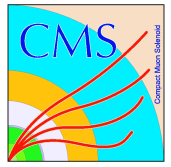
Beam-Halo Alignment

Jim Pivarski, Alexei Safonov, Aysen Tatarinov, Vadim Khotilovich

Texas A&M University

15 March, 2010

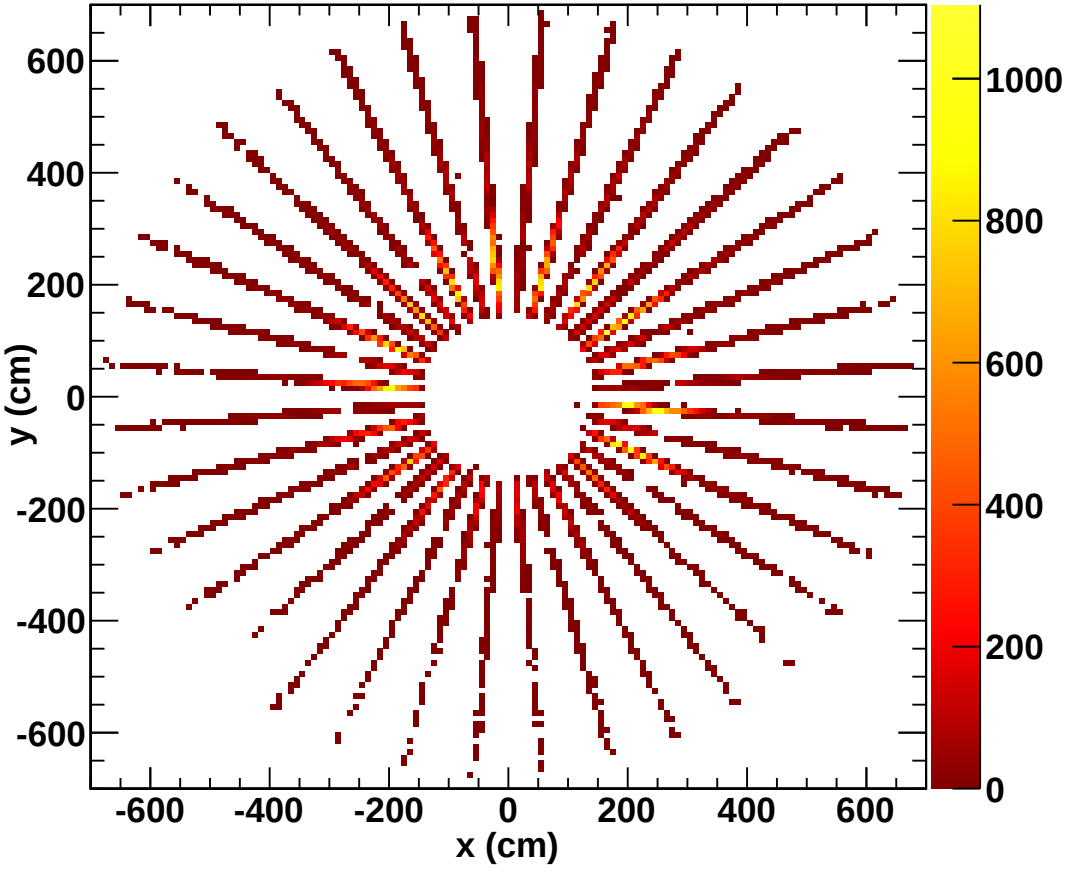
Outline

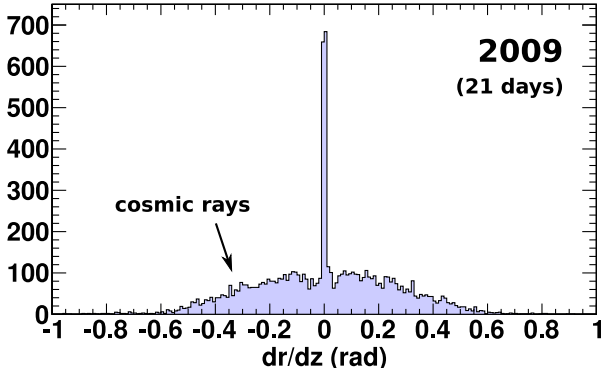


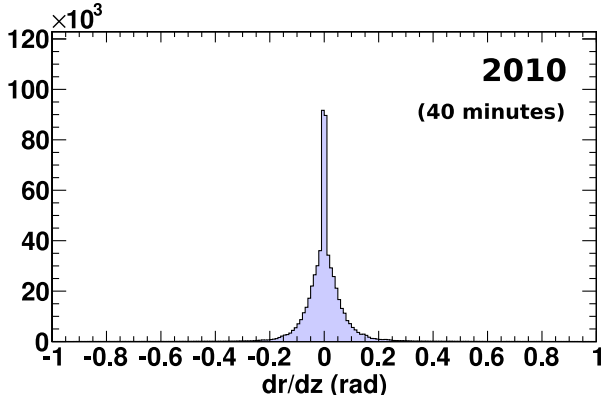
- Analysis of beam halo data, missing chambers
- Closure constraint
- Alignment results, compared with photogrammetry
- Resolution versus integrated luminosity projections
- Infrastructure developments

Beam-halo data!

