Test beam data analysis
&
validation of OSCAR/ORCA

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Outline

• Status of work on section in Physics TDR, Vol 1 (T. Cox, UC Davis)

• Endcap Muon Cathode Strip Chambers (CSC): comparison of test beam raw data and ORCA simulation/digitization
  • The time profile of signal for the cathode strips.
  • The ratio of charges for two adjacent cathode strips.

• Plans
What this is about

“Test beam data analysis and validation of OSCAR simulation”, one of the Muon PTDR tasks listed on http://cmsdoc.cern.ch/cms/Physics/muon/www/management/tasks_page.html

- Good: more people actually working on this than mentioned there.
- Details in https://uimon.cern.ch/twiki/bin/view/CMS/Muon
- Bad: work is really just starting so few real results.
- Bad: we haven’t got a list of ‘target’ plots yet. Please suggest such plots - evidence and support for reliability of simulation and reconstruction. (I presume we’d even like to know the detectors really work to measure what we expect they will.)
### Task ‘Test beam data analysis and validation of OSCAR simulation’

<table>
<thead>
<tr>
<th>Work underway?</th>
<th>DTs</th>
<th>CSCs</th>
<th>RPCs</th>
<th>OSCAR</th>
<th>Neutron bkgd</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no?</td>
<td>–</td>
<td>yes</td>
</tr>
</tbody>
</table>

#### People known to be contributing
- Cerminara
- Marcellini
- Hoepfner (Amapane)
- Belotelov
- Breedon
- Chertok
- Cox
- Meshcheryakov
- Moissenz
- Mumford
- Terentiev

#### Comments
- Web page: [https://uimon.cern.ch/twiki/bin/view/CMS/DTTestBeam](https://uimon.cern.ch/twiki/bin/view/CMS/DTTestBeam)
- Much work is getting going... need changes in ORCA for test beam data (& geom)
- Is anybody there?
- OSCAR general support, & knowledge of validation
- Phat has restarted work under Pedro’s guidance.
• Conclusions
  • Good: work underway for DTs and CSCs.
  • Bad: no RPC-related program of work?
  • Suggestions for *what plots* the task needs to supply for the PTDR, from physics, hardware, or software viewpoint, gratefully accepted.
CSC test beam data vs ORCA

- Sep-Oct ’04 EMU CSC Beam Test
  - Asynchronous (1.5 week).
  - 25 ns structured beam (1 week).
- Setup features
  - 5 CSCs, 3 RPCs, HCAL.
  - 4 peripheral crates.
  - New DDU/DCC.
  - TrackFinder crate (SP1+SP2).
  - Trigger: SC (Scint. Counters), TF (Track Finder).
- Details and some results at EMU Oct 2004 meeting by F. Geurts, D. Acosta, A. Korytov, M. Von der Mey, J. Hauser, S. Durkin
CSC test beam data vs ORCA

- CSC – Cathode Strip Chamber, six layers, two coordinates in each layer
  - Anode wires in azimuthal, cathode strips in radial directions.
  - Provides ~ 99% efficient 25 ns bunch crossing identification (anode front end + ALCT).
  - Precise measurement of the azimuthal coordinate (~ 150 μm) by cathode strips.
  - Trigger primitives for Level-1 trigger system.
CSC test beam data vs ORCA

- Test beam data (see details in www-hep.phys.cmu.edu/cms/Beam_Test_Sep_2004/tb.html)
  - CERN H2 150 GeV Muons.
  - 25 ns structured beam.
  - Require single muon track in analysis (one anode wire hit, one cathode comparator hit per CSC layer).

- ORCA (for EMU CSC simulated digitization in full CMS detector, not yet available for beam test geometry)
  - The single muon particle gun sample, Pt=100 GeV.
  - Flat in Phi over all Phi.
  - Flat in Eta from -2.5 to 2.5.
  - Used versions are OSCAR_3_2_2 and ORCA_8_1_3 (newer versions have the same code for the CSC raw data).
**CSC test beam data vs ORCA**

- **Test beam** - the time profile of signal for the cathode strip with max. amplitude
  - Data from CSC ME3/2.
  - Normalize to area in each event, average thru all events.
  - Time bin 50 ns.
CSC test beam data vs ORCA

- ORCA - the time profile of signal for the cathode strip with max. amplitude
  - All CSCs (Station 1 excluded).
  - Max. amplitude always in time bin 4.
  - Normalize to area in each event, average thru all events.
  - Time bin 50 ns.
CSC test beam data vs ORCA

- ORCA vs data for the time profile of the cathode strip signal
  - Reasonable agreement.
CSC test beam data vs ORCA

- Test beam - the ratio of charges \( Q \) (Log10) for two adjacent strips (\( N_{\text{max}} \) is a strip with \( Q_{\text{max}} \))
  - Data from CSC ME3/2.
  - At 0 – track between strips \( N_{\text{max}}-1 \) and \( N_{\text{max}} \).
  - At \(-2\) – track between strips \( N_{\text{max}} \) and \( N_{\text{max}}+1 \).
  - No correction for beam profile within two strips.
CSC test beam data vs ORCA

- ORCA - the ratio of charges $Q$ (Log10) for two adjacent strips (Nmax is a strip with Qmax)
  - Cut $1.3 < \text{EtaGen} < 1.6$ (~ as in the beam test).
  - All ME234/2 CSCs (Station 1 is excluded).
  - Preliminary, need more Monte Carlo statistics or switch to using actual beam test geometry in ORCA.
• **ORCA vs data** (preliminary)
  - Occupancies from previous figures are normalized to the distribution areas.
  - Reasonable agreement in case of the track between strips.
  - ORCA needs more study in other cases.
  - To adjust ORCA for the beam test conditions in the final comparison.
Plans

• Continue ORCA with test beam data comparison
  • Cathode strip pedestal RMS, amplitudes, noise, crosstalk.
  • Cathode strip comparator thresholds and timing.
  • Anode front end thresholds, timing.
  • Tracking in the beam test, cathode strip coordinate resolution.

• The beam test option in ORCA is greatly needed
  • Work is in progress (R. Wilkinson, A. Tumanov, T. Cox, J. Mumford,…).

• Picture/accompanying text selection for the Physics TDR, Vol 1