



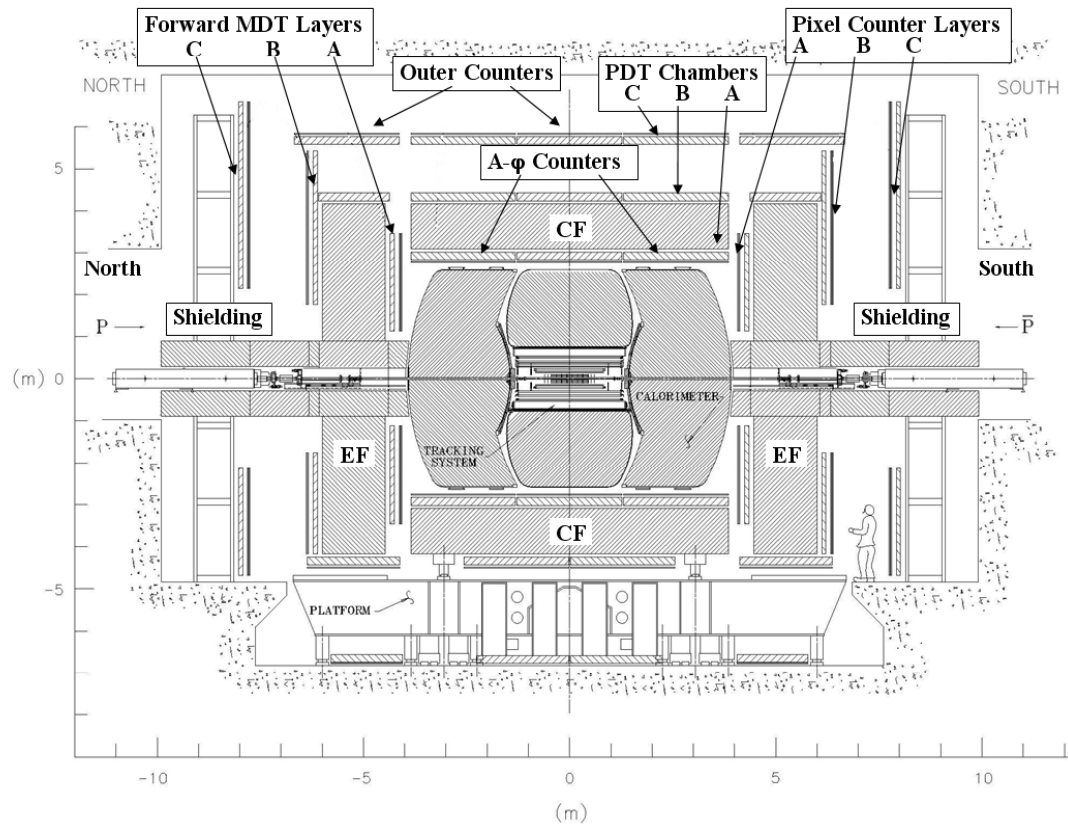
DZero Collaboration week Feb 2008

Muon system status and plans

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Feb 22, 2008

Muon system design overview



- The system is designed to provide muon tracking and triggering information for the DZero experiment.

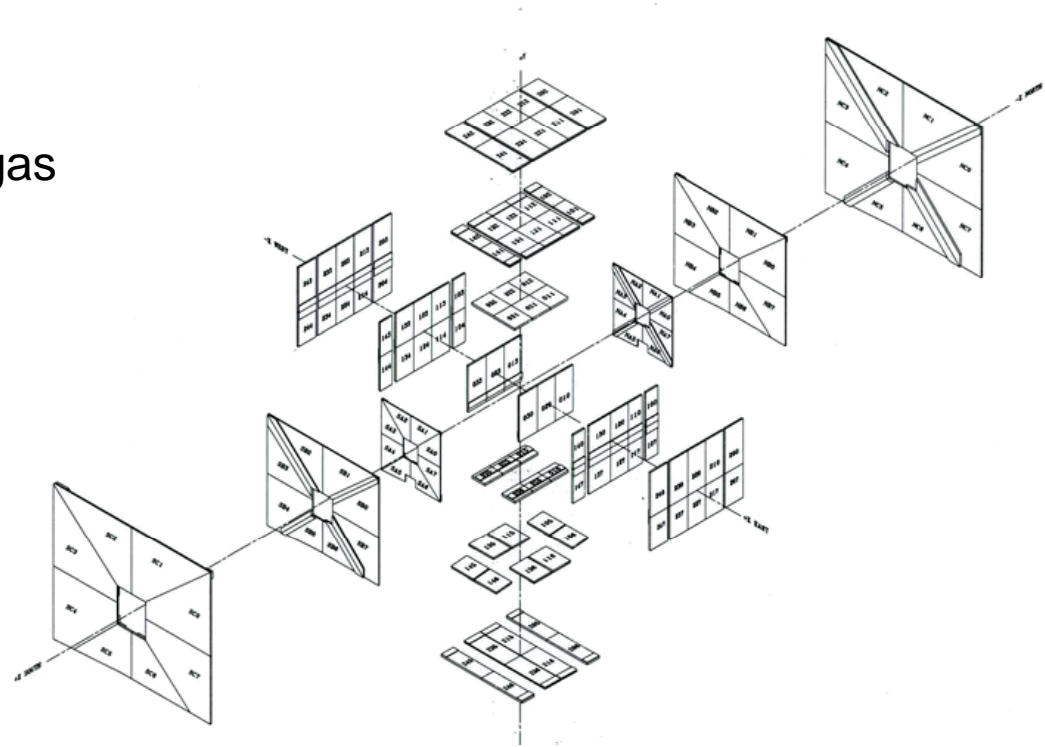
- Central muon system (PDT and scintillation counters) covers the region $|\eta| < 1$ and has 3 layers called A, B, C

- Forward muon system (MDT and scintillation counters) covers the region $1 < |\eta| < 2$ and has 6 layers called A, B, C – North and South

- Level 1 muon trigger system forms single and dimuon trigger terms based on wire and scintillation detector hits.

