FEE, DAQ and Online Software

Status & Issues

G.F.Pearce
RAL

- DAQ, FEE status & issues
- Anomalous Singles Rate Issue
- Run Control, DCP
- Online Software

DAQ
Hardware

- Hardware for both detectors delivered - *mostly*
  - Stored at Soudan
- DAQ h/ware loaned to ANL for ND v-slice
  - ND spares
- Left to purchase
  - UPS, RAID, remaining UDS devices by April
  - Online Monitoring PC ?
    - DP investigating requirement
  - Near Detector
    - PCs, Monitors, RAID will be ordered much later

DAQ
Soudan System

- 2-crate system operated routinely
  - 2 crates adequate for 1st 64 planes
  - Plane assembly reached this in early December

- Upgrade to 4-crate system in December
  - Delay due to crates not wired, TRCs late
    - Created schedule clash with ND v-slice work
  - Chose to upgrade to 4-branch system – all optical
    - Simplest upgrade
    - 1 crate/branch – full set of BRPs now in use

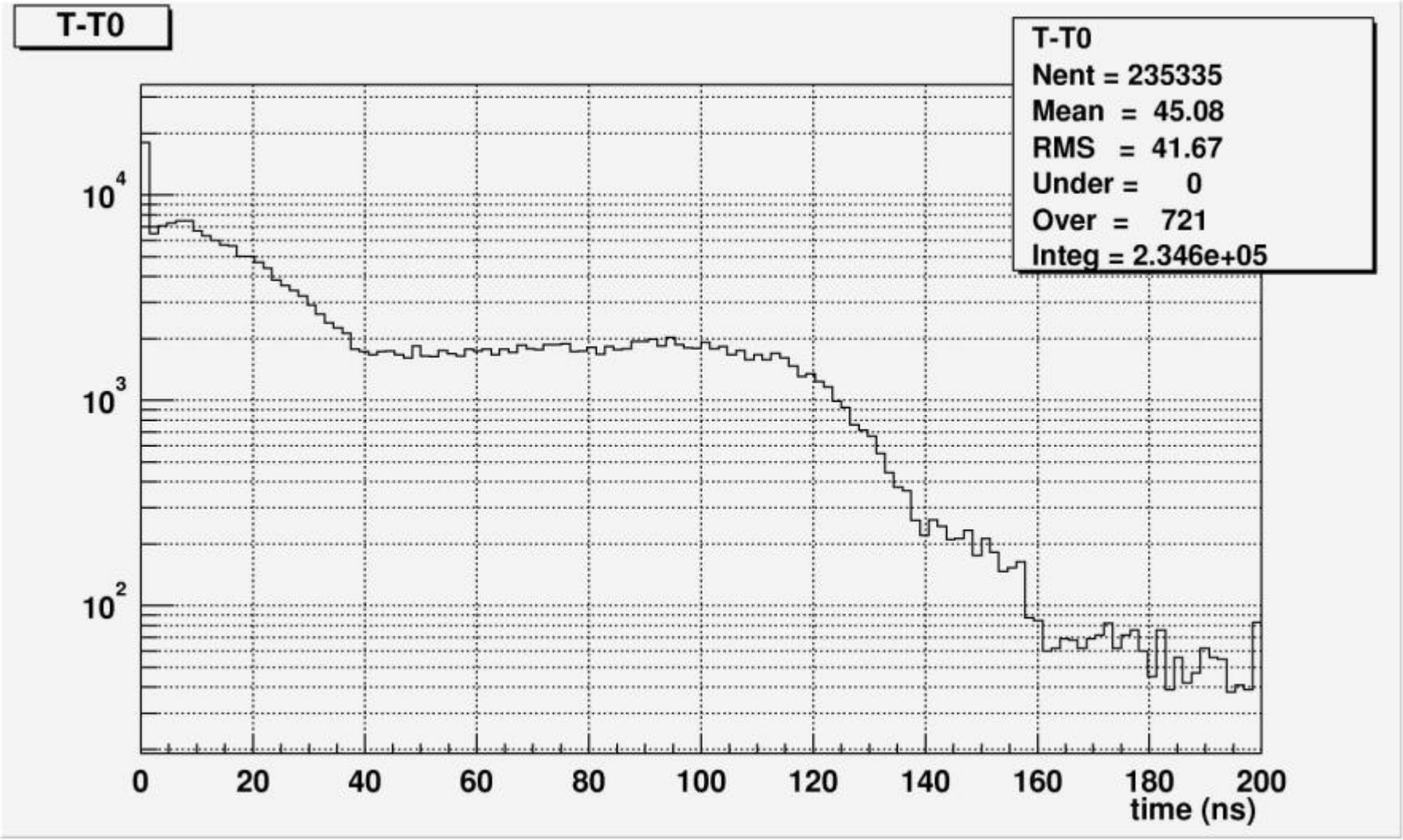
DAQ
Soudan System

- Upgrade to 4-crate system . . . .
  - No TCU available
    - mTRC-sTRC system extended to 4 crates
    - TRC upgrade allows compensation for cable delays
    - Adjustment granularity 12.5 ns
    - 1 card faulty – no spares at Soudan now
    - Time spread on crates/hits **greatly** improved

Hit Time Distribution

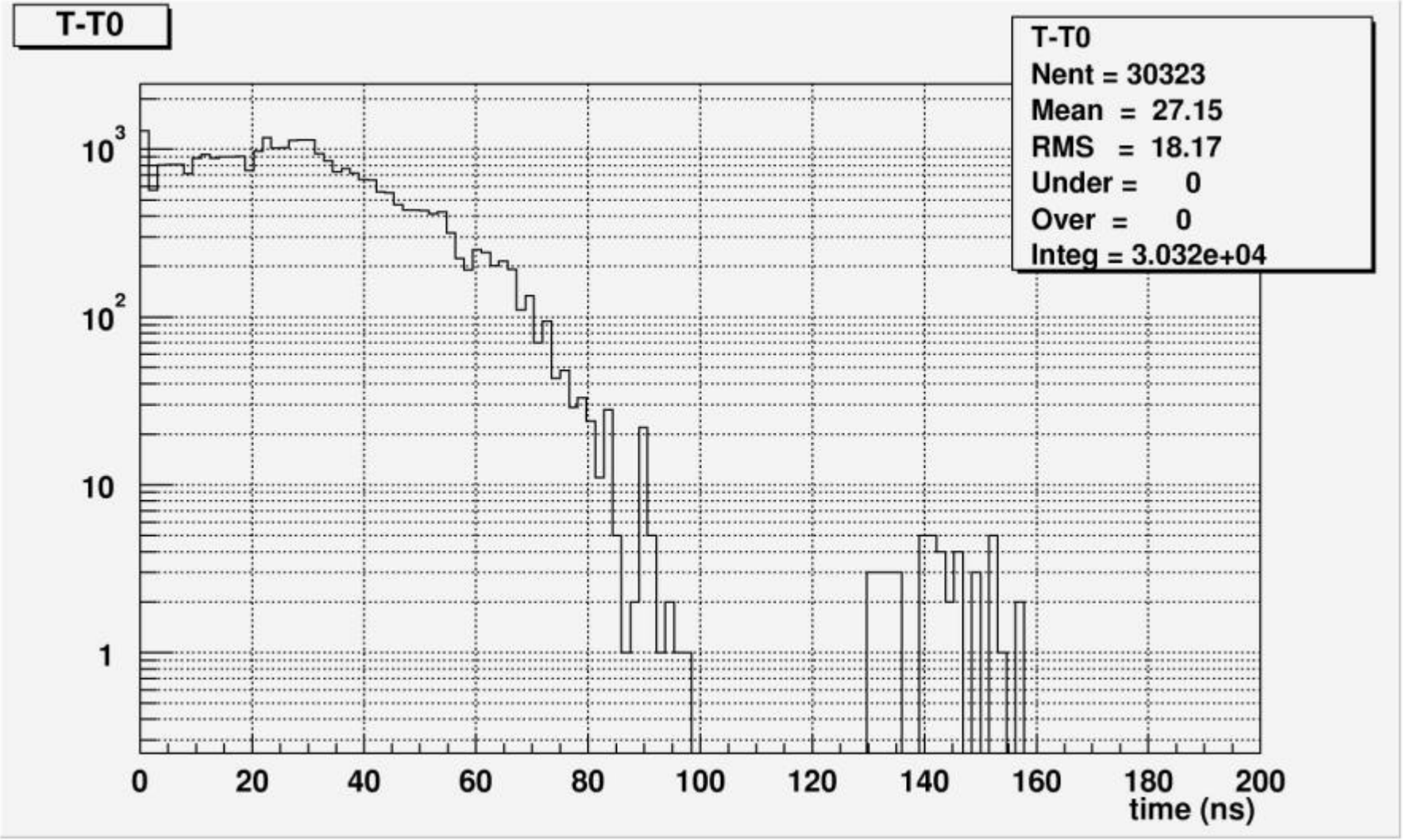
Before TRC upgrade (Run 1261)