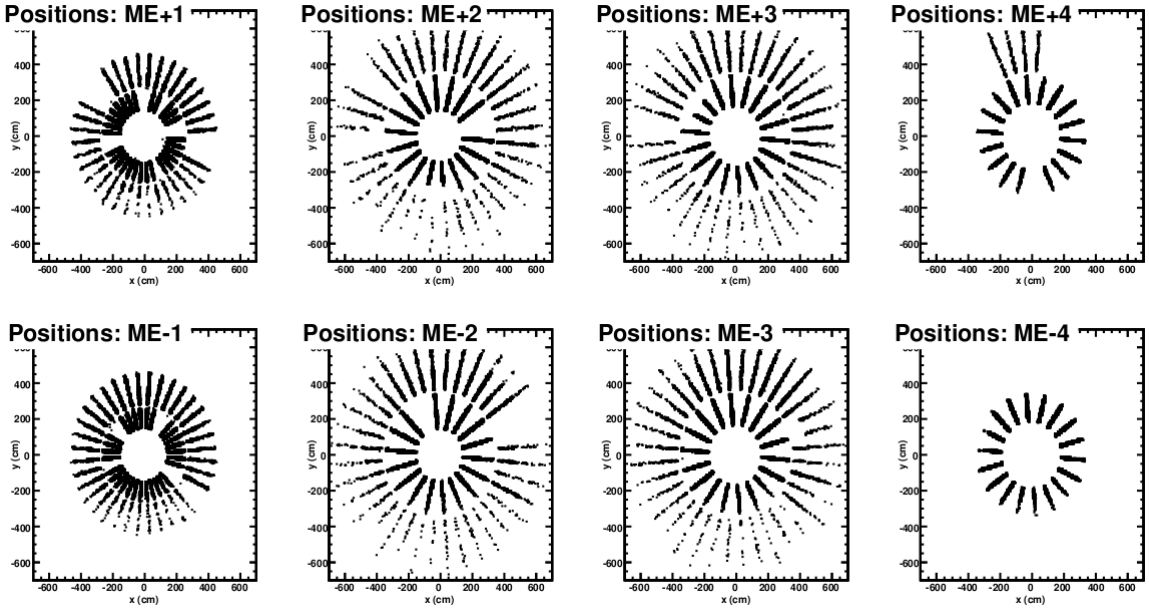
- About 1 million events in 40 minutes
- Distribution of beam-halo used in CSC-Overlaps alignment





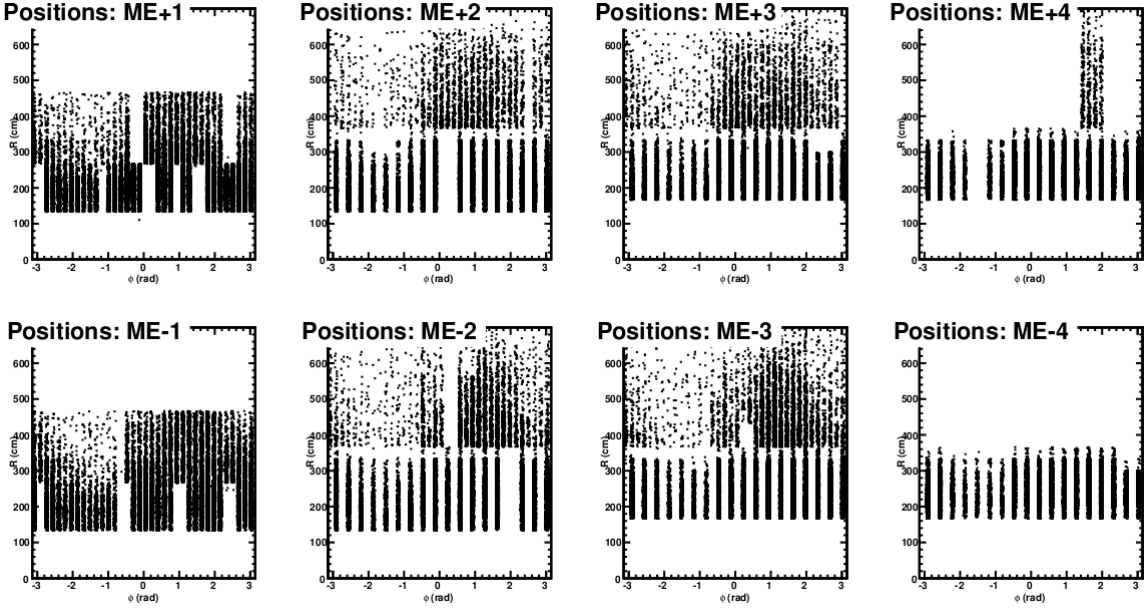


In more detail...