PDTs – proportional drift tube chambers

- Supported by Fermilab and NIU
- 94 PDTs
- A,B,C – layers
- 8 octants
- ~6600 wires
- 278 Front-End boards
- 94 Control boards
- 84% Ar + 8% CF₄ + 8% CH₄ gas mixture is used



PDTs – proportional drift tube chambers

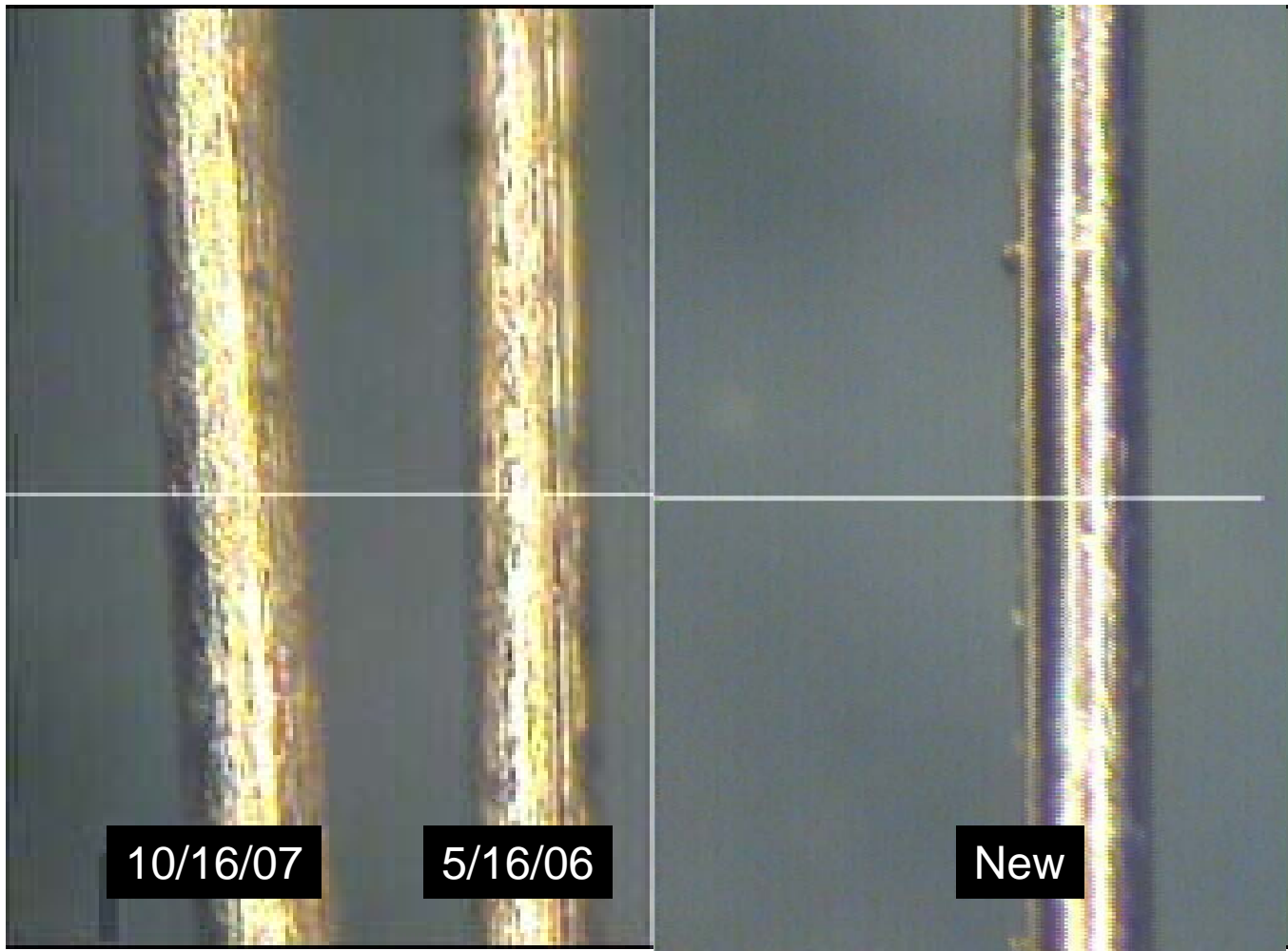
Electronics chips losses due to the beam losses

- The chips are obsolete and no longer available from the vendors
- The new replacement is found but due to higher current consumption only one new chip per board can be installed. This solution works if chips failure rate will not rise significantly.
- To reduce the number of FEBs failures A-layer and some of B/C layers PDTs are switched off during “acceleration”, “squeeze” and “initiate collisions” phases of shot setup.

