Testing barrel twist with beam-halo & transfer lines

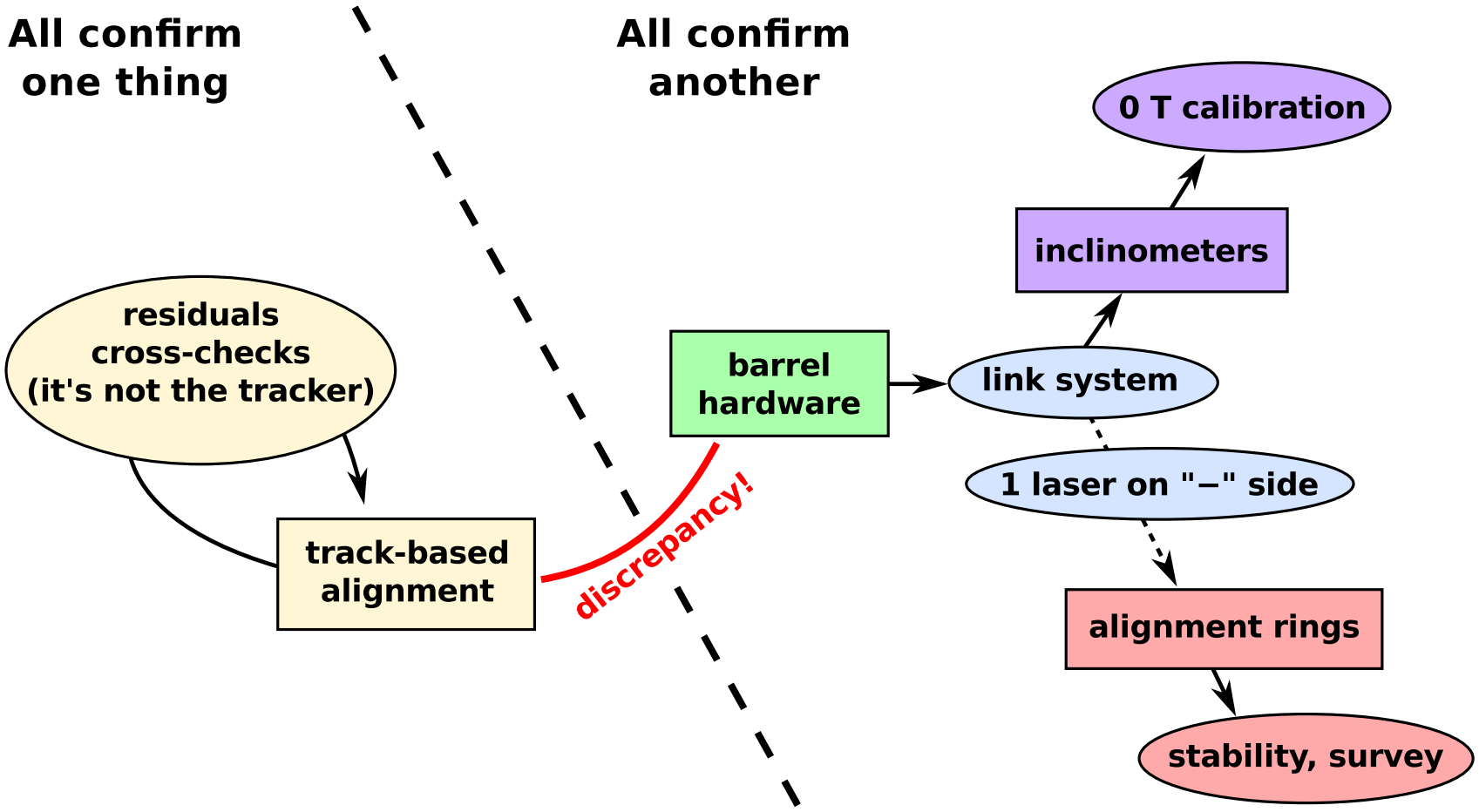
Jim Pivarski

Texas A&M University

24 September, 2010

Motivation

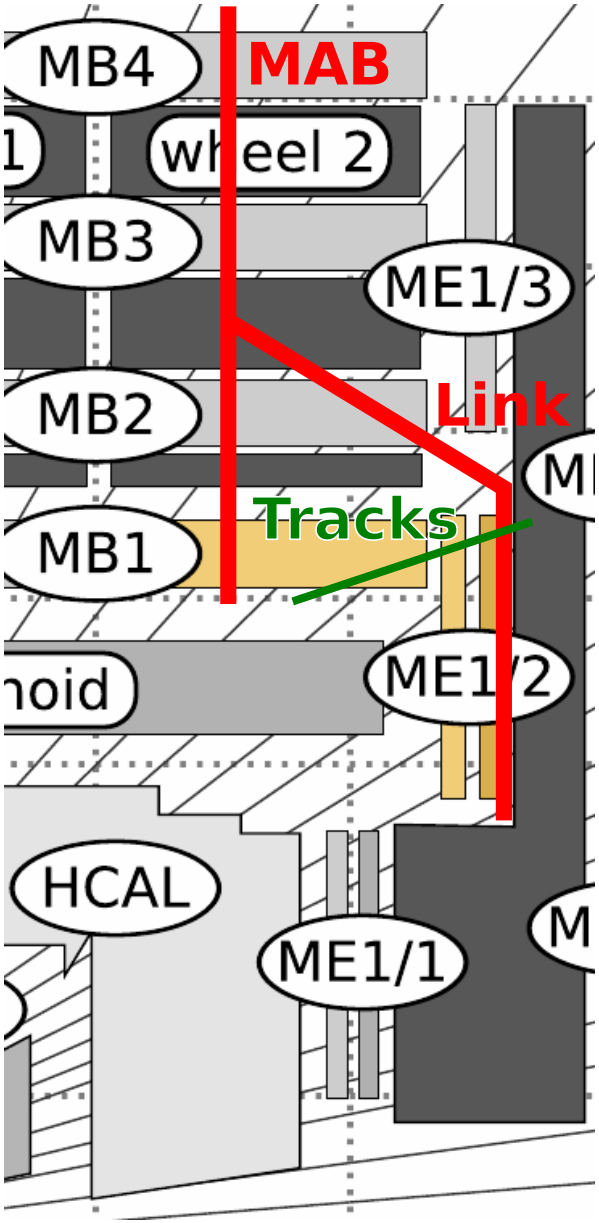
- Barrel hardware and track-based methods yield almost the same geometry (RMS 1.3 mm) up to a systematic twist (4 mm)
- Attempts to check each system for errors only strengthened the contradiction:



Motivation

- The problem is that this isn't conclusive enough to tell us what to do next: we continue to look at our own systems for a sign of a problem while suspecting that it really lies in the other system
- We need a method with a tighter network of cross-checks, more checks between hardware and tracks, and a larger number of degrees of freedom
- Any use of CSC hits, rather than just DT, would be good because detector problems are not likely to be the same
- Any use of local tracks, rather than just global, would also be good, because this is a global effect