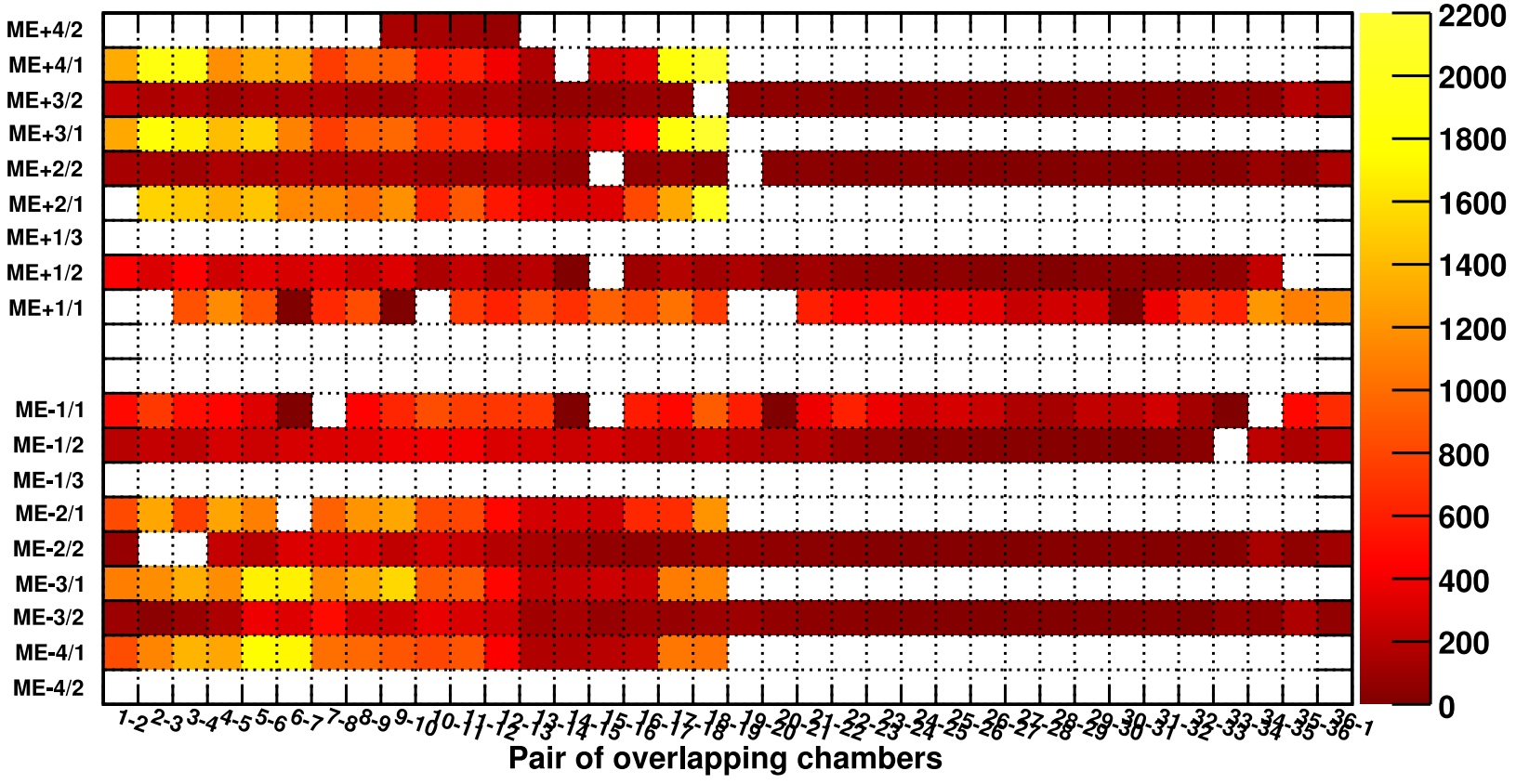


- Divided up by station
- Some overlaps are missing

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

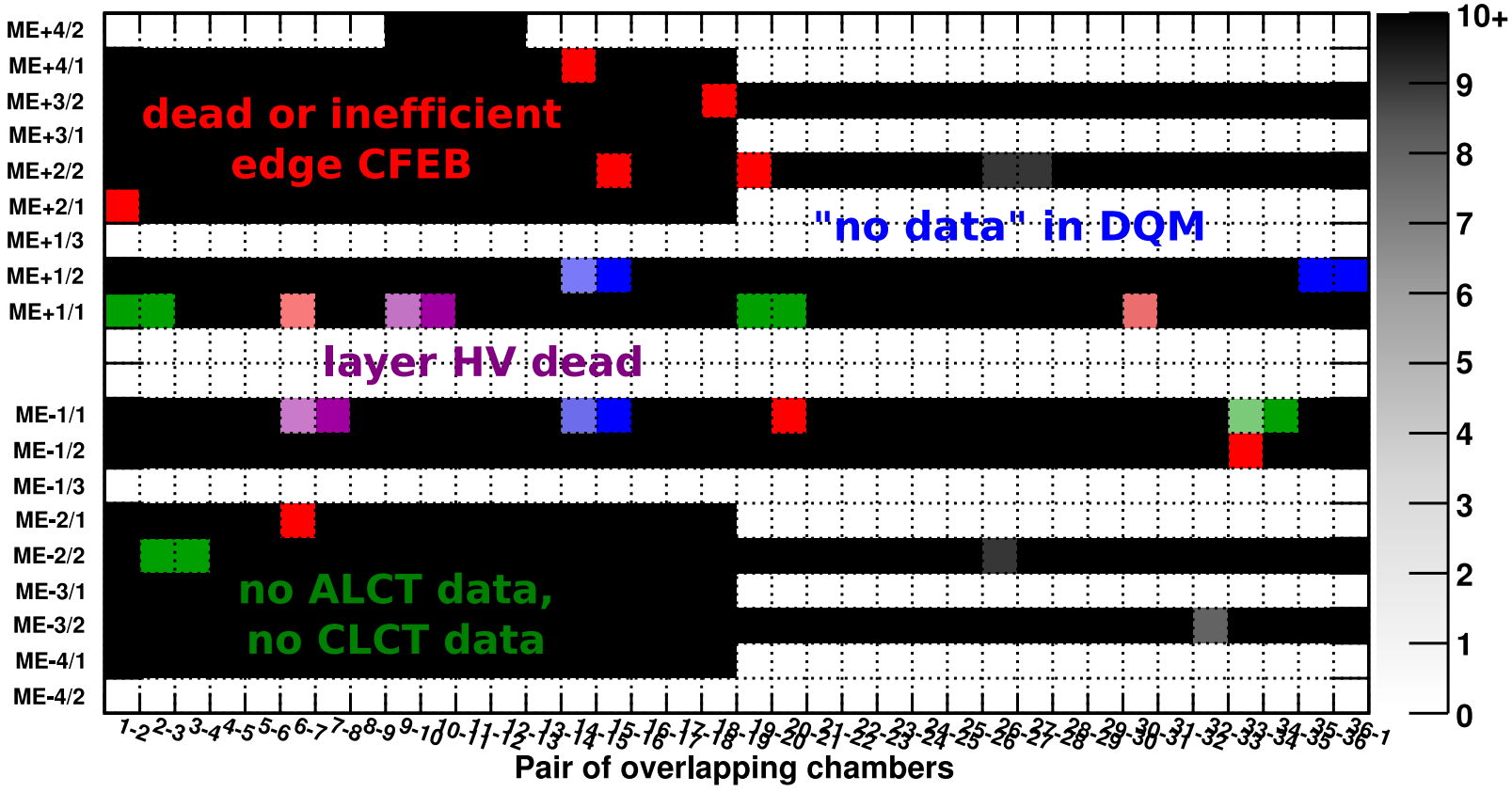


Missing overlaps



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

Missing overlaps

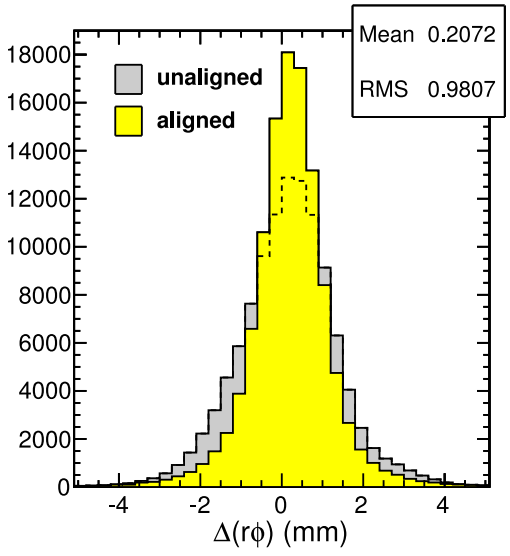


- 4 complete rings, 6 "almost complete" rings, out of 15
  - "almost": only one gap, which we can fill by *assuming* closure
- Most of the problems are edge CFEBs (1 or 5)

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



- Strip-width effect in 2008 (before correction): 800 μm