PDT wire ageing

- During last shutdown one PDT wire was removed and inspected to check for any aging effects
- No evidence of ageing is found (see next slide)

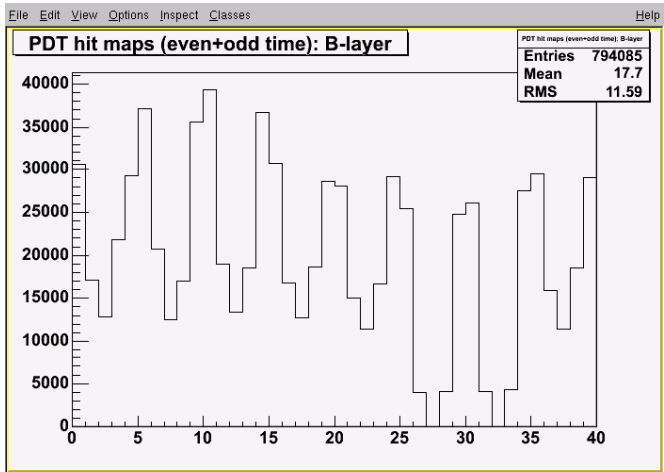
PDTs – proportional drift tube chambers



Picture from Mike Roman

PDTs – proportional drift tube chambers

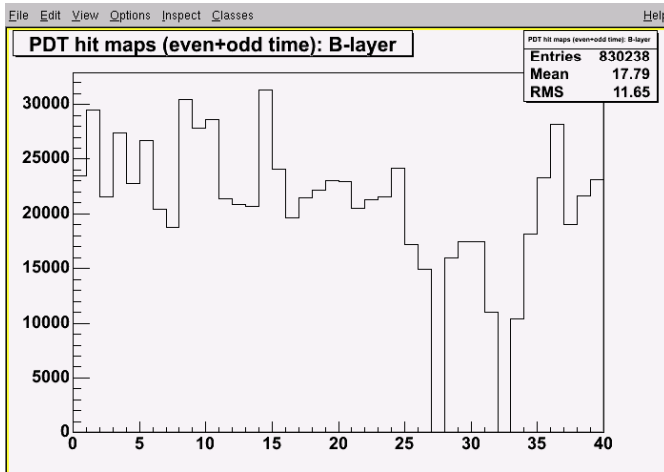
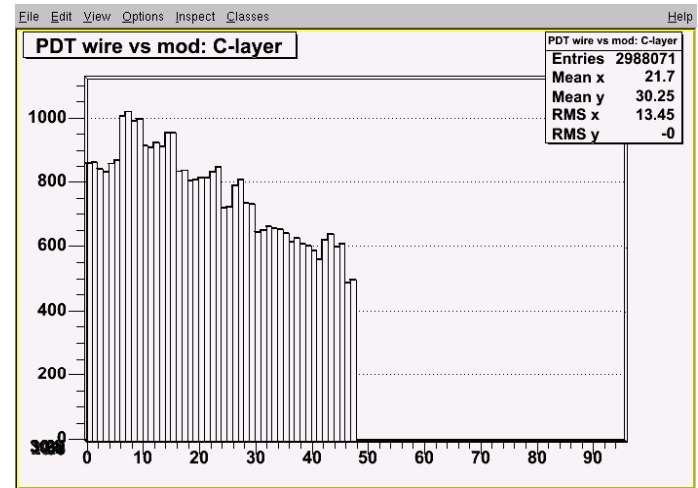
Noise issue



STORE 5876



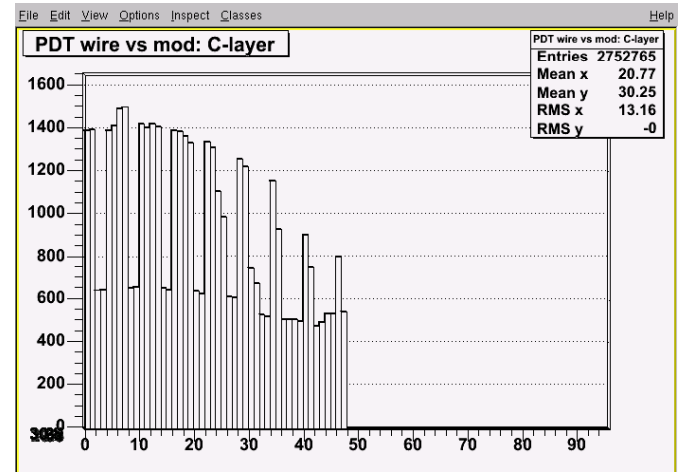
Good and clear octant structure and smooth wire hits distribution