G.F. Pearce
January 5, 2002



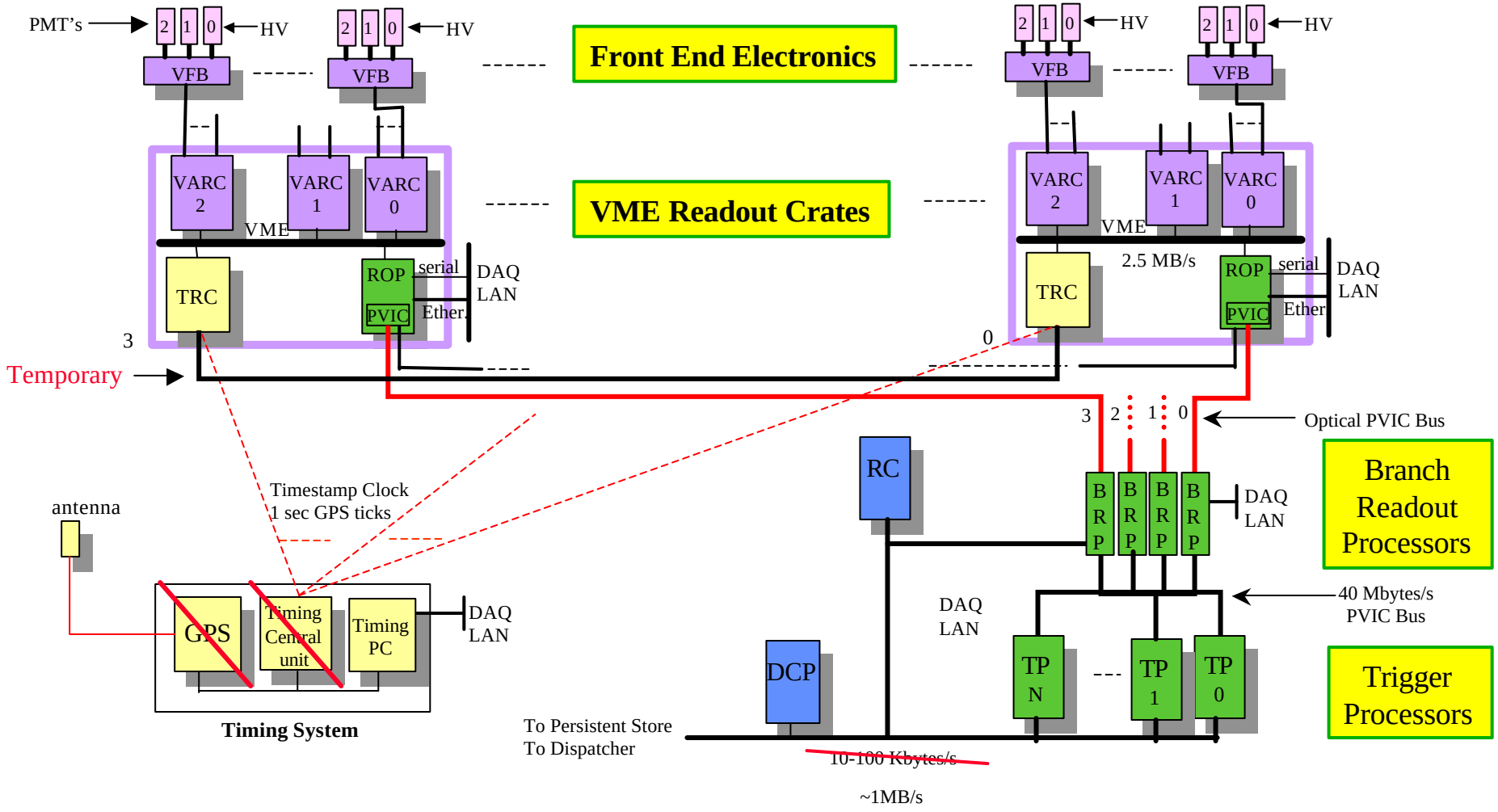
Hit Time Distribution
After TRC upgrade (Run 1708)

G.F. Pearce
January 5, 2002



DAQ System
Far Detector

G.F. Pearce
January 5, 2002



DAQ
Further Work

- Upgrade to 6 crates
  - Require for plane 128, ~ 1st week of Feb
- Multi-crate branches
  - Differential PVIC on a branch
  - BRP code upgrade
  - Reshuffling of crates between branches
- More TRCs required ~ now
- Extra crates wired up ~ now
- Plan - Work complete in time for plane 128
- Issue – ND vertical slice – see JLT talk

VA Issues

Alfons/Roy reported at parallel session

- Last chips for repair with IDE
  - Return in January
- New chips
  - New silicon at IDE
  - 150 new chips January
  - Remainder by April
- Single channel fault
  - Cause still unknown
  - IDE take responsibility – not our problem
- Cable faults?
  - ~ 10% bad
  - Appears to be cable/connector problem
  - Swap out and check
- Chip Failure Rate
  - No failures in operation
- Performance good
  - Stable, expected response
  - See Roy Lee talk October
  - See J.Nelson talk, this meeting

Far Detector
Singles Rate Issue

- Detector rates out of spec, ~ 6x higher than expected
- Issue for FEE is rate from PMTs
  - Rate is ~ maximum VARC can handle – not good
  - Readout deadtime increases to ~ 3% per VA chip
- Issue for DAQ is integrated rate from detector
  - Crate level OK. Branch level OK (probably)
  - Problem is where full detector singles rate merges
    - 484 planes => 85MB/s (0.7 Gbit/s) (2x over design max)
    - Design maximum 40 MB/s included ~ 250% contingency
    - Actual capability is higher, but not 2x
- Need to reduce or handle rate

Singles Rates
Options

- Raise thresholds
  - ~2x at 1pe, ~ 10x at 2pe
  - Need a threshold near maximum 2pe
- Local triggering in VARC
  - Simple to implement
  - Large rate reduction (5x -> 30x)
  - Readout deadtime greatly reduced
  - Some inefficiencies from hit loss at boundaries
- Local triggering in DAQ
  - Simple to complex (depending on acceptable inefficiencies)
  - Still have high rates in VARC and crates
  - Chip deadtime not addressed

Far Detector
Singles Rates – DAQ Options

- Data Reduction upstream of Trigger Farm
  - Identify ROI to reduce singles rate into farm
  - Software upgrade in ROPs or (preferably) BRPs
    - More complex messaging; triggering; buffering
- Add extra BRPs (e.g. 4->6 or 8 Branches)
  - Reduce load on each BRP ~ £6K/branch
- Dual Output PVIC + extra BRPs ~ £32K
  - Two output branches on each BRP (=>2x rate)
  - Interleave TF transfers into farm
- Option X – Replace PVIC
  - e.g. Gigabit ethernet, fast switches
  - New development cycle, Expensive, Risky

Software Development

Hardware Validation

Argh!

Far Detector
Data Reduction in Branches

- ROPs time sort (benchmark was OK)
- BRPs scan their TF for Regions Of Interest
  - E.g. 3 hits in 50ns (from 1 side of one SM if 4 BRPs)
  - ROI would be time window around this
- Could pass ROI singles data to farm now

OR

- Each BRP passes list of ROIs to mBRP
- mBRP sort/merges ROIs from branches
- ROI list passed to all BRPs
- BRPs pass single hits from ROIs to Farm
- Farm processes as at present

Singles Rates – FEE Options
(R.Lee, A.Lebedev, N. Felt, J.Oliver)

- Coincidence trigger in VARC firmware
  - Modification to FPGA firmware in VARC
  - VA chip readout only if coincident hits
  - 2/6 chips in ETC or 2/36 (2/30) in VARC within time window (up to 400ns)
- Large reduction of rate and chip deadtime
  - 2/6 implemented at Soudan
  - Rate reduction over 30x with 400ns window
  - Deadtime reduced~ 10^{-3}
- Inefficiencies studied with simulations

