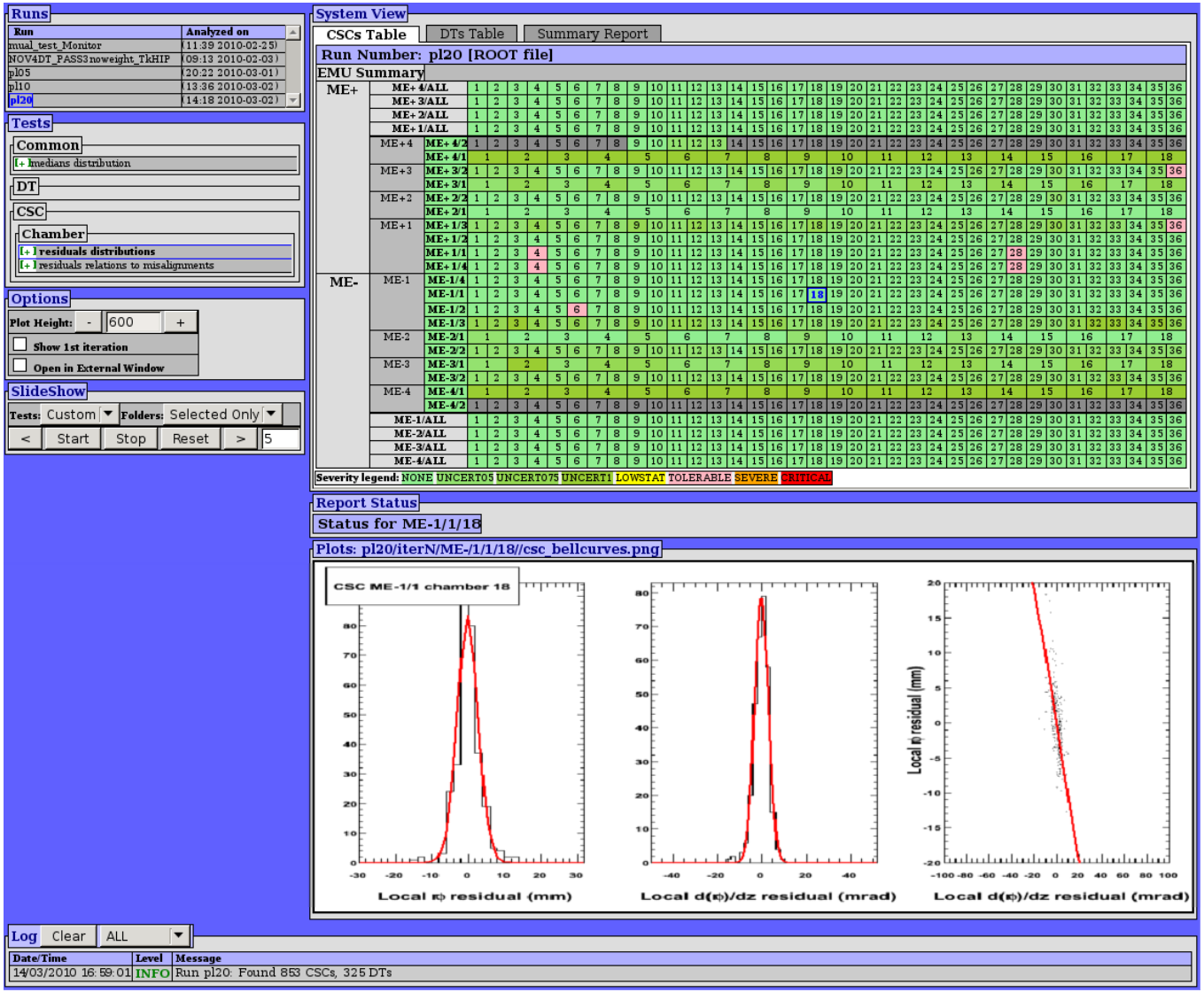
Reference-Target algorithm

- Alignment of each chamber relative to the tracker individually: does not require complete rings
- Comparison of CSC-Overlaps against Reference-Target would be a powerful systematics check, even if only in a few rings
- Aysen Tatarinov (TAMU) is learning the system from the inside out, and solved the problem of Minuit failing in some low-statistics fits

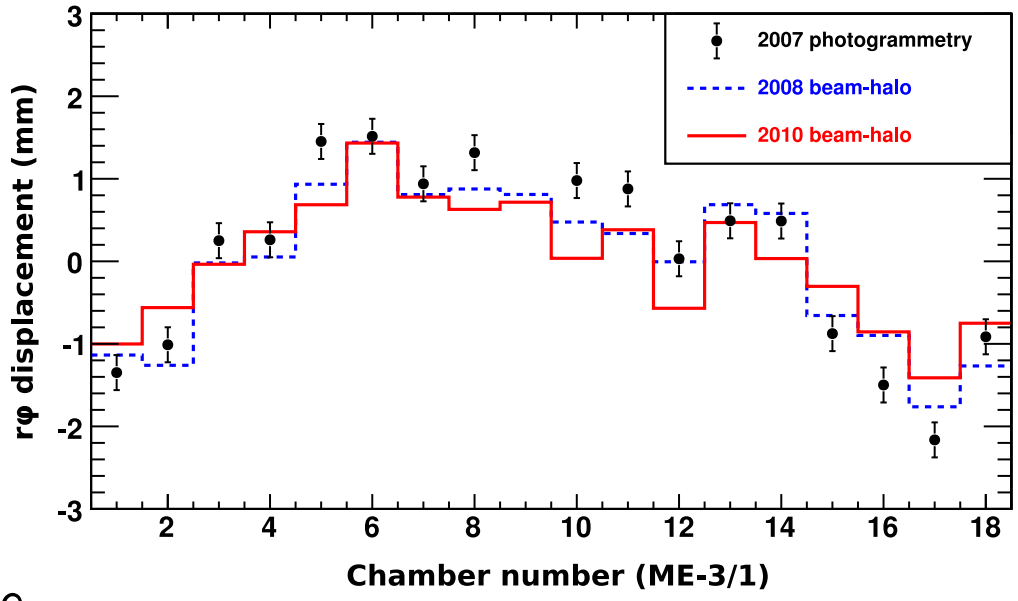


Infrastructure developments

- Alignment Quality Monitor, by Vadim Khotilovich
- Much easier than sifting through thousands of plots!



Conclusions



- Long-standing issues in hardware alignment reconstruction are being solved
- Beam-halo run was fruitful
  - obtained up-to-date constants for 4 rings
  - discovered a new closure issue
  - 2007 photogrammetry is still relevant
- Next steps have all been tested in data and resolution vs. integrated luminosity estimated
- New alignment group members are becoming well-versed and expanding functionality of the system