STORE 5885



Bad octants hit map and noise spikes in the wire hits distribution



What caused this noise in store 5885 is unknown yet and under investigation

PDTs – proportional drift tube chambers

Summary and plans

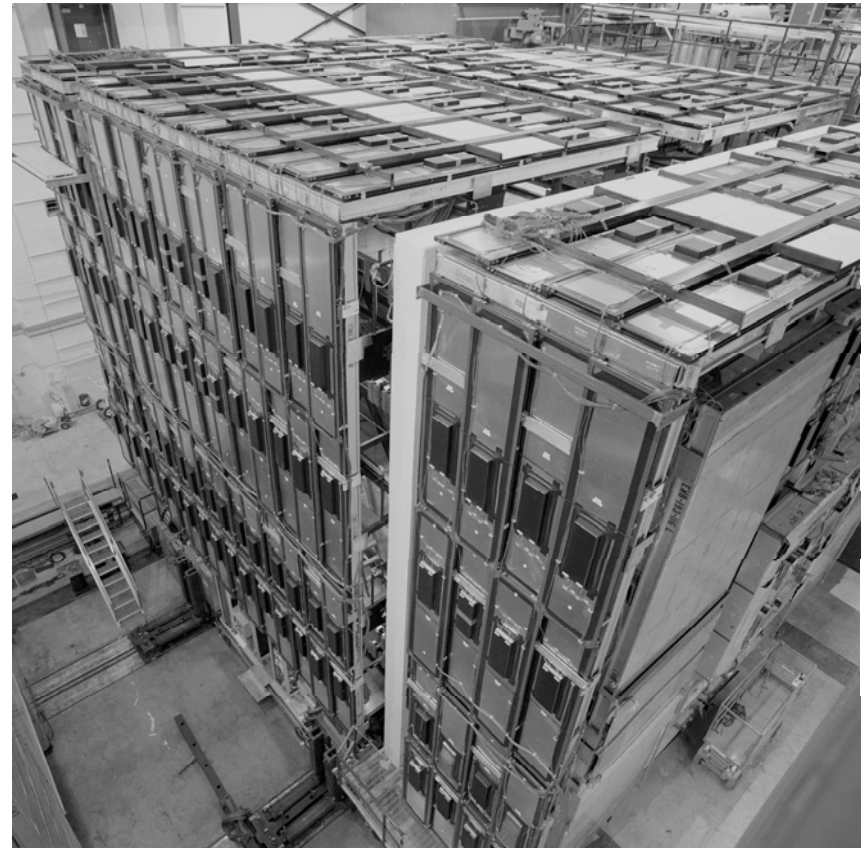
- PDT generally run smoothly
 - Front-end boards losses have increased a bit recently
 - HV system is stable
 - Drift velocity is stable
 - Very few hot channels
 - Number of disabled channels is ~1%
 - No ageing effects found
-
- Keep running
 - Continue Store 5885 noise investigation
 - Calibrate PDT HV system
 - Keep monitoring FEB losses

Central scintillation counters

- Supported by Fermilab, ITEP (Russia) and Panjab (India).
- 3 layers of scintillation counters:
 - 630 A-phi counters
 - 86 B-layer counters
 - 288 C-layer counters

6 front-end crates: 6 control boards, 36 front-end boards

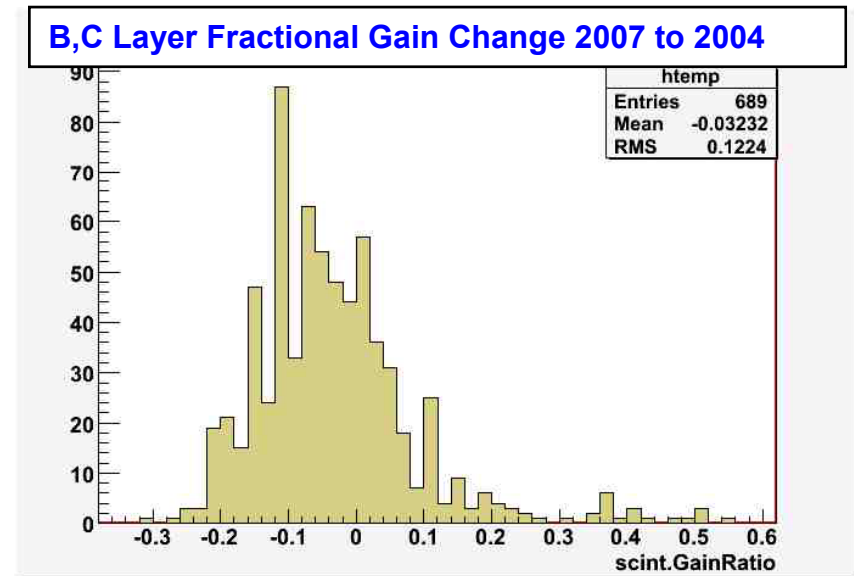
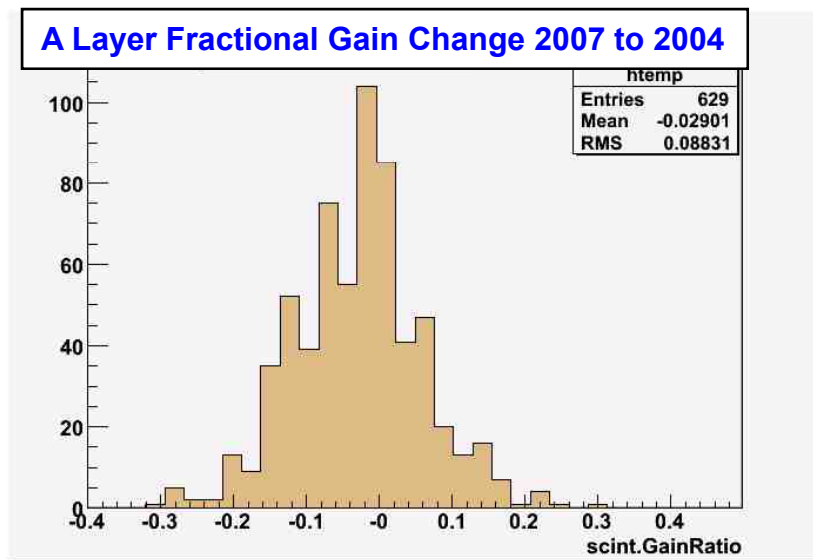
No changes since last year
No major problem during operation
No aging effects observed (see next slide)



Central scintillation counters

LED calibration is performed periodically to check for any gain changing effects.