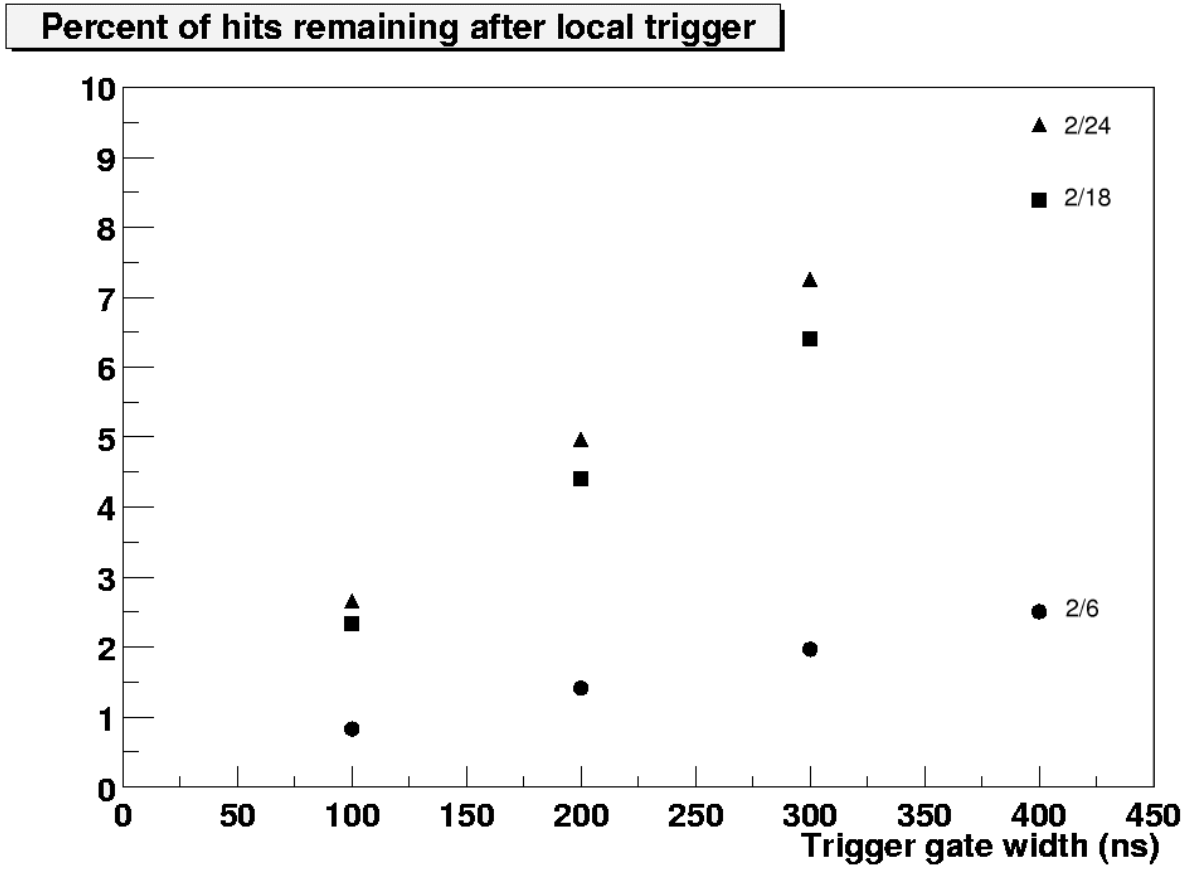
Far Detector

Singles Rates – FEE Options

- Data studies at Soudan with/without (2/6)
  - Extensive work by Roy / Andrei
  - One VARC upgraded with 2/6 ETC trigger
  - Rate reduction scales as expected from randoms
  - No discernable effect in pulse height or time distributions
  - 2/36 much lesser systematic effect
- MC studies on effect on physics (Andrei)
  - Issue - can lose single hits at VARC boundary
  - Largest effect is on shower energy - focus
  - Effect negligible on reconstructed showers with 2/36

Rate Reduction

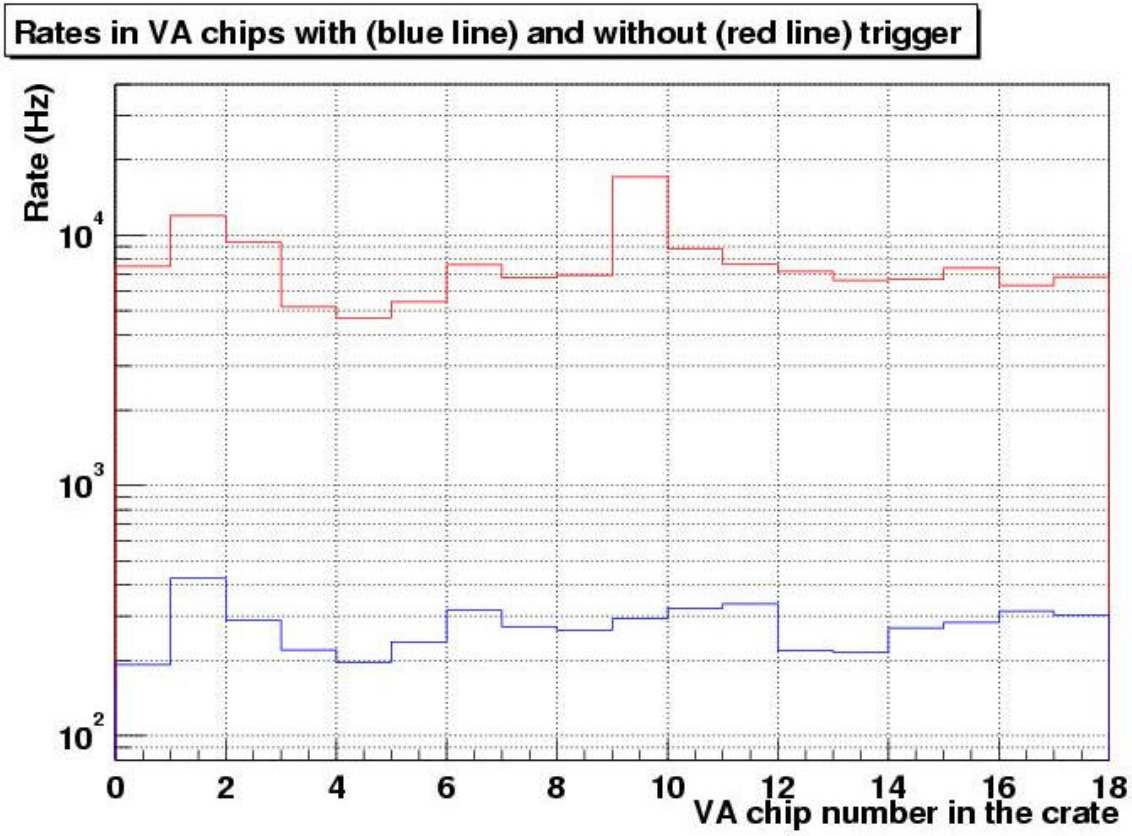
(A. Lebedev)



Data from Soudan

Rate Reduction, 2/6

(A. Lebedev)

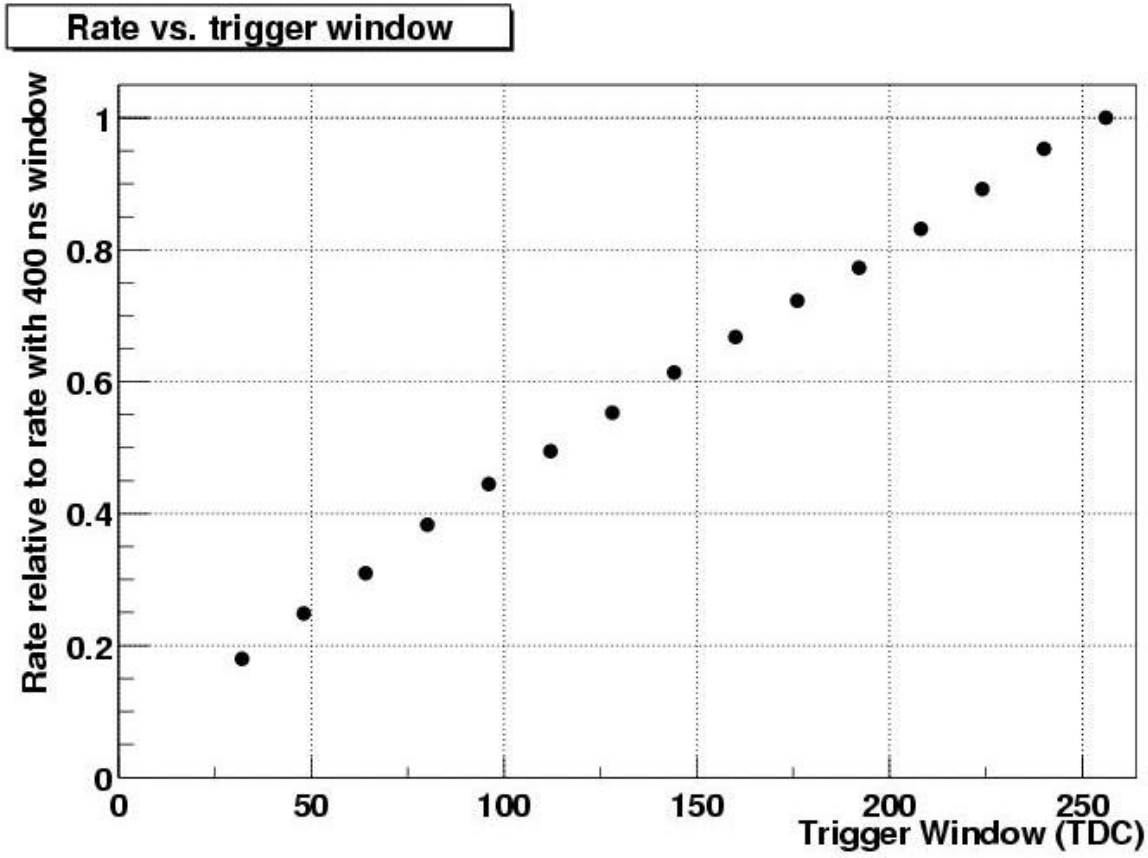


Rate vs Window, 2/6

(A. Lebedev)

