Experience from Operating TEC in the CMS Tracker

Tracker General Meeting
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For the TEC Community
TEC+ has joined the Slice Test
TEC+ has joined the Slice Test

Sector 2

Sector 3
Some Facts

- Sectors 2 & 3 read out on +z side
- Both sectors tested before in cold test
- TEC cabled and ready 14th of March
- First (real) data taking ~26th of March
- Roughly 2 ½ days of “TEC data taking” → very limited “experience”
- All results are preliminary!

Thanks to TEC slice test team:
Thomas Bergauer, Gaelle Boudoul, Erik Butz, Marko Dragicevic, Dirk Heydhausen, Gordon Kaussen, Marc Zoeller
Experience from Cabling

- Done by 2 physicists (Thomas Bergauer, Marko Dragicevic) and 2 Lyon technicians
- No particular problems
- Not a single power cable to be reconnected (i.e. low current or voltage)
- All MFS connectors cleaned on both sides before plugging
- All connections found in first connection scan
- Only two low ticks
- Time estimate difficult and anyway not representative for P5
The Start-Up

Slow start-up:

• Many problems with DCS hardware and software
  - TEC was guinea pig for conditioning cards (calibration, debugging, ...)
  - One of two conditioning cards faulty: jumps of temperature when control power was switched on
  - flaky cable to PLC → fake interlocks due to bad temperatures
  - various PVSS problems
  - upgrade of PLC system yesterday/today: second conditioning card added again

• Several problems with DAQ hardware and software
  - One FEC with bad soldered VME connector exchanged, all FECs to be checked
  - Two FED channels with failing TrimDAC
  - Some DAQ configuration problems

• Problems with power supply system
  - One MAO tripped, afterwards 14 PSMs broken

Nevertheless: support from DCS, DAQ & PS experts excellent & prompt!
Data Taking

- DAQ running smoothly now
- **First commissioning done:**
  - timing
  - gain scan (run # 7080)
  - timing (7096)
- Problems investigated, but no second commissioning done yet
- **Pedestals taken:**
  - deconvolution mode with bias off (7145)
  - deconvolution mode with 250V and TOB & TIB/TID off (7102)
  - deconvolution mode with 250V and TOB powered (7159)
  - peak mode with all subdetectors on (many)
- **TEC joined cosmics runs over the weekend!**
  - 190 000 events
  - “Default” trigger configuration (roughly position 1 in next slide)
  - Expected trigger rate for TEC: 1.5Hz (A. Dierlamm)
  - Number of tracks and number of hits per track to be checked
Cosmic Trigger

- Position 1 only good for TIB and TOB
- Position 2 good for part of TEC but most of acceptance lost
- Position 3 gives good tracks through TID and TEC, but misses half of TIB and TOB

A. Dierlamm, QA meeting, Monday, 26th of March

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TEC Slice Test
First Commissioning

• Commissioning & noise analysis by Marc Zoeller & Erik Butz
  Many thanks for plots!
• I²C communication to all modules is stable (more studies to be done)
• All connections found at first connection scan
Gain from opto scan, $T_{\text{silicon}} \approx 21^\circ \text{C}, T_{\text{hybrid}} \approx 31^\circ \text{C}$

- Analysis from html file
• 13 lasers with set gain = 3 after gain scan
• Only 3 of them have gain < 0.6
Timing Run

- One laser with high baseline: Sector 2, BP8, 5.6/1
- To be investigated

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TEC Slice Test
• 3 Lasers with low tick:
  - Sector 2, FP1, 6.2/2: ~ 200 ADC counts
    (reflection seen in OTDR (D. Ricci), indeed fixed by cleaning at MFS connector)
  - Sector 3, BP1, 5.3/0: ~ 400 ADC counts (nothing strange in OTDR)
  - Sector 3, BP4, 2.1/0: bad tick (problem known from cold test)
Timing Run

Sector 2  Run 7102  Deconv warm HV On

Tickheight [ADC counts]