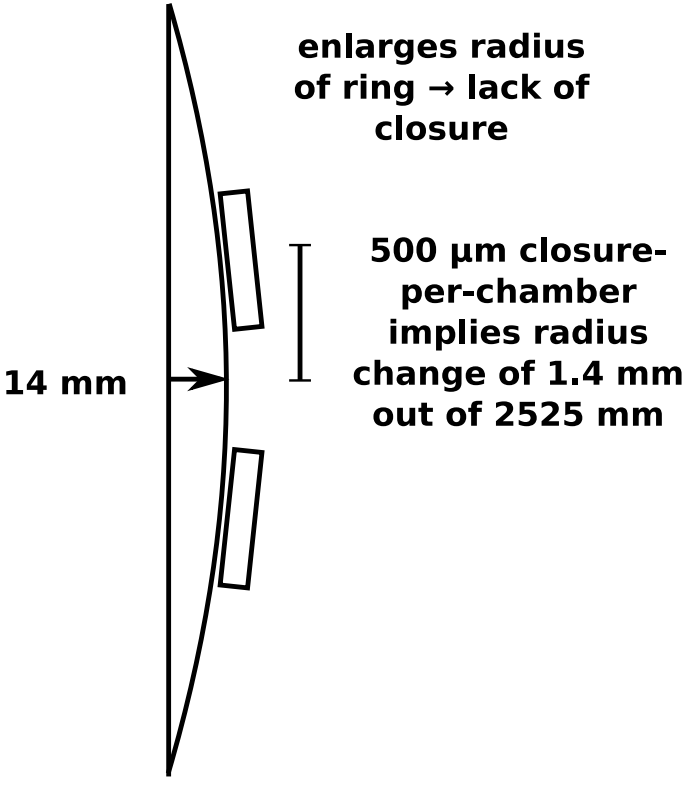
Hypothesis #1: curving tracks

- What's different between the 2008 and 2010 data? Magnetic field
- Radial component of magnetic field can affect beam-halo, parallel with the beamline; field is significantly radial in endcap
- In the algorithm, tracks are assumed to propagate linearly (over a 10's of cm distance through gas volume)
- Perhaps we're seeing a bias from curving tracks?

- No. Select straight $|p| > 100$ GeV tracks
- No significant effect on closure:

	2008 (no field)	2010, all momenta	$\|p\| > 100$ GeV
ME+3/1		$+298 \pm 9$ μm	$+188 \pm 53$ μm
ME−3/1	-20 ± 28 μm	$+486 \pm 9$ μm	$+483 \pm 50$ μm