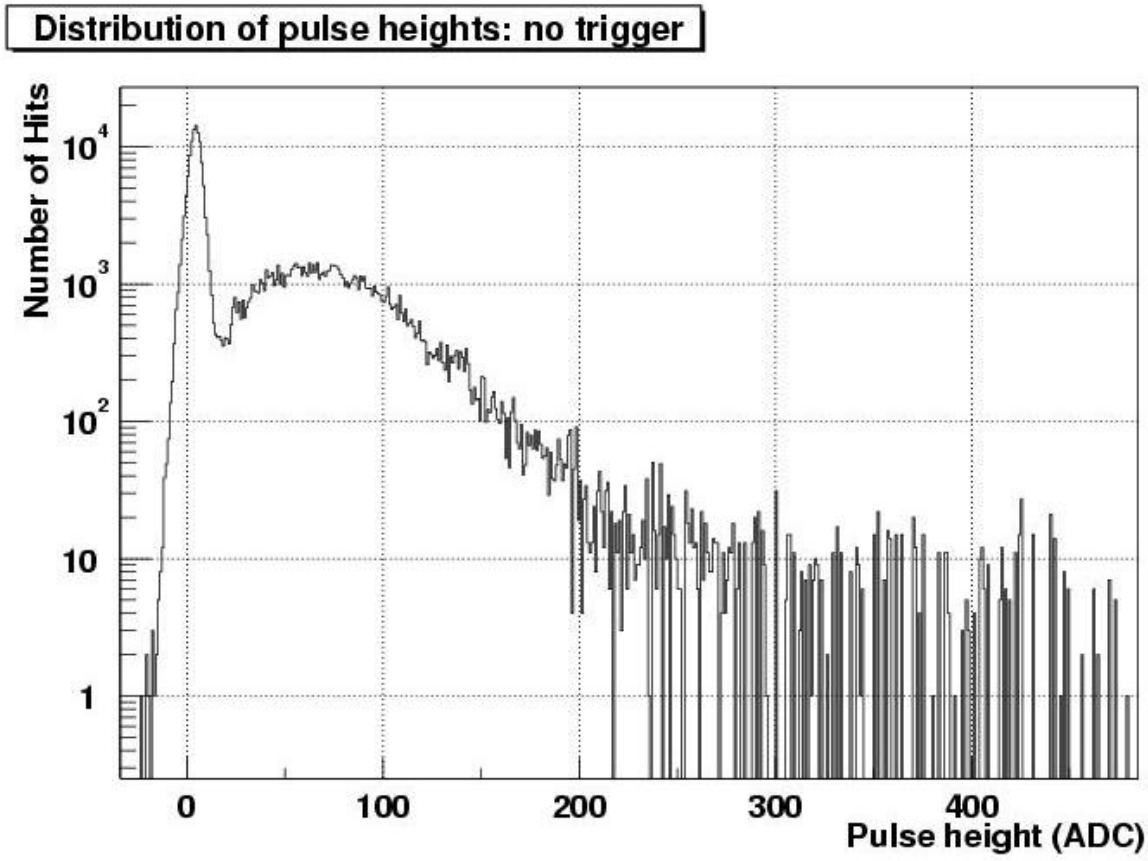
Linear.

Consistent with randoms



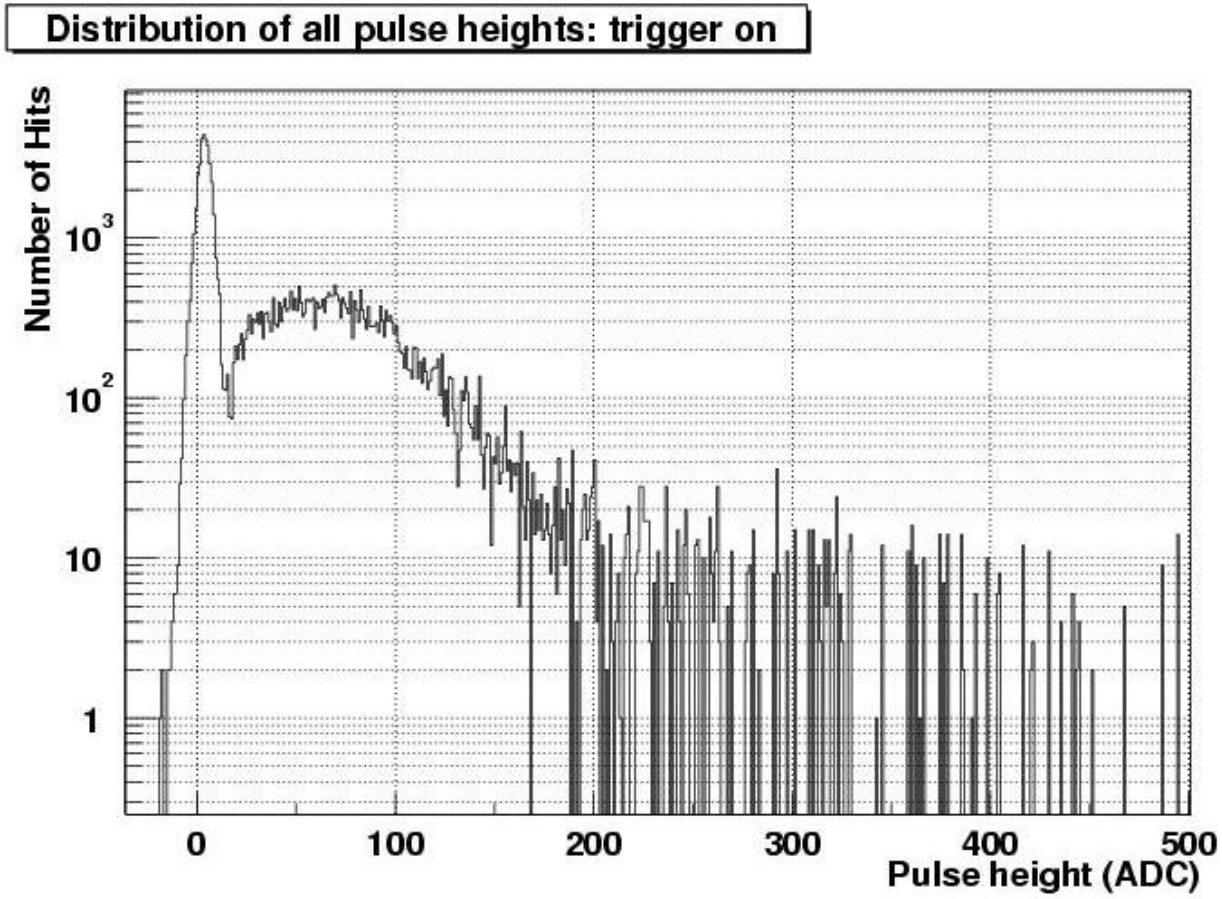
Pulse Height Distribution, All

(A. Lebedev)



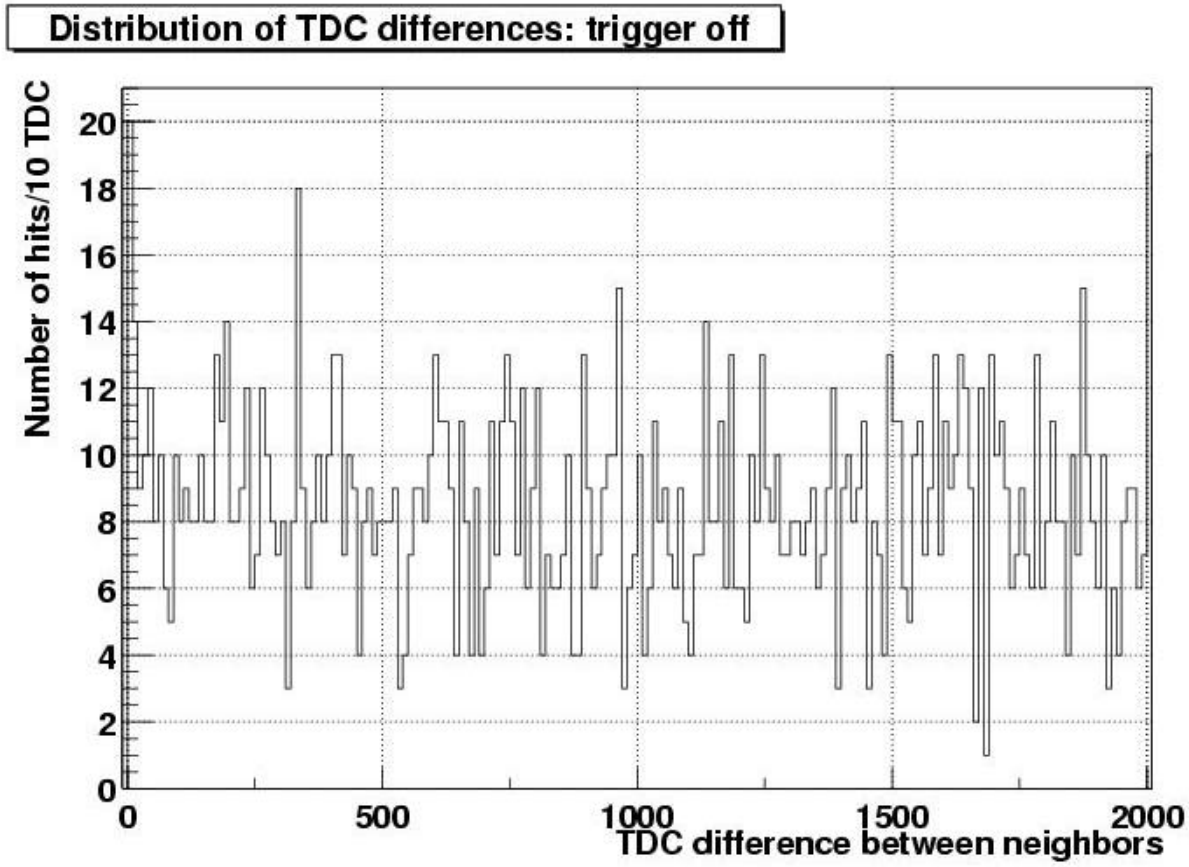
Pulse Height Distribution 2/6

(A. Lebedev)



