Summary of RUN Period 24

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Start:	$10 - 6 - 1993$
End:	$2 - 8 - 1993$
People on shift:	57
Number of Spills:	≈ 430
Average beam rate:	595 kHz
$\Sigma\,\overline{p}$	$\approx 1.1 \cdot 10^{12}$
used $\overline{p}$	40%
Recorded events on tape	$570 \cdot 10^{6}$
$\pi\pi$ candidates	$28 \cdot 10^{6}$
$\pi^{o}\pi^{o}$ candidates	$1.7 \cdot 10^{6}$
Sum of written tapes:	6293
On Exabyte:	100%
Average number	
of tapes/shift	53
in best days	67
maximum	102

Contents

1 Short Summary of RUN Period 24

Beam arrived at 10th of june at 19pm. The first three days were spent for beam tuning (error fixed in the beam tuning program, a new degrader had to be installed), detector tuning (DC, PID, CAL) and trigger studies. During the first days a lot of valet crashes were recorded (PC,CAL,EB,tape) and the problem with the ST readout (blocking the busy) has been observed the first time.

Data taking with the full trigger (T505163323) started on tuesday 15th of june. The situation concerning the beam intensity and stability was very bad during the first week. The average beam intensity per spill was less than 400kHz, spills were lost from time to time. There were spikes in the intensity near the end of a spill which caused HV trips in all the chambers. Some beam time was lost because of time spent for trying to understand the reasons for the LEAR problems. On friday 18th of june a compromise was found (reducing the stack in LEAR, shorter spills) to assure a more stable running for the weekend. The experiment PS201 (OBELIX) was running parallel to us during the first week.

Machine development was done during the shutdown from 21th of june until first of july and some problems of LEAR were found and solved. Nevertheless the beam quality was very bad for the first 2 days after the restart. Some operators on shift for LEAR didn't knew what to do in case of problems. These introduced additional deadtime. The spill duration was kept at 60 min. On the PS-meeting of 16th of july it was mentioned that LEAR is running satisfactory only in 60% of the time. During this week we wrote in average 200 tapes/day. The beam was shared between us and PS203 (20% of $\int \overline{p}$) and in addition there were several fast extractions for PS203.

On 6th of july we had again a ST readout problem. The interface to the HWP still worked so we decided to continue for some time ($\approx$ 12h) without the ST readout. Some information about the ST hitmap is available anyhow through the spy channel. The number of reconstructed $K^o \rightarrow \pi^+\pi^-$/tape seemed to be not affected. The problem disappeared after investigating the ST-frontend electronics. It reappeared again on 17th of july, but this time after investigating the ST-frontend electronics also the HWP interface stopped working. It was found out that one CPU-card (MVME101) was damaged by condensation water. We run with trigger T401 for semileptonic normalisation studies until we found a replacement (after 24h).

Since the beginning of the run we had a communication problem between the CPM cards and the HWP25. The HWP25 saw only 40% of the hits in the calorimeter. This forced us to reduce the cut on the cluster multiplicity from 6 to 5. This had no impact on the quality of the data on tape. The number of $K^o \to \pi^o\pi^o$ was approximately the same as last year. On the 10th of july the HWP25 cluster multiplicity increased by 1 shower. We had to change to T605173323. Finally it was found out that one CPM caused additional hits in the HWP25. The communication problem was finally solved during the shutdown from 19th of july to 22th of july. It was found out that the so called masking procedure on the CPM's didn't worked correctly (reason unknown). Twelve CPM's were modified to ensure that the HWP25 gets all the hits.

After the break LEAR was able do give us high intensity and longer spills because no other experiment was running in parallel. On friday afternoon the electron cooling caused beam instabilities. All the experts were on holiday. Therefore it was decided on saturday to stay with the stochastic cooling only until the end of this period. This caused longer interspill times (+8 min). There was no beam on sunday during the day because of AA problems.

During the last week the LEAR performance was rather poor. Because of the LEAR instabilities also the fast extractions to PS196 took much longer than the normal 1h.

In the last two days we took tapes with our standard trigger and ToF in (T607163323), and with ToF in and dE/dx on pions out. We are waiting for a detailed offline analysis to show which trigger is the best for the maximum number of good events per time.

During the last week an unusual large fluctuation in the S1 ADC spectra were observed (6 channels, see also figure on page 16). Investigations are going on to see possible correlations with the temperature of the ADC crate. Also possible correlations between shifts of the beamcounter and the ToF calibration are under study.