The gain of 2007 is compared to 2004:

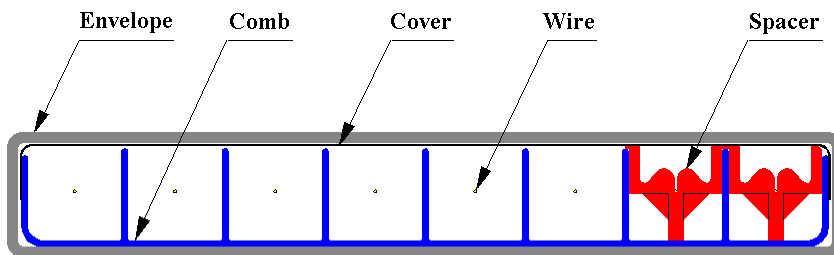
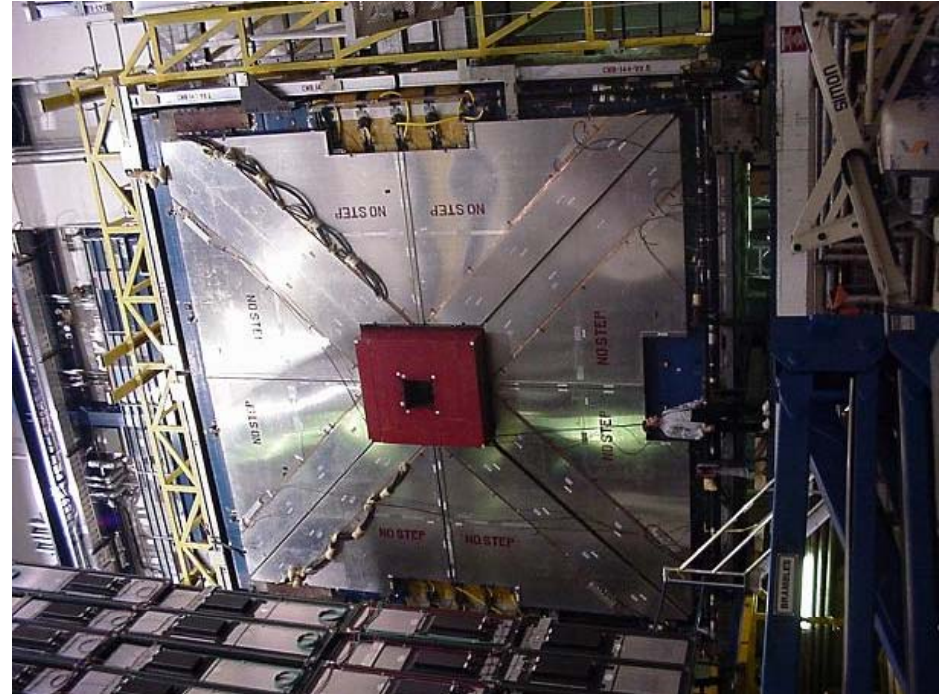


- PMT gains are OK
- PMT thresholds were adjusted in 2005 and will be adjusted early 2008
- All counters are operational

MDT – mini drift tubes

- Forward muon tracking detector
- ~50.000 channels
- 6 layers – A, B, C
- 48 octants
- 1500 amplifier-discriminator boards
- 24 front-end crates
- 90% CF_4 + 10% CH_4 gas mixture is used

Supported by JINR (Russia) and PNPI (Russia) groups.