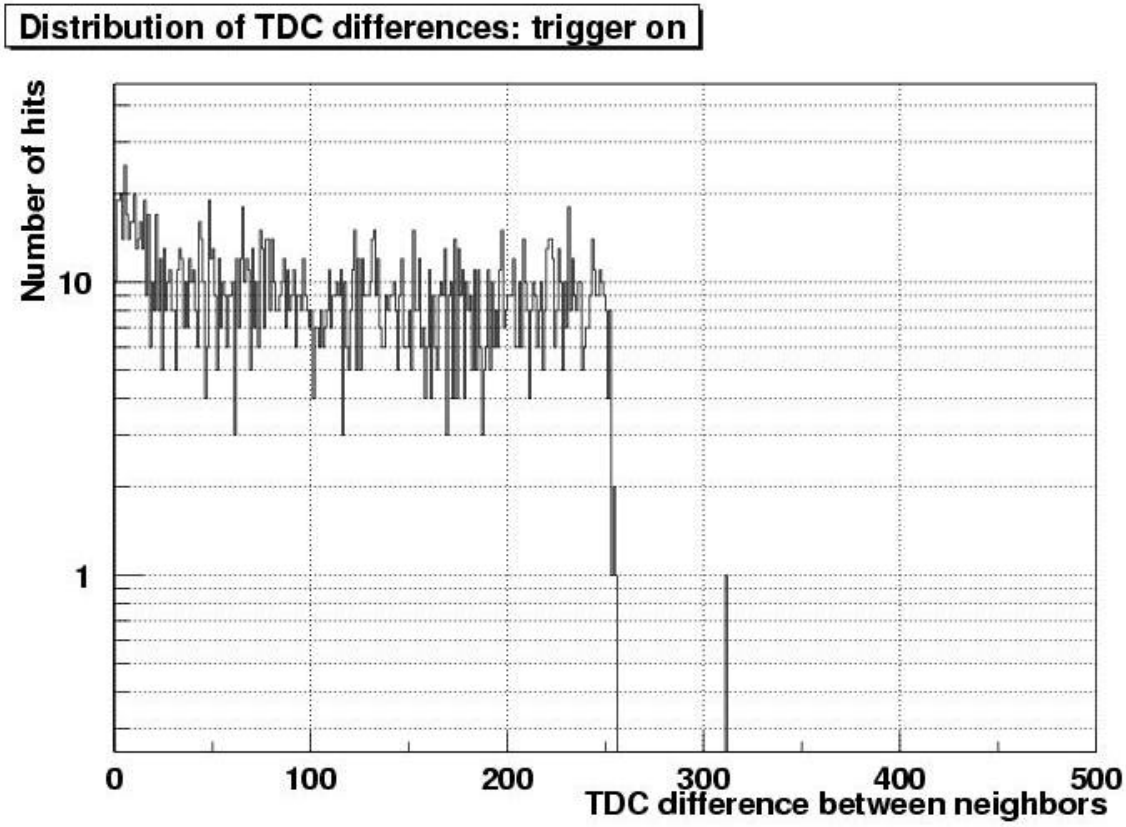
Time Distribution, NoTrig

(A. Lebedev)



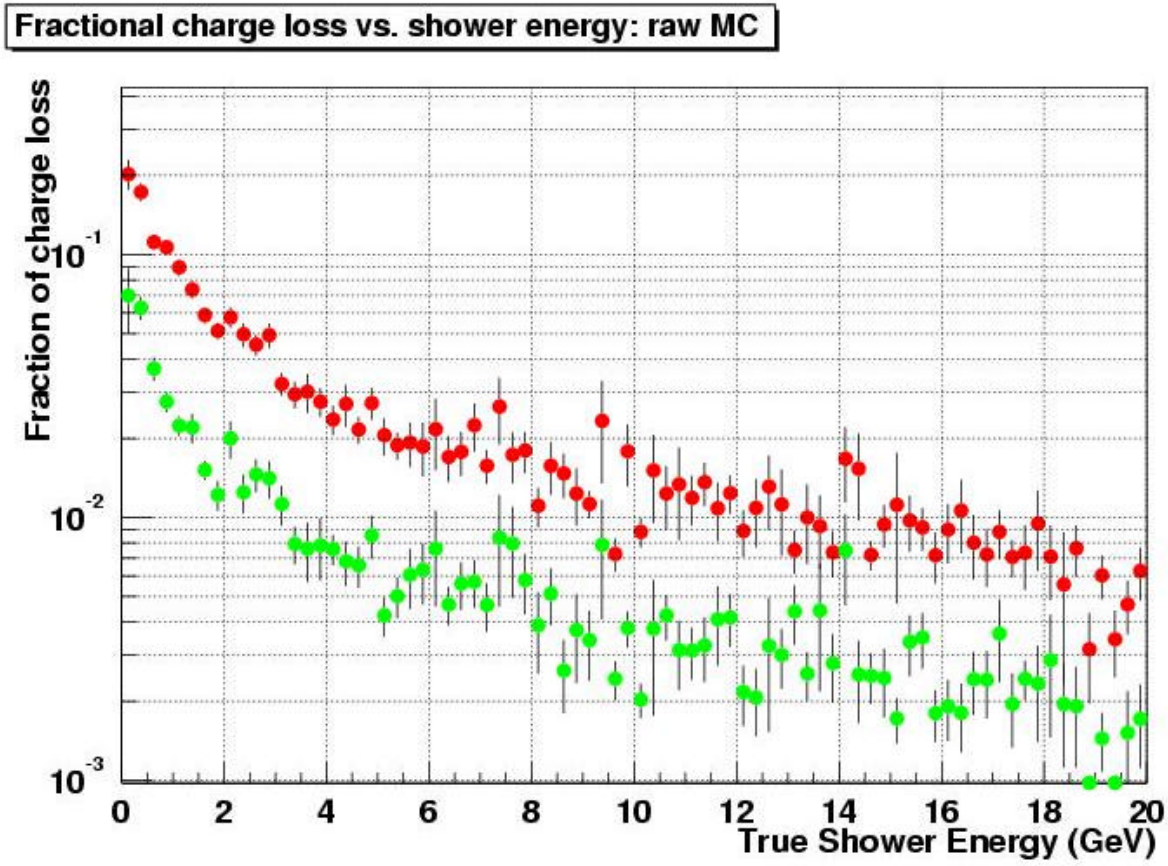
Time Distribution, 2/6

(A. Lebedev)