0  400  600  800  1000

Number of APVs

0  400  600  800  1000

Sector 3  Run 7102  Deconv warm HV On

Tickheight [ADC counts]

0  400  600  800  1000

Number of APVs

0  400  600  800  1000

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Hybrid & Silicon Temperature

- Common calibration constants from Wim Beaumont
- Chips configured
- Chiller at 15°C

- 10 bad silicon temperature readings
Low Voltage: 1.25V

- Common calibration constants from Wim Beaumont
- Chips configured
- Chiller at 15°C
Low Voltage: 2.5V

- Common calibration constants from Wim Beaumont
- Chips configured
- Chiller at 15°C
Noise Performance

Sector 2, FP1

Already normalized to tick height

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Noise Performance

Sector 3, FP4

Ring number

CMS Noise
Noise Performance

Sector 2, FP3

tick ok; to be studied

Ring number

CMS Noise

Sector 2 - Run 7102
Decorr warm HV On
Front Petal Disc 3

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Noise Performance

Sector 3, BP5

known since integration in Aachen
Mean CMS Noise per APV - Dec. Mode

Sector 2 Run 7102 Deconv warm HV On

Scaled Noise [electrons]

FP1 FP2 BP1 BP2

Number of APVs

Sector 2 Dec. mode

Sector 3 Run 7102 Deconv warm HV On

Scaled Noise [electrons]

FP1 FP2 BP1 BP2

Number of APVs

Sector 3 Dec. mode

bad tick  known problem

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Mean CM Noise / Mean CMS Noise per APV

Sector 2 Run 7102 Deconv warm HV On

Bad tick

Sector 3 Run 7102 Deconv warm HV On

known problem

Sector 2 Dec. mode

Sector 3 Dec. mode

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TEC Slice Test
Summary of Peculiarities

• Known problems reproduced:
  - bad tick in S3 BP4 2.1/0
  - two bad APVs in S3 BP5 7.3

• Two fibers with low tick after first commissioning:
  - S3 BP1 5.3/0
  - S2 FP1 6.2/2, solved by cleaning

• One fiber with good tick but strange noise (S2 FP3 1.4/0)

• One fiber with high baseline (S2, BP8, 5.6/1)
Noise Performance

Detailed quantitative comparison with cold test results still to be done!
⇒ TOB powered and read out (not synchronous to TEC): no effect  
⇒ More systematic studies to be done
Tracks in TEC

Track reconstruction by shifter Thomas Bergauer
Data Taking Plans

• Weeks 14/15:
  - Repeat commissioning after cleaning of MFS connectors
  - Pulse shape tuning for next cosmic run:
    VFS and ISHA scan using calibration runs (Christophe Delaere)
• From week 15 onwards:
  - Grounding studies to optimize configuration at patch panel 1 (PP1)
• Week 16:
  - Cable and read out one sector of TEC-
  - Take cosmics with TEC- ?
• Sometimes:
  - Laser alignment runs (warm & cold)
• Sensitivity to other APV parameters? Tuned for certain temperature, but dT = 10K between 4 and 6 APV hybrids.
Data taking:

• Until now: ~7 people at CERN
• During April: 3-4 people at CERN  
  (Erik Butz, Gaelle Boudoul, Alexander Linn, KK)  
  ⇒ Not convenient, but still doable
• From May onwards: 2-3 people at CERN?

Data analysis:

• Commissioning: Erik Butz & Gaelle Boudoul
• Detailed noise analysis: Marc Zoeller (to be taken over by Erik Butz)  
  - Former TEC- analysis
• Cosmic analysis: Gordon Kaussen  
  - CMSSW analysis on EDM files  
  - Study cluster and track distributions, S/N etc.
• Cosmic tracks with final focus on alignment: Thomas Bergauer & Marko Dragicevic
• Efficiency of defects & APV edge strips: Alex Linn?
Summary

• Up to now, no big problems found operating TEC in the tracker
• First cosmics taken with TEC
• Analyses are taking shape
• Exciting weeks ahead for TEC