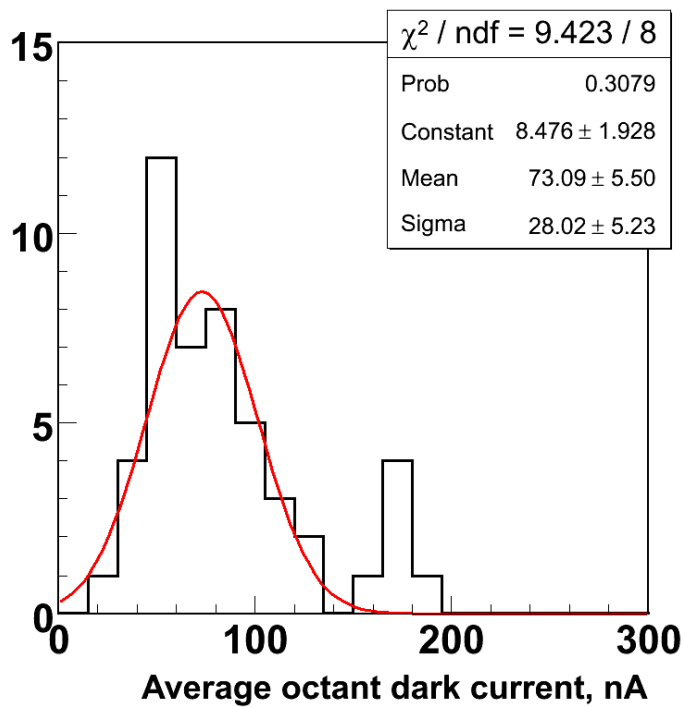
MDT – mini drift tubes

MDT OPERATION

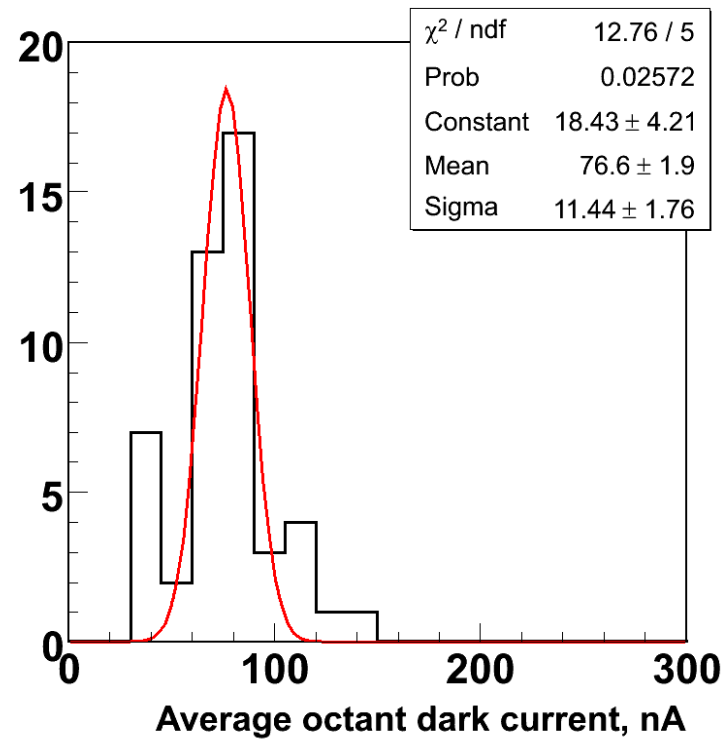
- Number of disabled channels is ~300 (0.6%) – within specifications
- All spares are available
- During last shutdown part of MDT LVPS is replaced with brand new ones
- MDT HV system was tested during last shutdown:
 - operating voltage is 3200 Volts
 - measured voltages are 3200V +16/-9 Volts
- Significant gas leak was fixed by DZero mechanical operations team recently
 - total gas leak is <5% now
- Front-end firmware is checked/refreshed during each reasonable long shutdown

MDT – mini drift tubes

The ageing of MDT system is monitored by measuring dark currents and counting rate curves. Both methods show no ageing effects



2003



2007

MDT – mini drift tubes

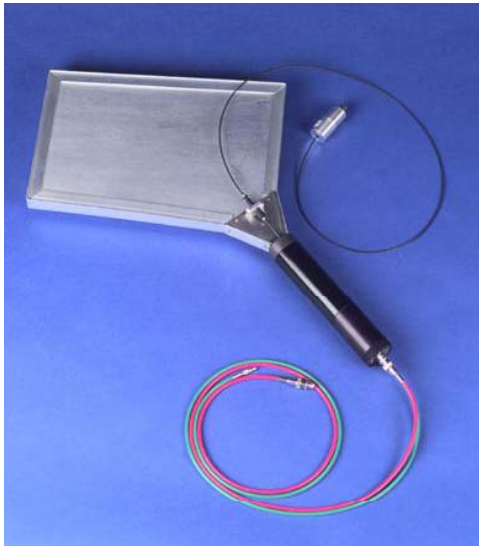
SUMMARY and PLANS

- MDTs work well without major problems except power supplies failures
 - No ageing effects observed
 - Experts coverage is good
 - Gas and spares are OK, but some extra spare front-end power supplies are needed if failures rate will not decrease
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- Keep monitoring system
 - Dark currents and counting curves update
 - High voltage system calibration update

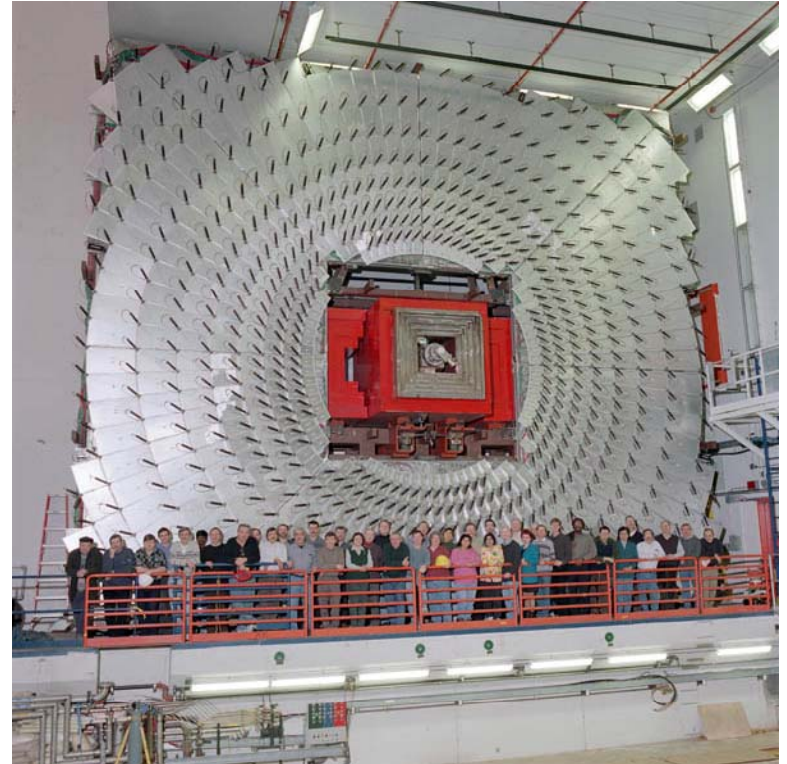
Forward muon scintillation counters (pixels)

4214 scintillation counters
48 octants in A, B, C layers (North and South)
12 front-end crates
12 control boards
96 front-end boards

Supported by IHEP (Russia) group.