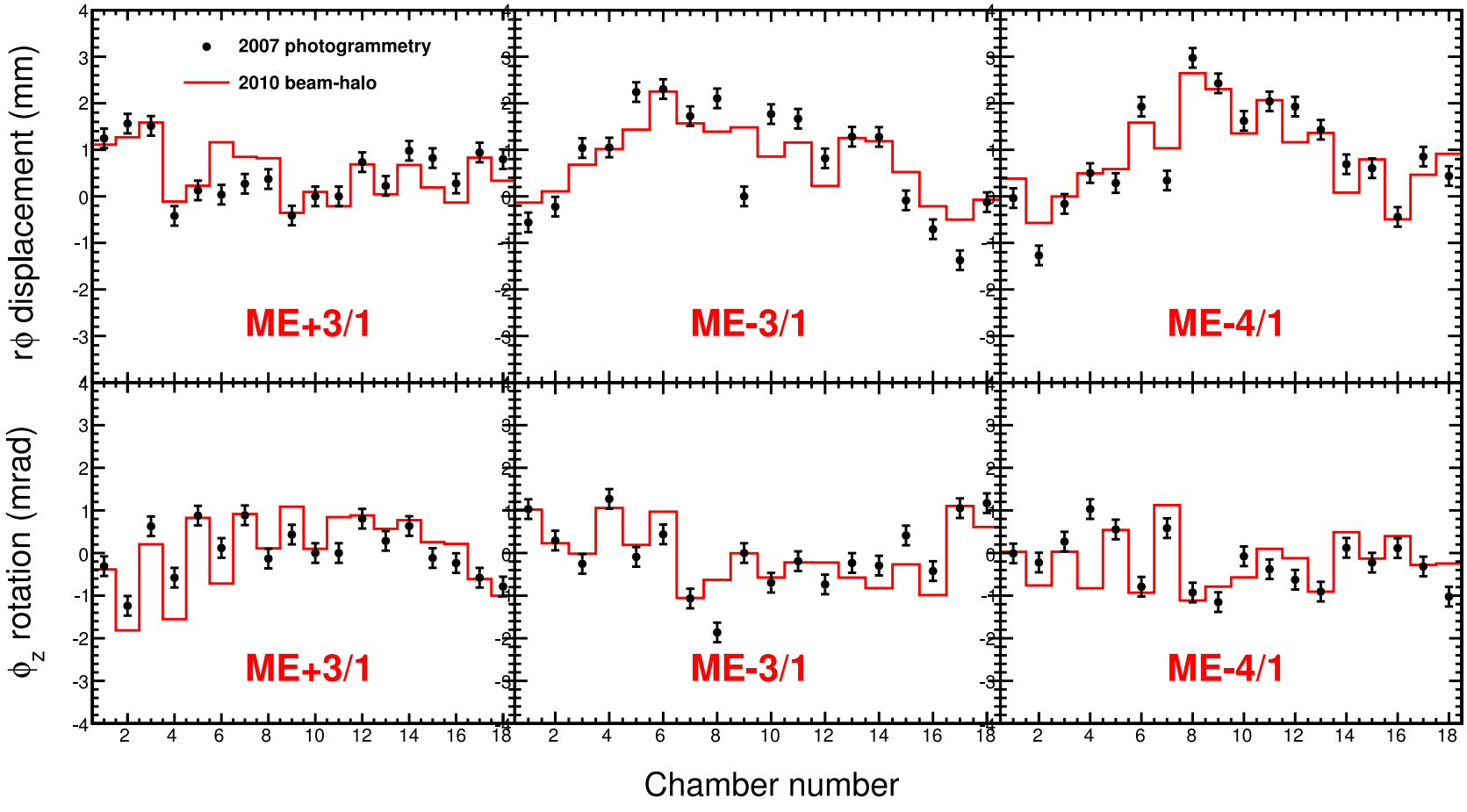
Hypothesis #2: curving disks



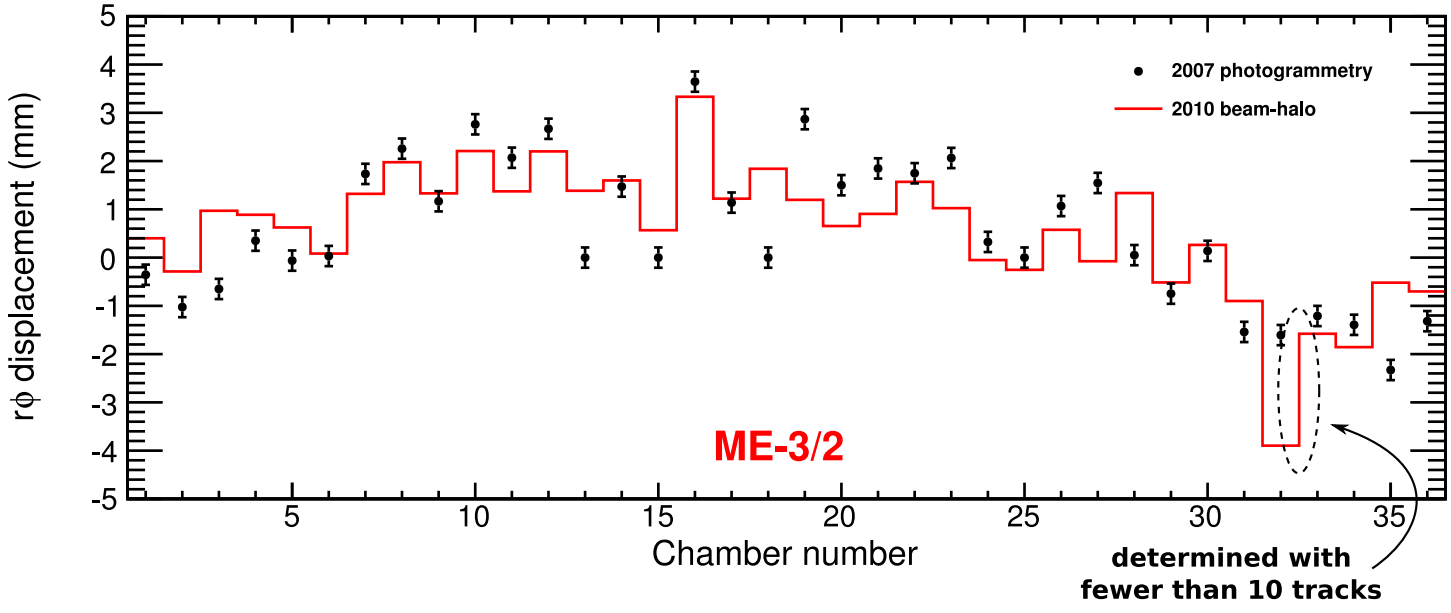
- Δcircumference = $N \cdot$ closure-per-chamber $= 2\pi\,\Delta$radius
- Should try realistic disk-bending simulation from Oleg
- With correct closure in complete rings, we can align "almost complete" rings by assuming closure = zero, but it wouldn't be valid now