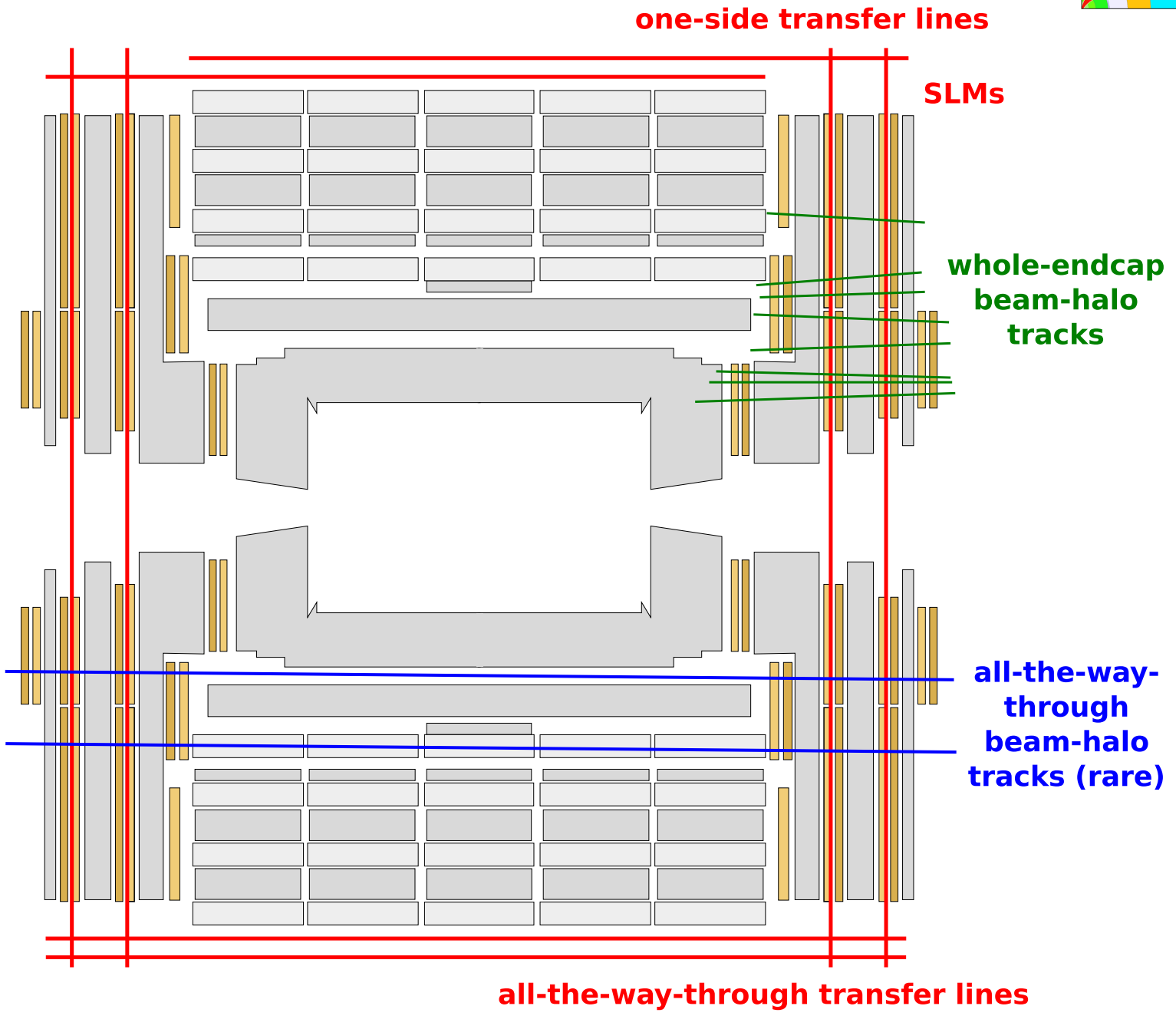
Idea #1: DT-CSC overlap



- Idea: use Link system or transfer lines to put wheel +2 and ME+1 in the same coordinate system; look for kinks in tracks or at least discontinuities in residuals distributions across the border
- If tracks/residuals are smooth: then we will know that there are no local track reconstruction issues **and** that the Link system is working well
- If not: then one of the two is broken
- But in neither case do we learn if the barrel is twisted
- It's a good study to do, and should be done at some point

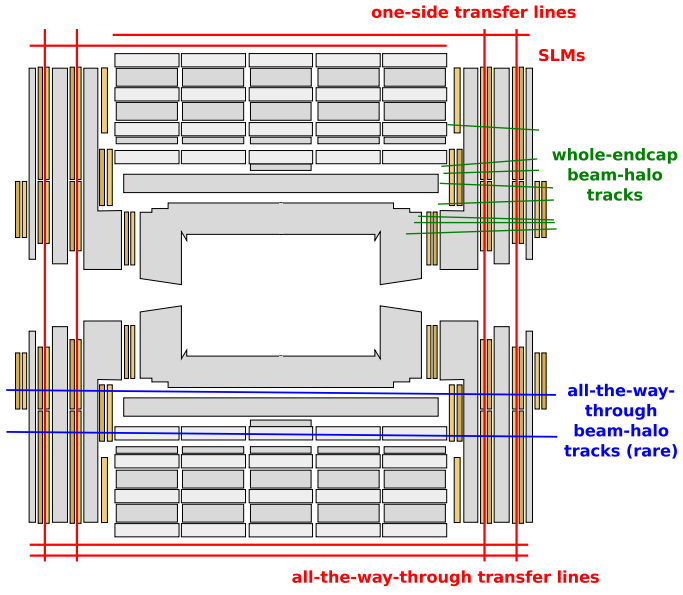
Complications: (1) CSC chamber positions must be prepared as a CSCAlignmentRcd for track-reconstruction (2) only monitored CSCs can be trusted, which reduces track statistics, (3) the magnetic field is significantly radial in this region: calibration and field-map are important, (4) there aren't many cosmic rays in this region; need to use collisions