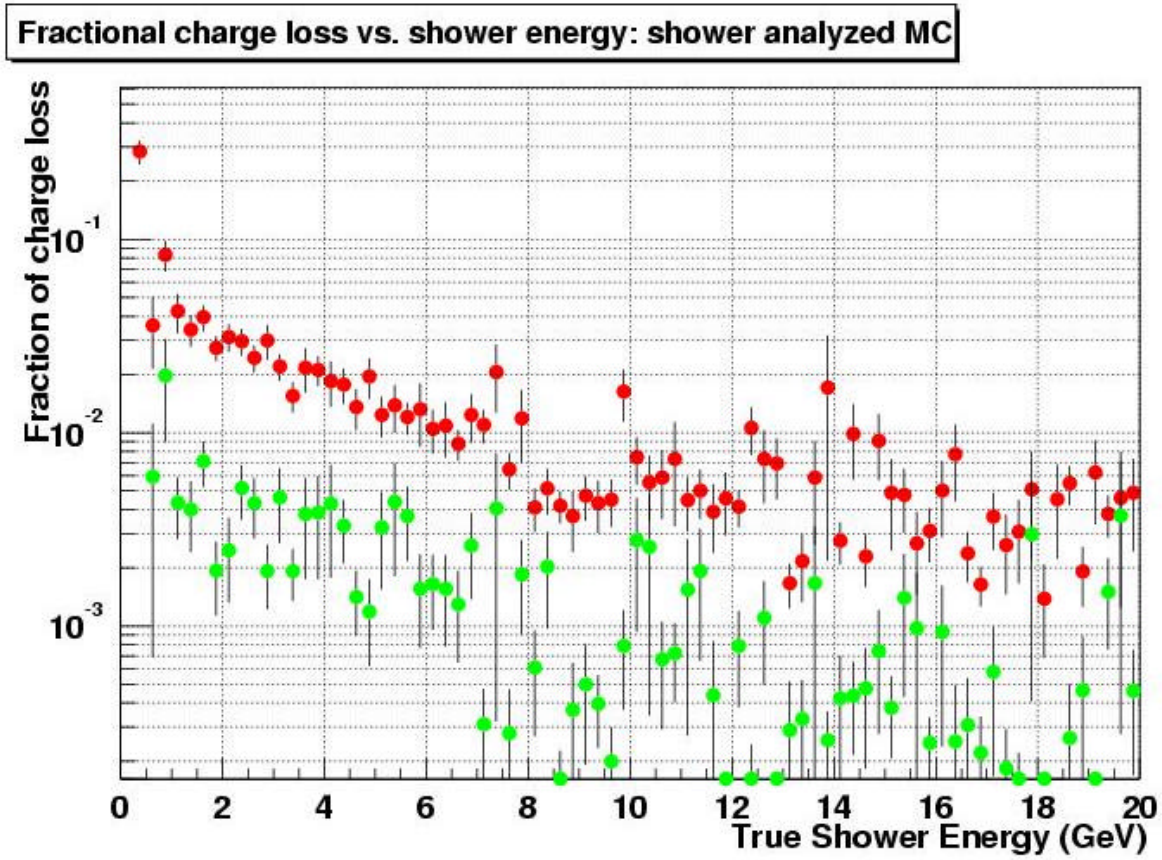
Shower Losses - Raw

(A. Lebedev)



Shower Losses - Reconstructed

(A. Lebedev)



Hits loss is peripheral to shower core

excluded in recon. anyway

Singles Rates

Recommendation

- Implement local trigger in VARC
  - 2/36 in VARC within 200-400 ns window
  - > 5x reduction in rate
  - Requires ETCs to communicate on VARC
  - Existing lines (share) – firmware change
- Timescale
  - 2/6 currently implemented – use as interim
    - Full firmware upgrade at Soudan next week
  - 2/36 implemented in VARC end of January
  - ETC configuration by DAQ in February
- Options in DAQ remain if required

Run Control
Recent Upgrades

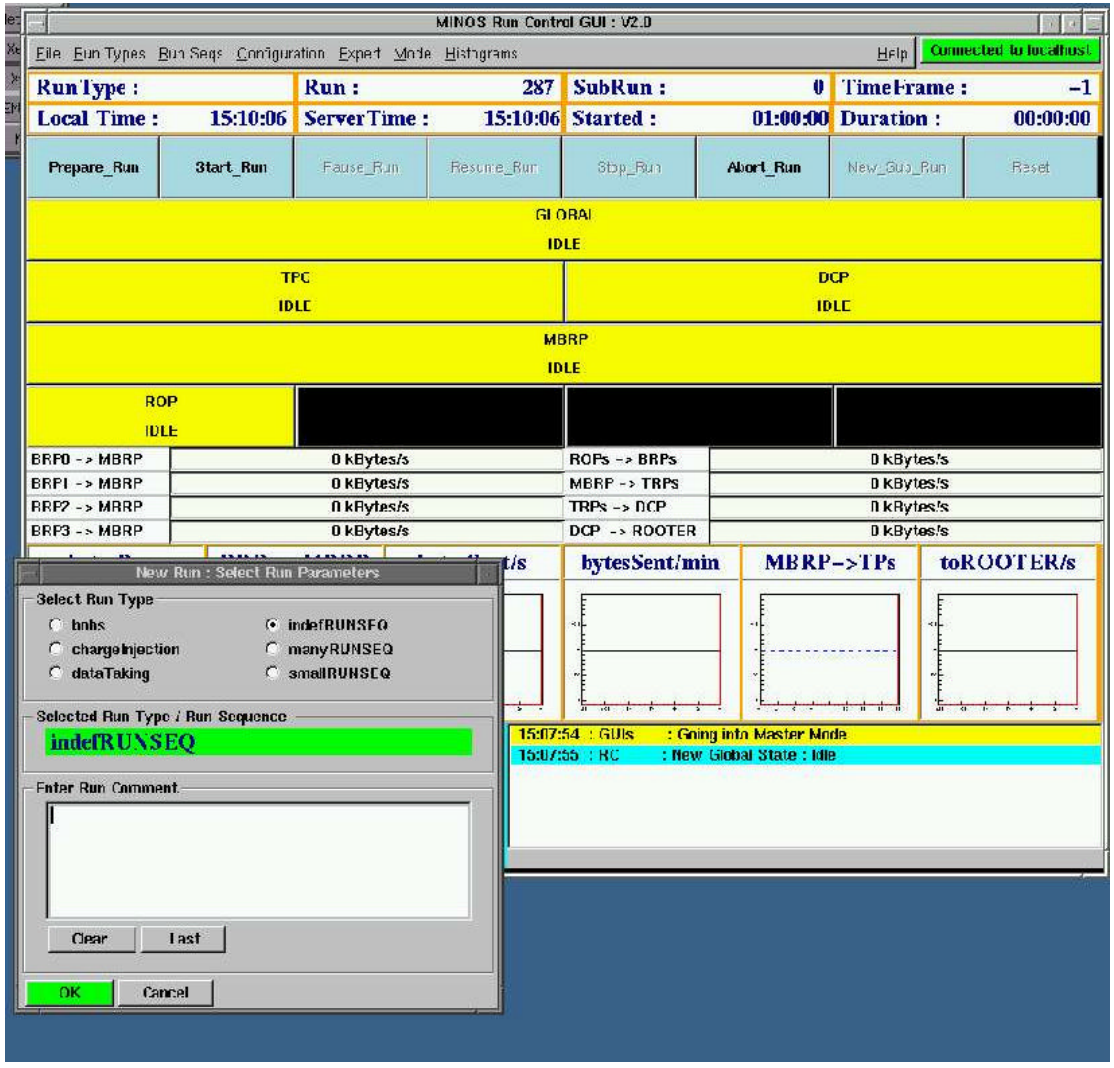
- Automatic Run Sequencing
  - Automatic sequence of runs taken by RC
  - Run sequences defined in config file as series of run types and durations
    - Files edited by experts
  - Repeatable 1->infinite number of times
  - Sequence can be started at prescribed times
  - RunSeqs is a “dummy operator” - RoboOp

Run Sequence

Starting

G.F. Pearce

Start a seqeuence like a normal run



Run Sequence

Running

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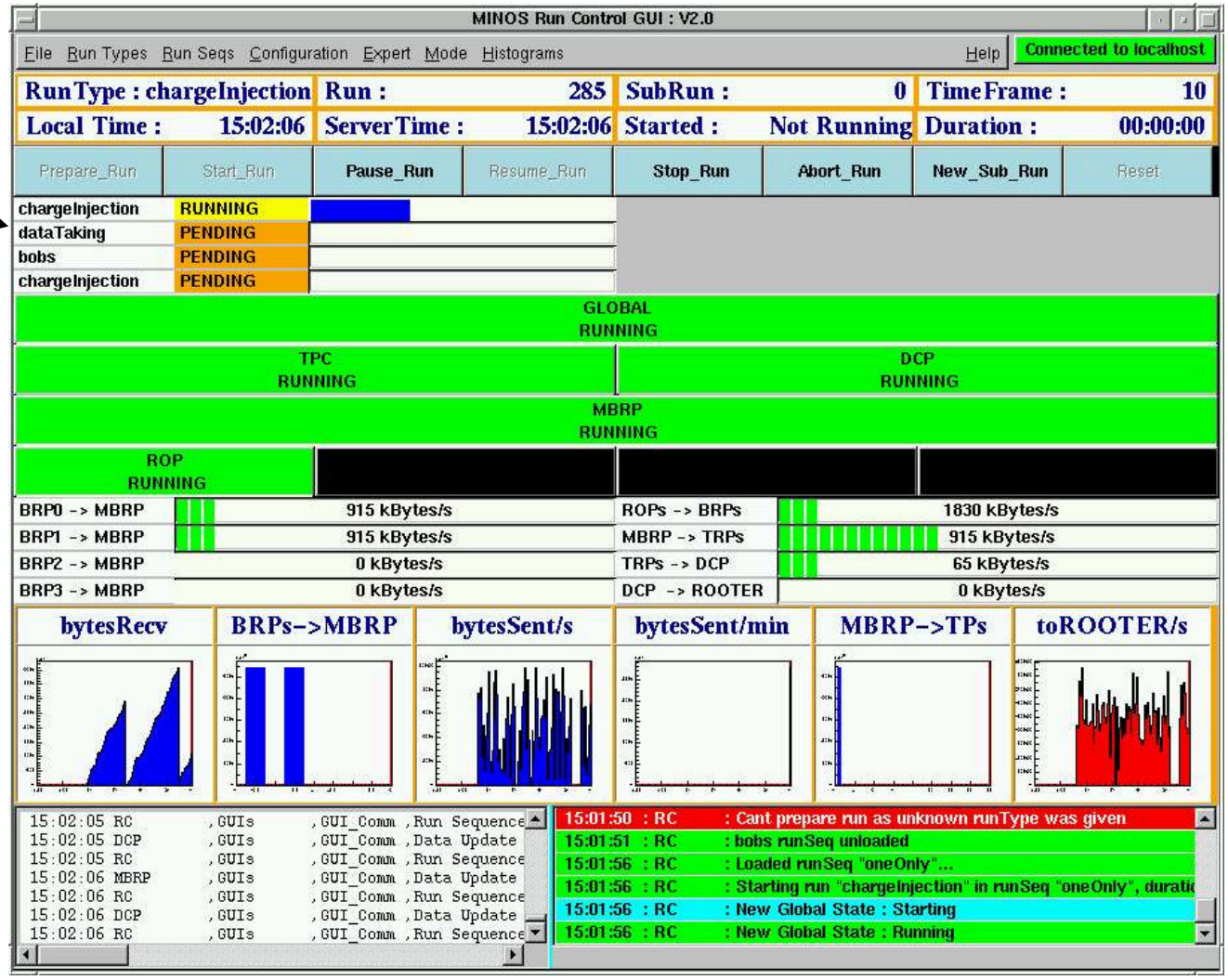
Status of runs shown on RC GUI