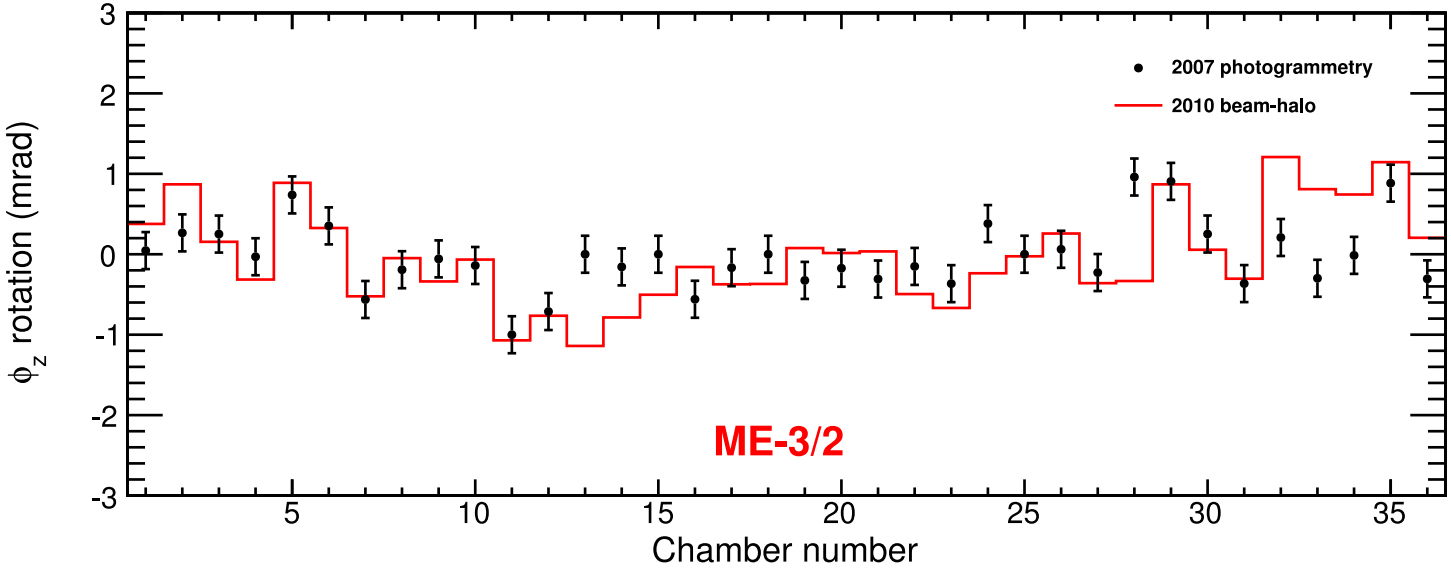
Inner ring results

- Complete rings only



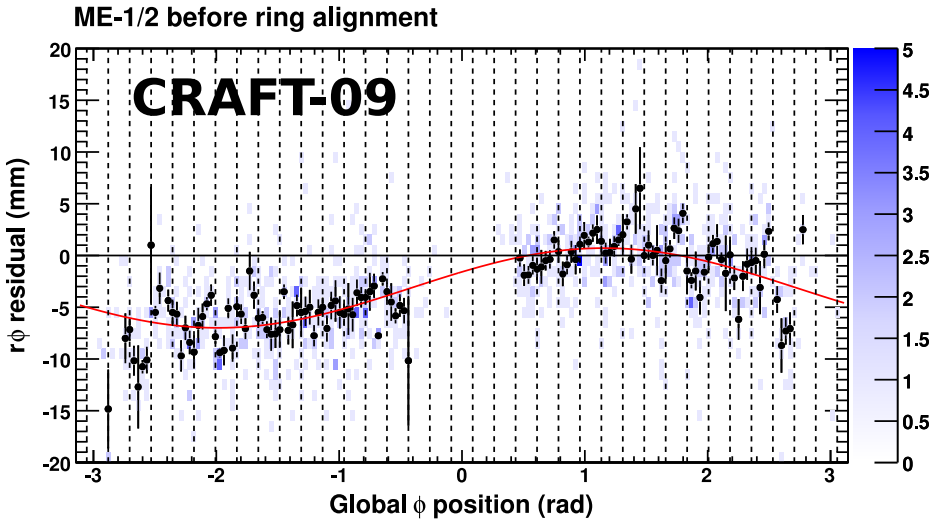
First complete outer-ring

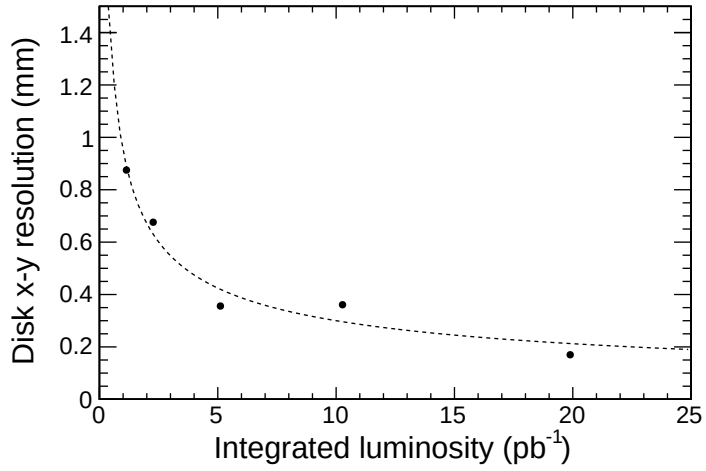


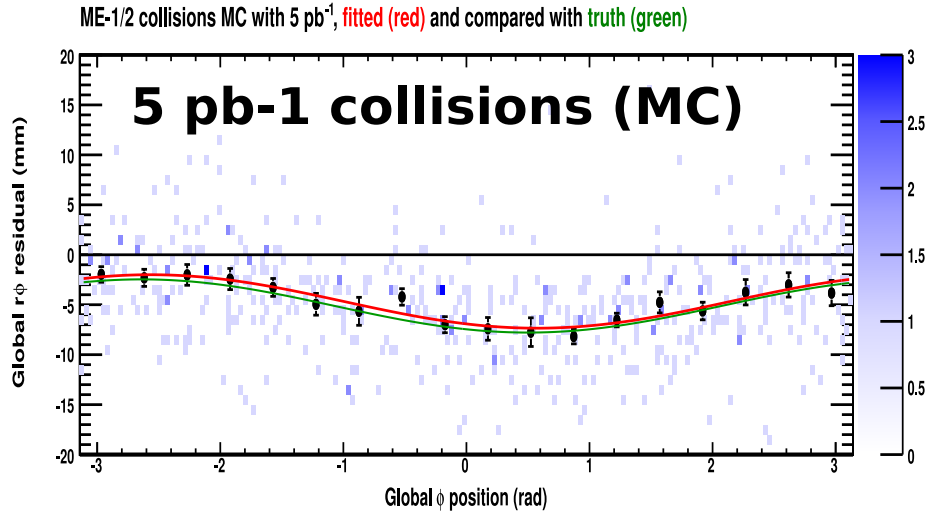


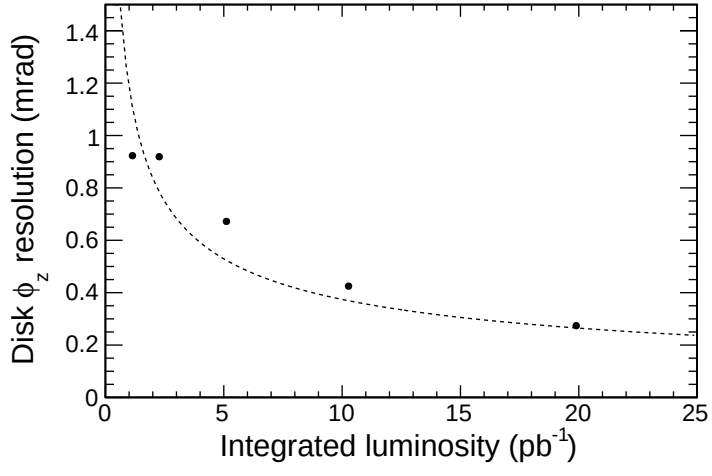