Forward muon scintillation counter



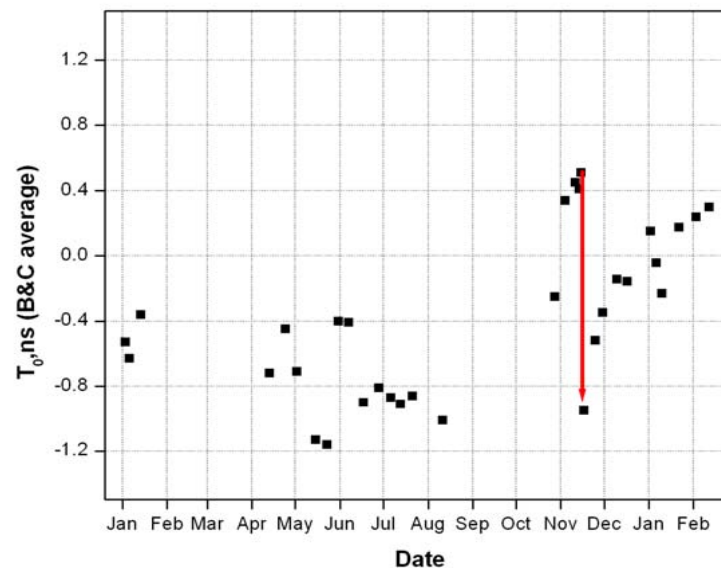
C-layer plane

Forward muon scintillation counters (pixels)

OPERATION STATUS

- running well without major problems
 - during last shutdown all front-end power supplies are replaced with brand new.
 - 2 front-end power supplies failed for last 6 months period
 - Number of non-working channels is 0 (zero!) now
 - muon timing monitored weekly
 - calibration and maintenance work is performed periodically
-

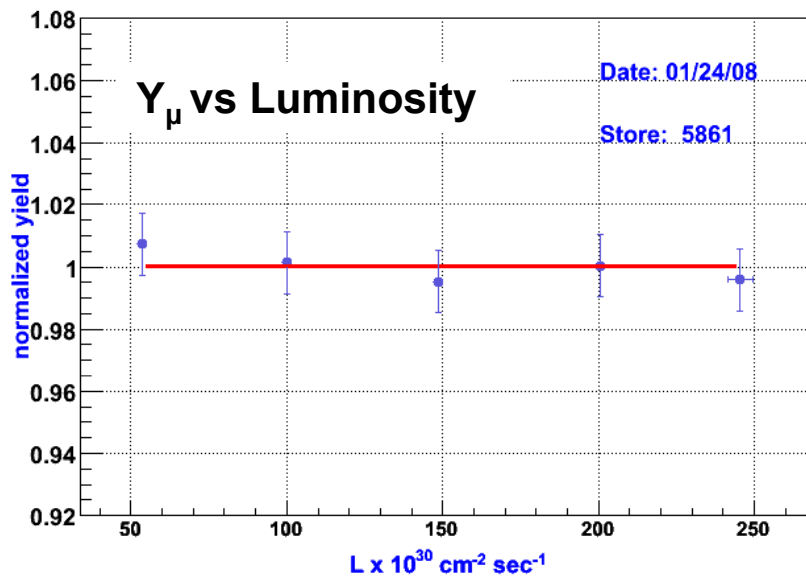
Muon timing measured with the pixels is being corrected via D0 Clock adjustment 4 times per year to keep muon timing peak position reasonable close to zero.



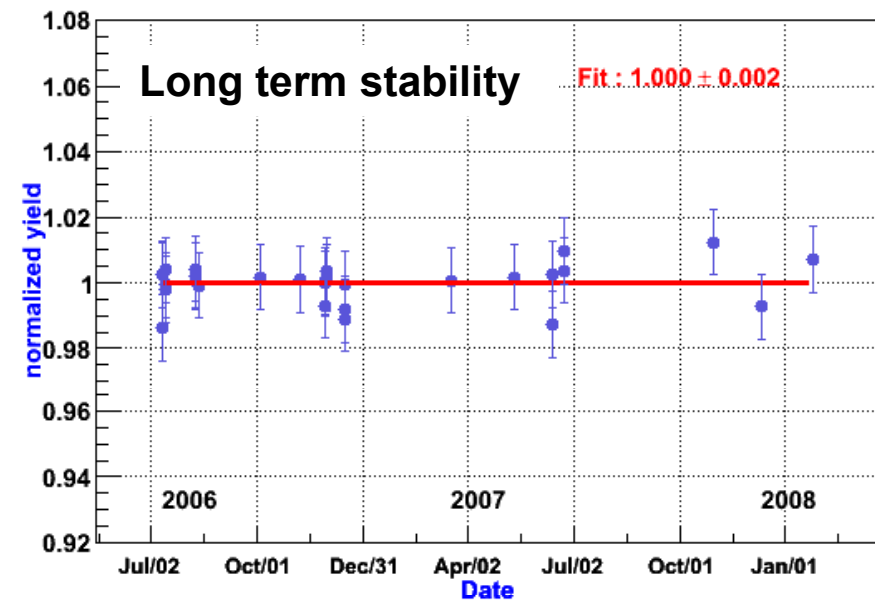
Forward muon scintillation counters (pixels)

- Pixels and MDTs are used to monitor muon yields.
- This is a good check for detector, trigger, muon ID, luminosity performance.
- Special muon runs are taken ~monthly.