Run Control

Auto-sequence configuration

G.F. Pearce

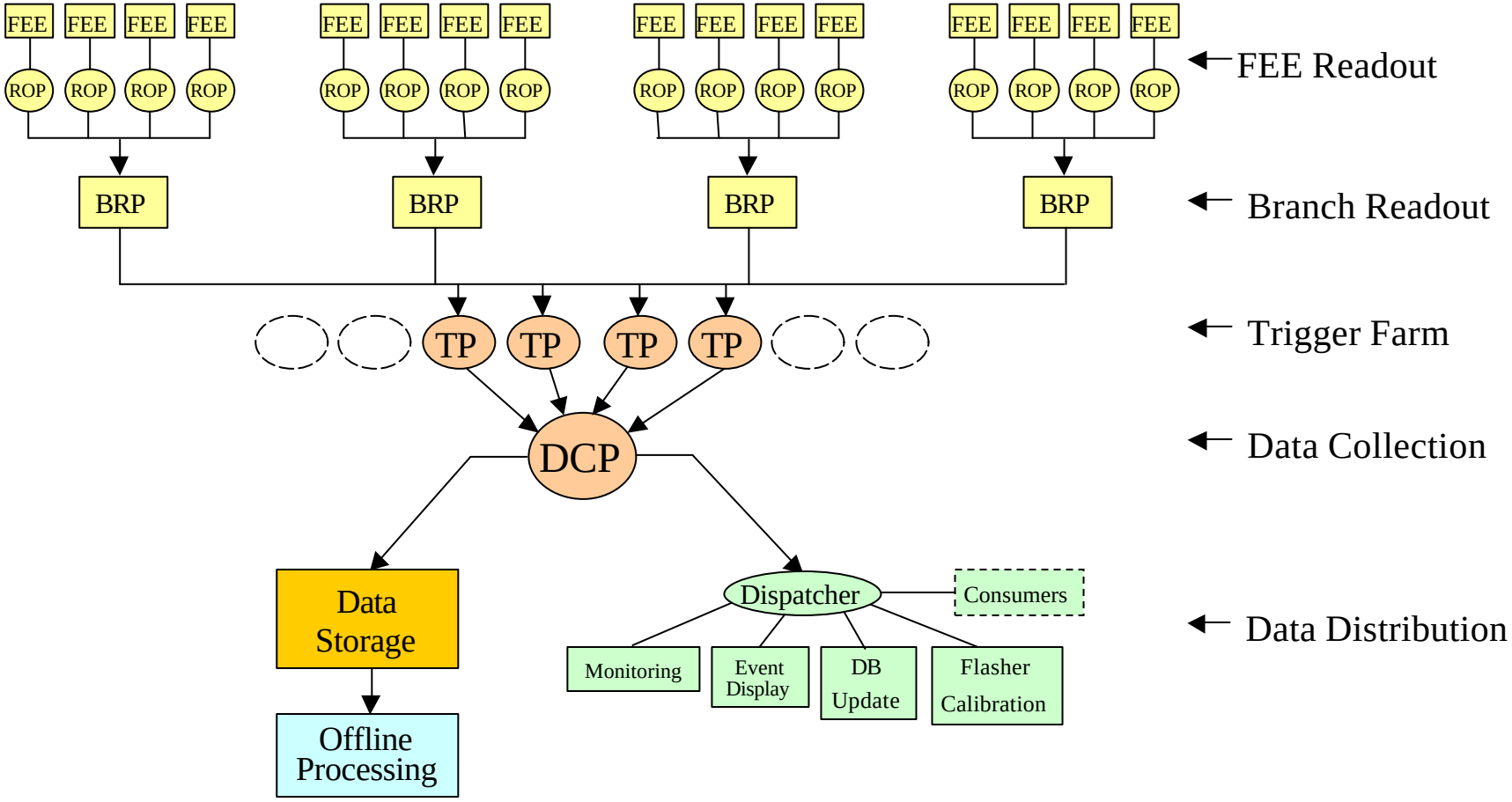

```
//list of registered runSeqs, do not edit by hand
<runSeqList>
regRunSeqs#S=smallRUNSEQ,manyRUNSEQ,indefRUNSEQ;
</runSeqList>

<smallRUNSEQ>
runNames#S=chargeInjection,dataTaking,bobs,chargeInjection;
runTimes#F=0.5, -1.0, 3.0, 1.0;
repeat#I=2;
</smallRUNSEQ>

<manyRUNSEQ>
repeat#I=2;
runNames#S=dataTaking,chargeInjection,dataTaking,chargeInjection,dataTaking,chargeInjection;
runTimes#F=0.5, 0.1, 0.2, -1.0 , 0.5 , 1.0 ;
</manyRUNSEQ>

<indefRUNSEQ>
repeat#I=1;
runNames#S=dataTaking,chargeInjection;
runTimes#F=-1.0, 1.0;
</indefRUNSEQ>
```

Run Control
Recent Upgrades

- rcLogger upgrade
  - Warnings, errors, info… from DAQ/Online etc
  - Fully searchable on priority & string
  - Colour coded display

- Mini-run summaries automatic
  - Comment
  - Run type, start/stop times etc

Data Flow


FEE
ROP
BRP
TP
DCP
Data Storage
Offline Processing
Dispatcher
Consumers
Monitoring
Event Display
DB Update
Flasher Calibration
FEE Readout
Branch Readout
Trigger Farm
Data Collection
Data Distribution

Data Collection Process

- Installed and tested at Soudan
- Ready to go
- Multiple trigger processors tested with dummy TPs
- Make the default system in January
- Both ROOT and native DAQ binary o/p supported – same as current TP o/p.

Light Injection

- LI summary maker operational since Summer
  - Works!
- LI Control Software operational at Soudan
  - Full control of system/ Full LI hardware set
- Pulser box settings not yet passed to SM
  - Upgrade coming shortly - Settings then written with summaries to data stream
  - Separate log files on FPC provide info until then
- LI run modes defined in Soudan system
  - Plane Checkout trigger to be defined
- CalDet control system upgraded also

Data Archival

- Archiver installed and in use at Soudan
  - Runs continuously in background
- Files flagged by DCP for archival
- Files stored in Fermilab mass storage
- Work in progress on error recovery procedures
- DAQ auto clean process removes old or large files from disk
  - Warnings to syslog & rcLogger, e.g. if files not archived

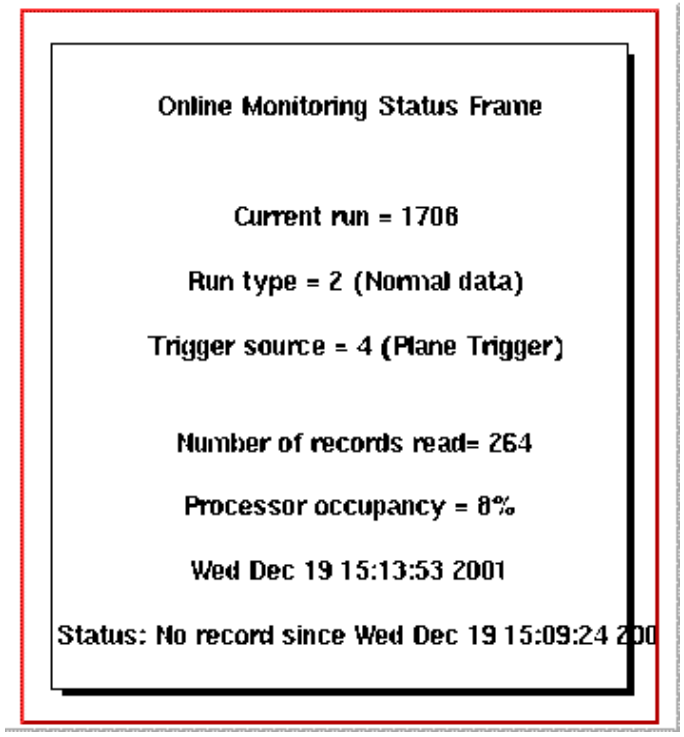
Dispatcher

Installed and in use at Soudan

- Autosave frequency set for all run types
  - 1000 records or 10secs
  - Adjustable with experience
- File sharing with DAQ
  - Ready for tests
  - RotoRooter / Persistency / .. Upgrade at Soudan had problems
  - Try again – next week?