Connecting rings to tracker

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



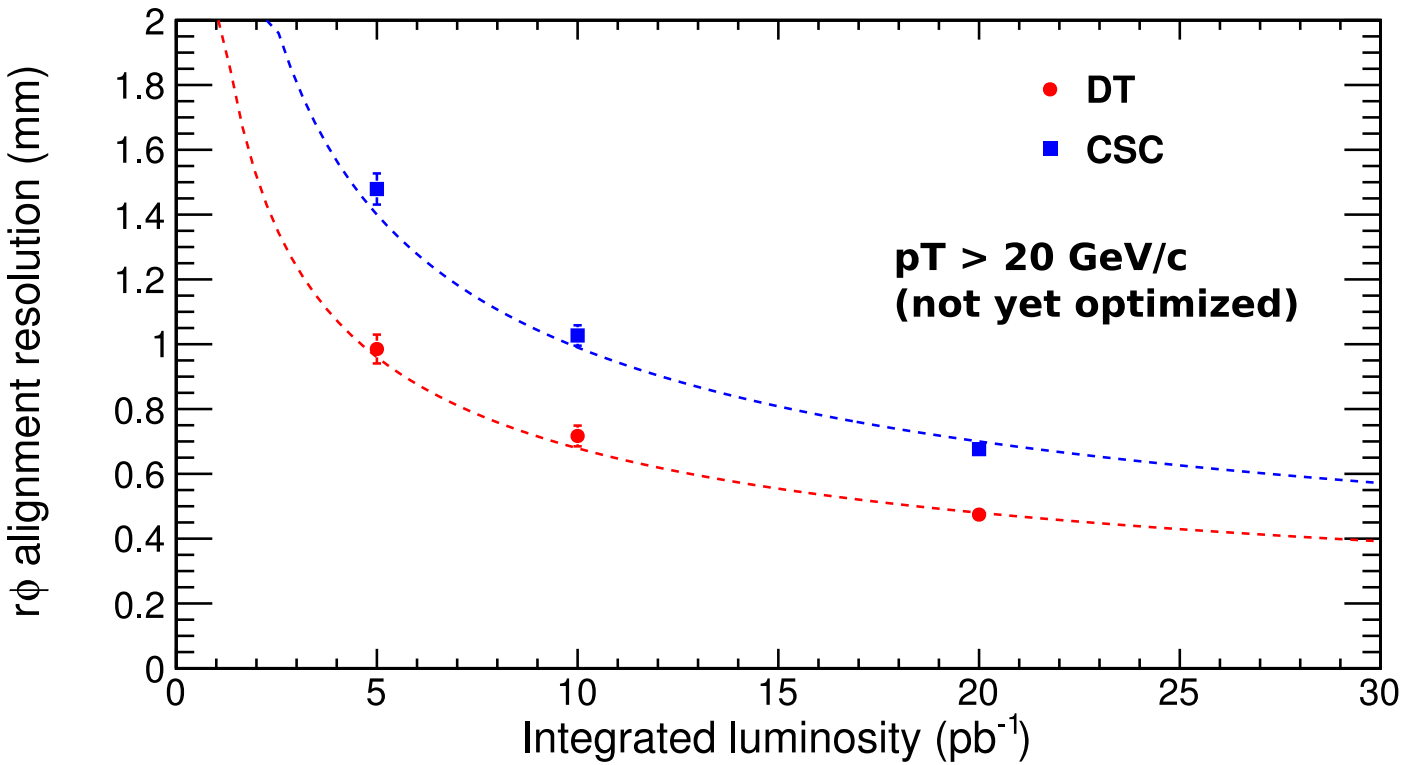






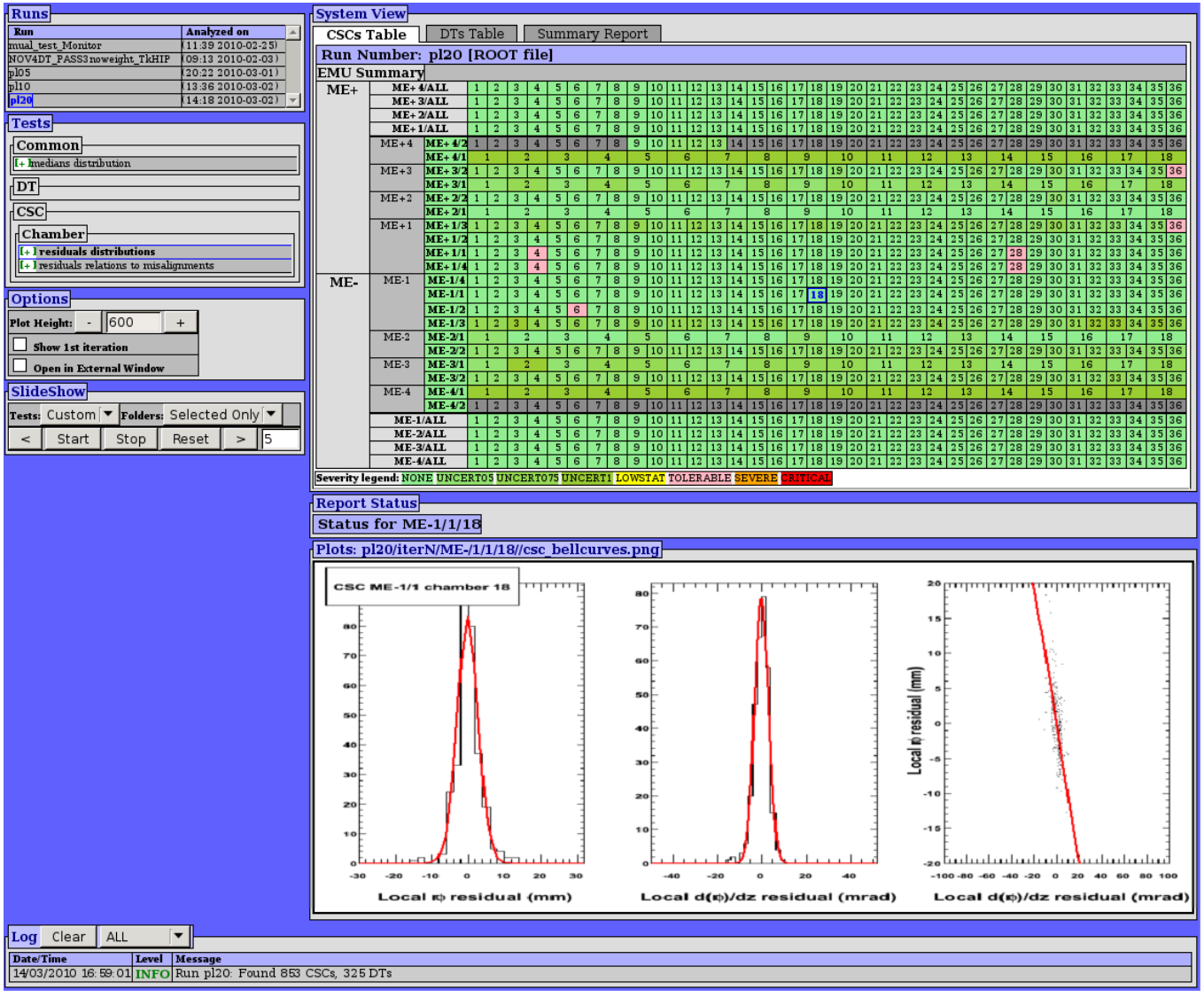
Reference-Target algorithm

- 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