Single Muon Yields. January 2008



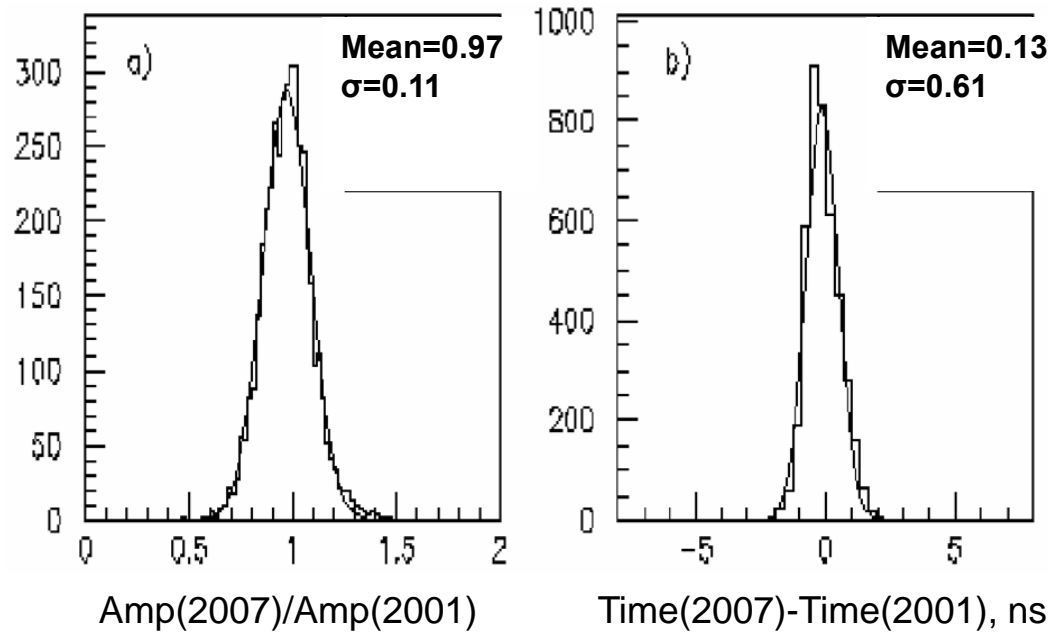
Single Muon Yields from July 2006 to January 2008.



- Muon yields are stable in RunIIb
- No luminosity dependence up to $250 \cdot 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$

Forward muon scintillation counters (pixels)

Ageing studies are performed with LED calibration procedure.



- No noticeable ageing effects are observed.
- Radioactive source tests shows no ageing as well

Forward muon scintillation counters (pixels)

SUMMARY and PLANS

- Forward muon scintillation counters work well and stable
- Status of manpower and spare parts is good, but some extra spare front-end power supplies are needed if failures rate will not decrease
- No ageing effects are observed for last 6 years of operation

- Keep running smoothly
- Keep monitoring the system
- D0 Clock adjustment – mid April, 2008
- LED calibration update – summer 2008

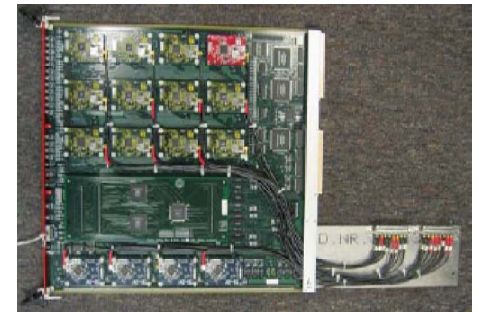
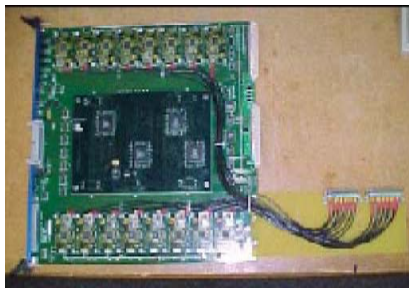
L1 muon



- 9 crates
- 49 Muon Trigger Cards
- 43 Muon Centroid Cards
- 4 Trigger Crate Manager Cards
- 5 Muon Centroid Crate Manager Cards

Receives inputs from muon scintillators, MDTs, PDTs, and CTT.

- Triggers are formed for three geographic regions: Central, North and South.
- Muon Trigger Cards cards form octant-level trigger decision.
- The decisions are then summed by regional Muon Trigger Crate Managers to form regional triggers.
- Regional Triggers are combined by the Muon Trigger Manager to form a global trigger
- The global trigger is sent to the trigger framework.

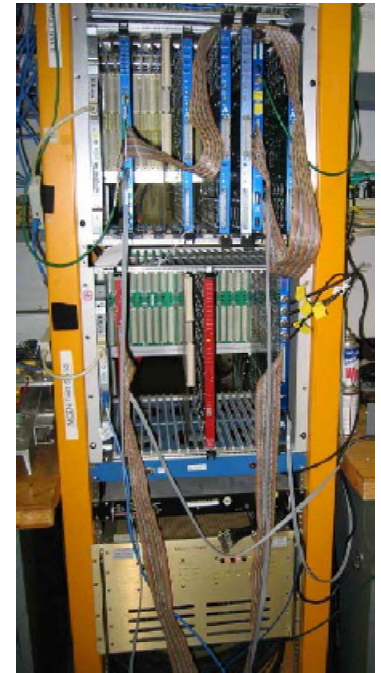


L1 muon

- L1 muon is supported by Fermilab and Arizona
- L1 muon system works well
- Number of spare cards is enough for operation
- All recent problems are well understood and successfully resolved
 - “Octant 0” problem
 - Electronics failures due to power cycling
 - Parity Errors
 - other minor issues

Latest improvements:

- New test setup improves the tests for all types of L1 muon cards
- Receiver/Transmitter test equipment is received from Arizona
- All power supplies have delay system
- All problematic input cables are re-terminated during and after last shutdown to prevent parity errors
- The blowers are replaced with more reliable ones.



Muon system summary

- Muon system is running well with no major issues
- No ageing effects observed in sub-systems
- System monitoring is strong and reliable
- Low voltage power supplies issue may require to buy some extra spares units
- **KEEP RUNNING!**

... but

We do have a need for more manpower in the Central Muon/L1 group and would welcome anyone who has an interest in joining us.