PID, ST and DC were running with their new readout software. The readout time was reduced by $200 - 300$ μs. In addition the CAL group installed a new FASTBUS/VME interface which reduced the readout time from 850 μs to 520 μs. In the beginning it was found out that the new EB software caused additional deadtime in the order of 20%. This was due to a call to COMPACT every second. After modifying the EB software the readout rate increased from 360 Hz to 450 Hz. With a trigger reduction of 750 and a $\overline{p}$ rate of 900 kHz the readout rate was 450 Hz and a tape was written in 200 s.

We wrote over the whole period in average 160 tapes/day. When LEAR worked perfectly we wrote $>$ 90 tapes/shift. Therefore we would have written 250 tapes/day if there would have been no LEAR problems which means 56% more data than we have collected so far.

2 Status of the Readout Times

In P23 we introduced a double busy logic to divide the readout time in two parts. The first part covers the time when the data is transferred from the frontends to the FIC. During this time no new strobe FE is possible, the trigger is blocked. The second part covers the time when the data is transferred from the FIC to the eventbuilder. During this time the trigger can start to look for a next good event, only the readout is blocked. Since the next good event comes in average after 1.2 ms, the busy 1 determines mainly the deadtime of the DAQ system. The second part is finished in about 68% of the events before the next good event is found (see copies of tranparencies about the CPLEAR busy logic)

During the time between P23 and P24 the readout software of DC, PID and ST was improved by O.Wigger. At the same time a new hardware for CAL was installed to replace the FVSBI by a STR330-VSB-Interface which allowed direct access from VME to the FASTBUS memory.

The EB-DDS-TAPE software was upgraded by D.Francis to allow a data transfer rate of 50 blocks/sec compared to 34 blocks/sec of last year.

In P24 it was possible for the first time to measure very precisely the different readout times of each detector.

Detector	Busy 1 in μs	Busy 2 in μs	old Busy in μs
PC	104	104	104
DC	655	881	1160
ST	495	613	880
PID	594	709	890
CAL	517	517	850
HWP	509	590	590
HWP3	354	354	700
EB		222	220
Global busy 1: 790 μs Global busy 2: 1200 μs			

Further improvements: Replacing ODL by a VIC bus. Would allow to increase the data rate from 50 blocks/sec to 65 blocks/sec.

Reduction of the DAQ deadtime is only possible by upgrading the speed with which the data is transfered from the detector frontends to the STRUCK302. This could be done by a new module called FTS developped at CERN. The aim is to reduce the busy 1 to 200μs. At the same time it is possible to reduce the busy 1 of the CAL to 0 μs and to have only a busy 2 of 520 μs.

3 Problems in P24

- Beam intensity was very low for the first 10 days.
- Beam stability was very bad. Spills were lost.
- Short spill duration ($<$ 60min) and long interspill times ($>$ 15min) caused additional deadtime. ($>$ 25% compared to 12% last year)

- Unexperienced operator during the time when LEAR was not running very stable caused avoidable deadtime.
- No electron cooling during last week. Therefore longer interspill times (+8 min).
- ST readout blocking the busy. Partially solved by taking the ST out of the mask. Finally solved by replacing the MV101 CPU. The MV101 card was most probably damaged by condense water.
- CPM/HWP25 communication problem. The HWP25 saw only 40% of the calorimter hits. Partially solved by changing the cluster threshold in the trigger to 5 instead of 6. The number of $\pi^o\pi^o$ candidates on tape were the same as last year. Finally solved by reprogramming one PAL on 12 CPM's.
- ST valid bit wrong. Detailed sector information for HWP1 was wrong for 3 sectors. Was solved for two sectors and later for the remaining sector.
- ToF decision for the trigger was not working with 100% efficiency because of wrong z-information in 1 out of 32 sectors of the ST-hitmap.
- Large ToF reduction factor (> 3) due to wrong timings on the HWP2 side. Solved by changing the microcode of the HWP2 processor.
- DC gas mixture. Partially solved by increasing the HV (3350V to 3400V) and lowering the LV threshold (4V to 3V) to ensure same resolution as last year. Strip efficiency slightly increased.
- Corrupted data on the VSB bus. Solved by changing the terminators on the FIC and EB side. This caused most probably together with the new readout software for the DCs the "p_T cut inefficiency" of the trigger during the first days.
- ST, PID and DC were blocking the busy with the new readout software from time to time. Finally solved by introducing an automatic reset in the new readout software. The busy is cleared if no readout signal is seen in 1 ms.
- Cassettes were stucked in the tapedrive. Situation improved after a tape service was performed.
- Large number of wrong labelled tapes found. Solved by checking the labels on the DEC5000 before putting them to the tapedrive.
- Break down of the PID Lecroy power supply. Solved by moving half of the PM's to the Beam Lecroy power supply.
- 64 channels of DC6 strips down for about 24h.