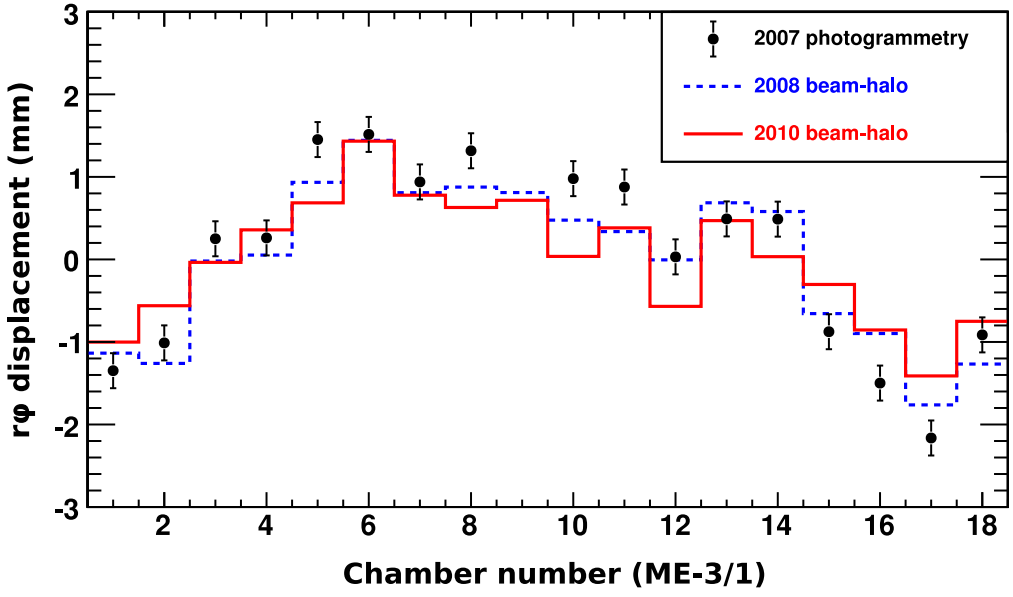


Infrastructure developments

- Alignment Quality Monitor, by Vadim Khotilovich
- One application: server for hardware/track-based comparison plots



Conclusions



- 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