Muon Endcap Alignment
Marcus Hohlmann - Florida Tech

Hardware Alignment System

R-sensors
Z-sensors
DCOPS

Crosshair laser lines:
Straight Line Monitors (SLMs)

Note: only a small sample of analog sensors shown

This figure featured in Physics TDR – Vol.1

View across an SLM

3D-CAD model by F. Feyzi et al.
(PSL, U. Wisconsin)

ME2-2 Back chamber
ME2-1 Front ch.
Mounting tower
DCOPS

Transfer laser line
Transfer Plate
with clinometer

R-sensor

3 Straight Line Monitors (SLM) across ME+2 disk

Beam axis

5/30/2006
M. Hohlmann - Southeastern CMS Physics Workshop, UF Gainesville
**Hardware Status for MTCC**

1. **Sensor Installation**
   - ME+ complete!

2. **Lasers**
   - ME+ lasers operational
   - Have permission from CERN safety to operate red Class 3A crosshair lasers
   - Working to get permission for IR Class 3B lasers needed for Barrel-Endcap Z-measurements

3. **Sensor Readout**
   - ME+1,2,3 operational (DCOPS & Analog)

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**Alignment Software: Data Structure & Flow**

- Optical & analog sensor raw data
- Geometry of Alignment system
- Event data in Root file
- XML files
- COCOA IN
  - Alignment fits (in CMSSW framework)
- COCOA OUT
- CSC data
- Offline Muon reco
  - CSC "Alignment object" contains chamber center offsets \( \Delta x, \Delta y, \Delta z, \Delta \alpha, \Delta \beta, \Delta \gamma \ldots \)
  - POOL-ORA object
  - Muon Trigger HLT, L1
- Muon TRACKS

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Software Status

• **Sensor Calibration Data**
  – Analog sensors: Almost complete
  – DCOPS: Some more input from FNAL needed

• **Raw data structure**
  – Framework for root files in place with 3 parallel branches of different sensors for barrel, link, endcap
  – Beginning to fill Endcap branch

• **Geometry for COCOA alignment fits**
  – Verifying COCOA geometry against CAD drawings
  – Big task! CAD incomplete: expect delays

The Path forward

Prepare w/ max. speed for MTCC

Analyze alignment data from MTCC; produce first chamber alignments

Fully commission h/w & s/w for the Alignment system

Integrate Alignment and Muon Reco; contribute to track-based alignment

Begin physics with dileptons: first µµ, then µ-tau, later e-tau
• Dileptons:
  – $\mu^+\mu^-$: Interest in $Z' \rightarrow \mu^+\mu^-$ and $H \rightarrow \mu^+\mu^-$ (direct)
  – $H_{\text{SM}} \rightarrow \tau^+ \tau^- \rightarrow \ell + \tau_{\text{had}}$
    with $\ell = \mu$ of initial interest
  – General interest in $\ell + \tau_{\text{had}}$ channel, which is fed by many other Higgs channels:
    $WH_{\text{SM}}, ZH_{\text{SM}}, t \bar{t} \rightarrow WH^\pm, H^+H$