Idea #2: beam-halo/transfer lines



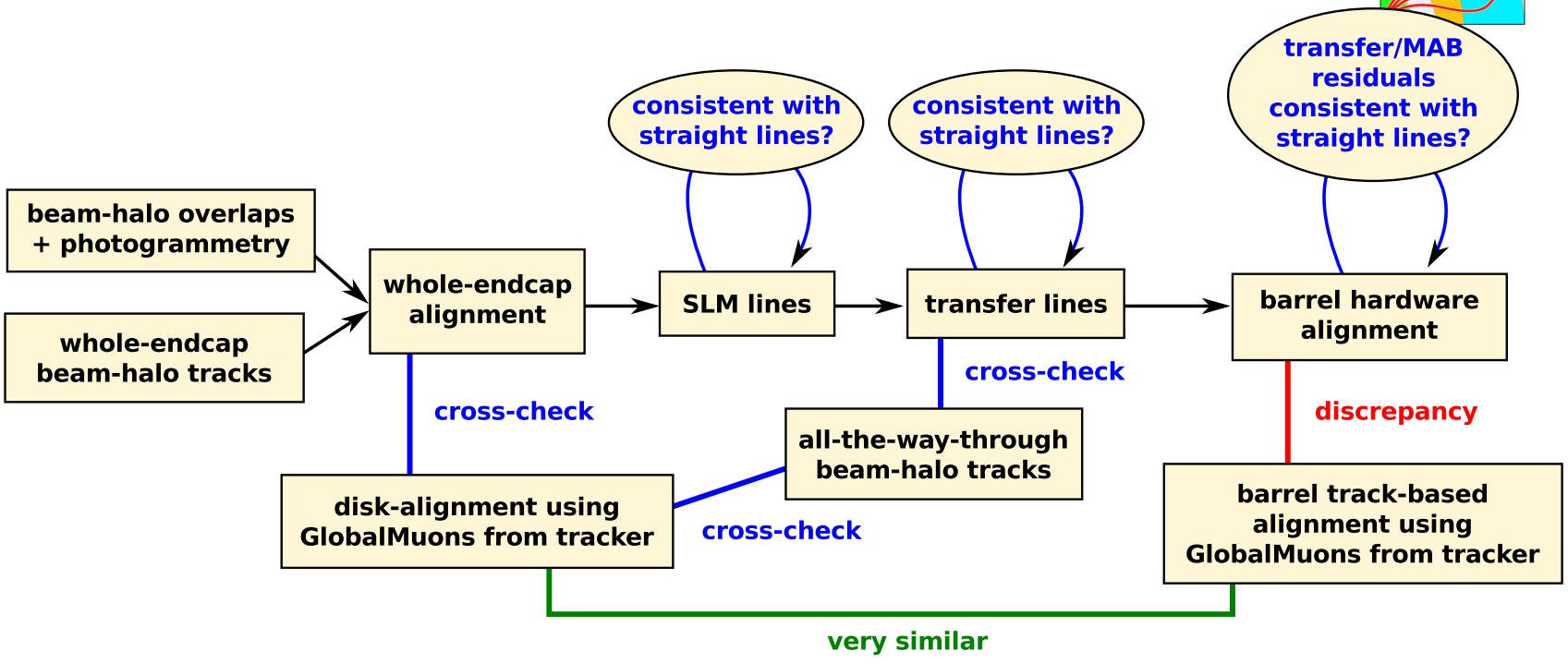
Idea #2: beam-halo/transfer lines

- Beam-halo overlaps + photogrammetry define well-aligned disks
- Whole-endcap beam-halo aligns disks relative to one another
  - cross-check: are these disk positions consistent with GlobalMuons from tracker?



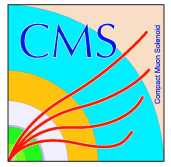
- SLMs take chamber measurements to transfer plates (cross-check: consistent with straight lines?)
- Transfer lines take transfer plates to barrel
  - cross-check: are the transfer line/MAB residuals straight lines?
  - barrel twist check: are those residuals sloped in $r\phi$ vs. z?
- All-the-way-through beam-halo can cross-check all-the-way-through transfer lines if both are available

Pattern of cross-checks



- Doesn't require a separate hardware fit: just put hardware components in the geometry provided by track-based "whole-endcap alignment" and ask if hardware measurement residuals are consistent with straight lines
- If any of the three "straight-line consistency" checks fail, then the barrel twist check is inconclusive (but we'll learn something about SLM/transfer lines)

Conclusions



- If we can do this in the next two weeks, then we may get a compelling answer to the question of which barrel alignment to use
- All of these cross-checks *pin-point* the system in which there may be a problem, and there's one track-based check in the middle of the hardware propagation chain
- It improves our chances of knowing what's wrong, not just knowing that there's a problem somewhere