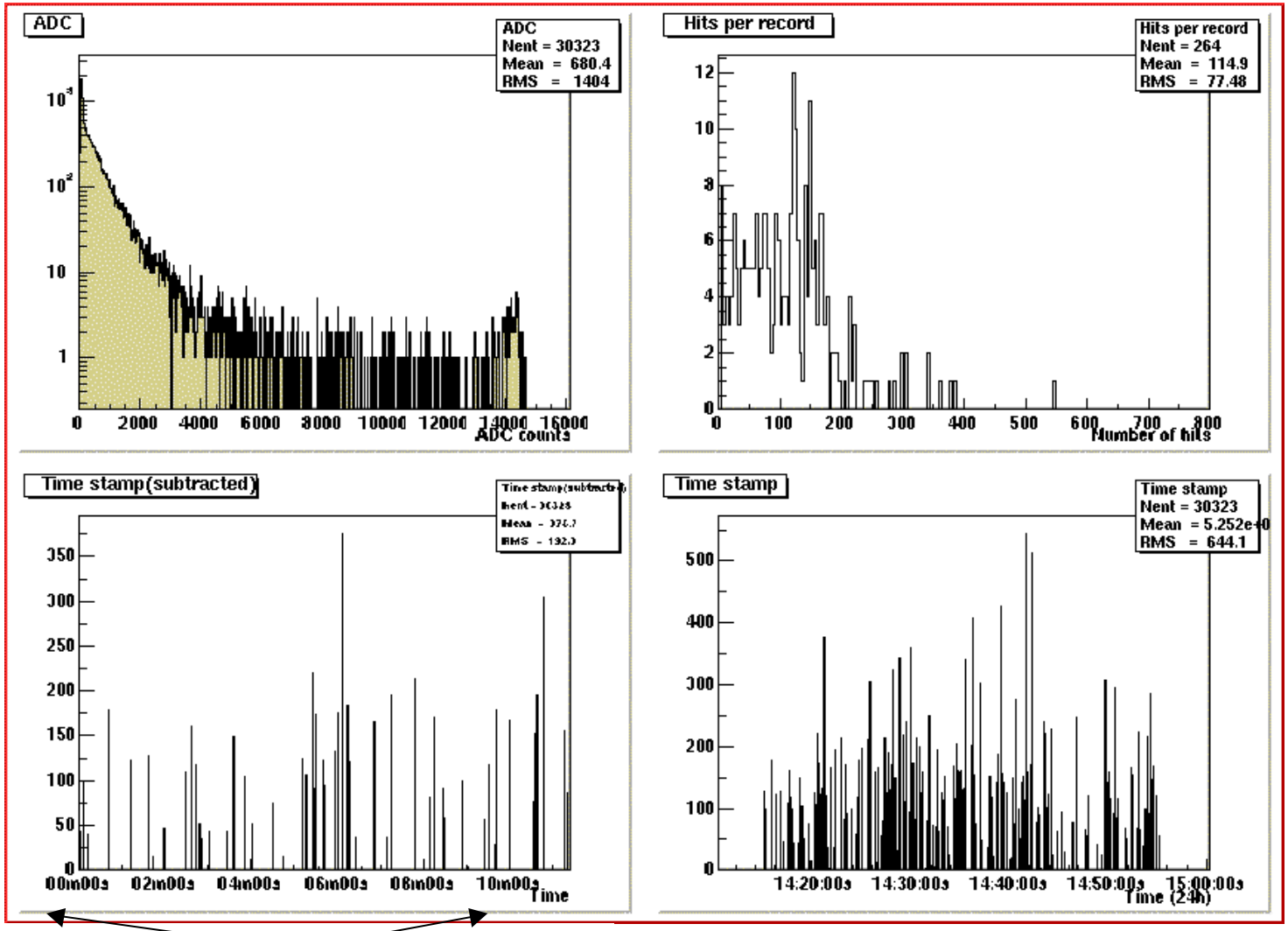
Online Monitoring

- Still working at the mine (usually!)
  - new quantities - in particular for LI & CI
  - introduction of summary canvases
    - important quantities grouped together - easier access to information
    - run type/record type information available
- Current/future work
  - new quantities and summary plots for plane checkout procedure (see JN's talk)
  - preparation for "online" running
    - updates to DAQ, rotorooter and dispatcher
    - should happen in Jan '02
- Monitoring is also being used as an offline data analysis job



One of the status canvases

Online Monitoring



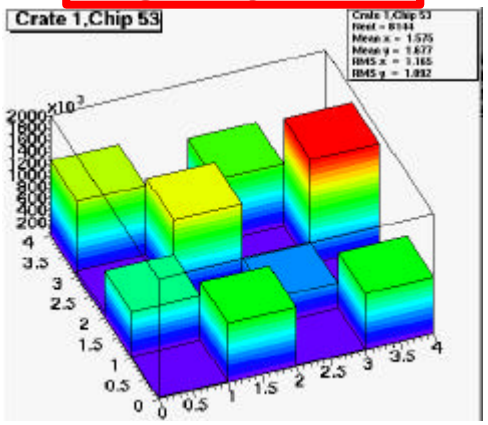
Zoomed in

Online Monitoring

Run Types

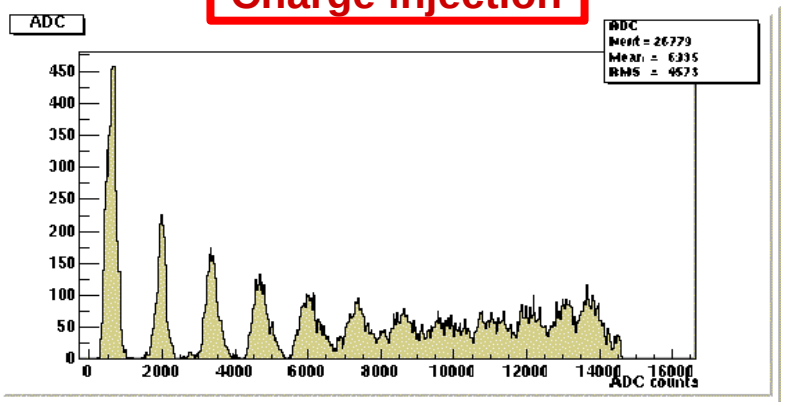
G.F. Pearce
January 5, 2002

Light injection



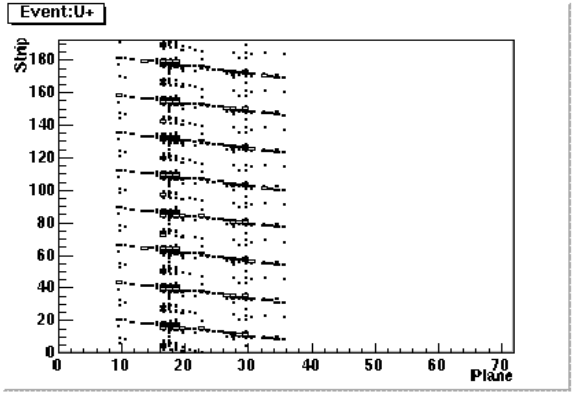
PMT hit map - checkerboard pattern

Charge injection



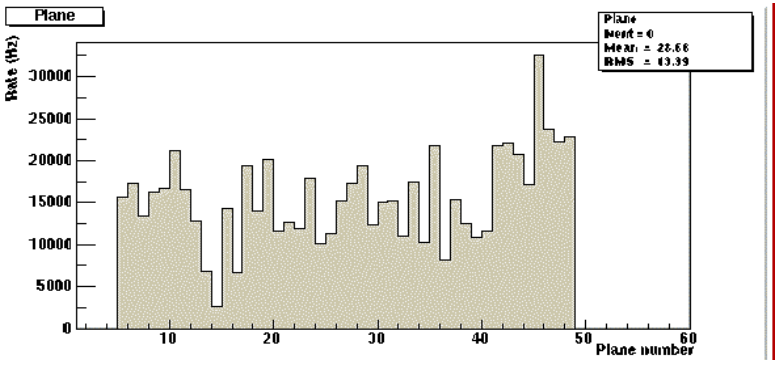
Charge inject scan

Plane trigger



"Event display" - plane vs strip

Singles data



Singles rate per plane

Database

- Online Database installed
  - E.g. Plex used by Online Monitoring
- Writing of DAQ data to database
  - DBU process still close to ready
  - DAQ data all written to the data files
    - Pedestal tables, Run start/End records, etc
  - Estimate few weeks
- Writing of DCS data to database (or ROOT files)
  - Needs focus