4 Achievements in P24

- New EB/tape software: 50 blocks/s (32 blocks/s last year)
tape changing time 7 s (35 s last year)
all events to tape (90% last year)
- Upgrade of DC,ST,PID readout software (gain $200 - 300\mu s$)
- Upgrade of CAL readout hardware and software (gain $350\mu s$)
- stable Run control and fast restart if necessary
- stable exabyte copy
- offline analysis done parallel to data taking on the ALPHA.
- Reduction of the bubbles in the pids
- PID online calibration system installed and tested
- precise measurements of readout times

5 Conclusions

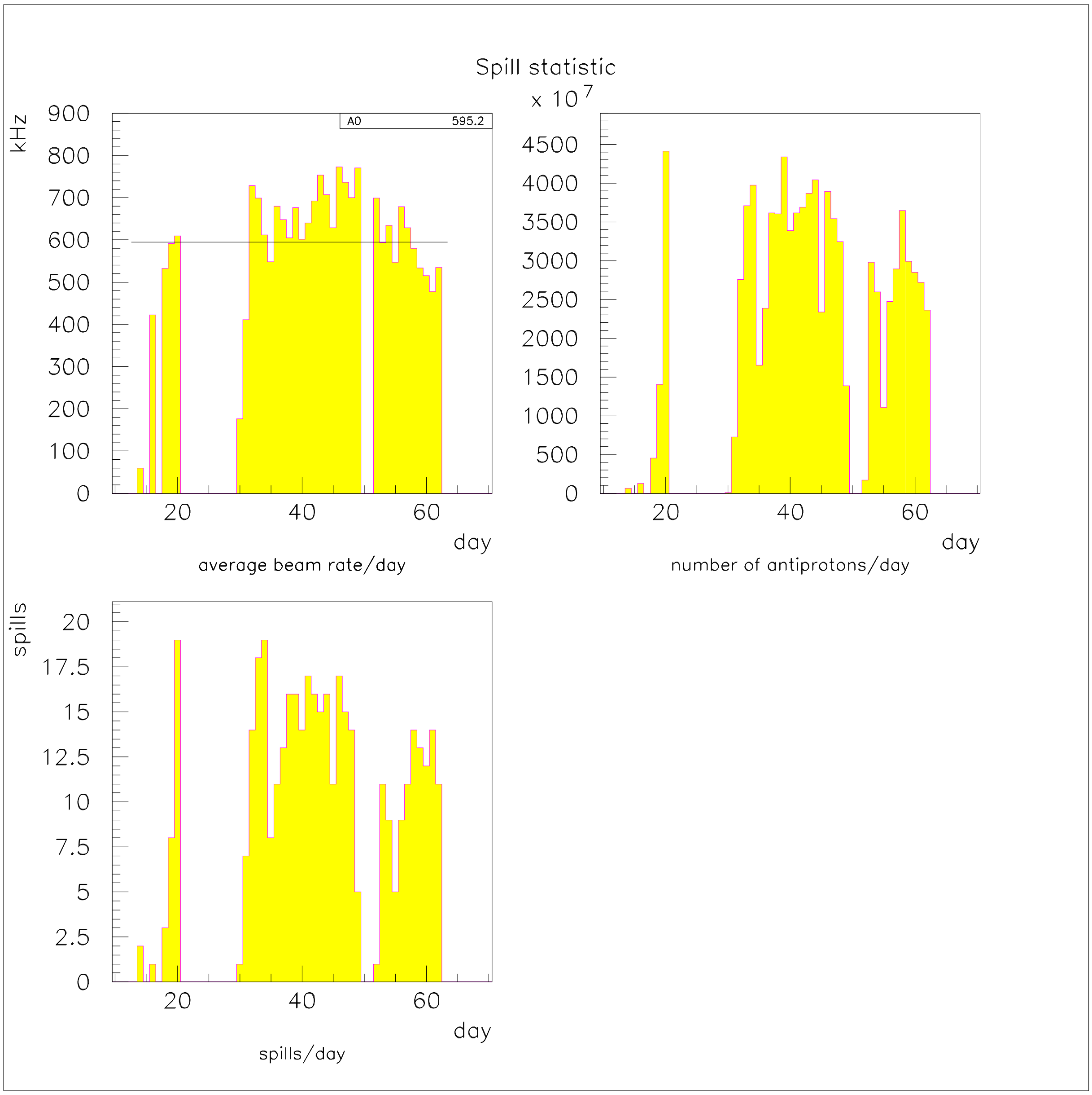
- All improvements which we aimed at are working.
- The detector worked very stable.
- With stable LEAR conditions we could write 250 tapes/day instead of 160 tapes/day.

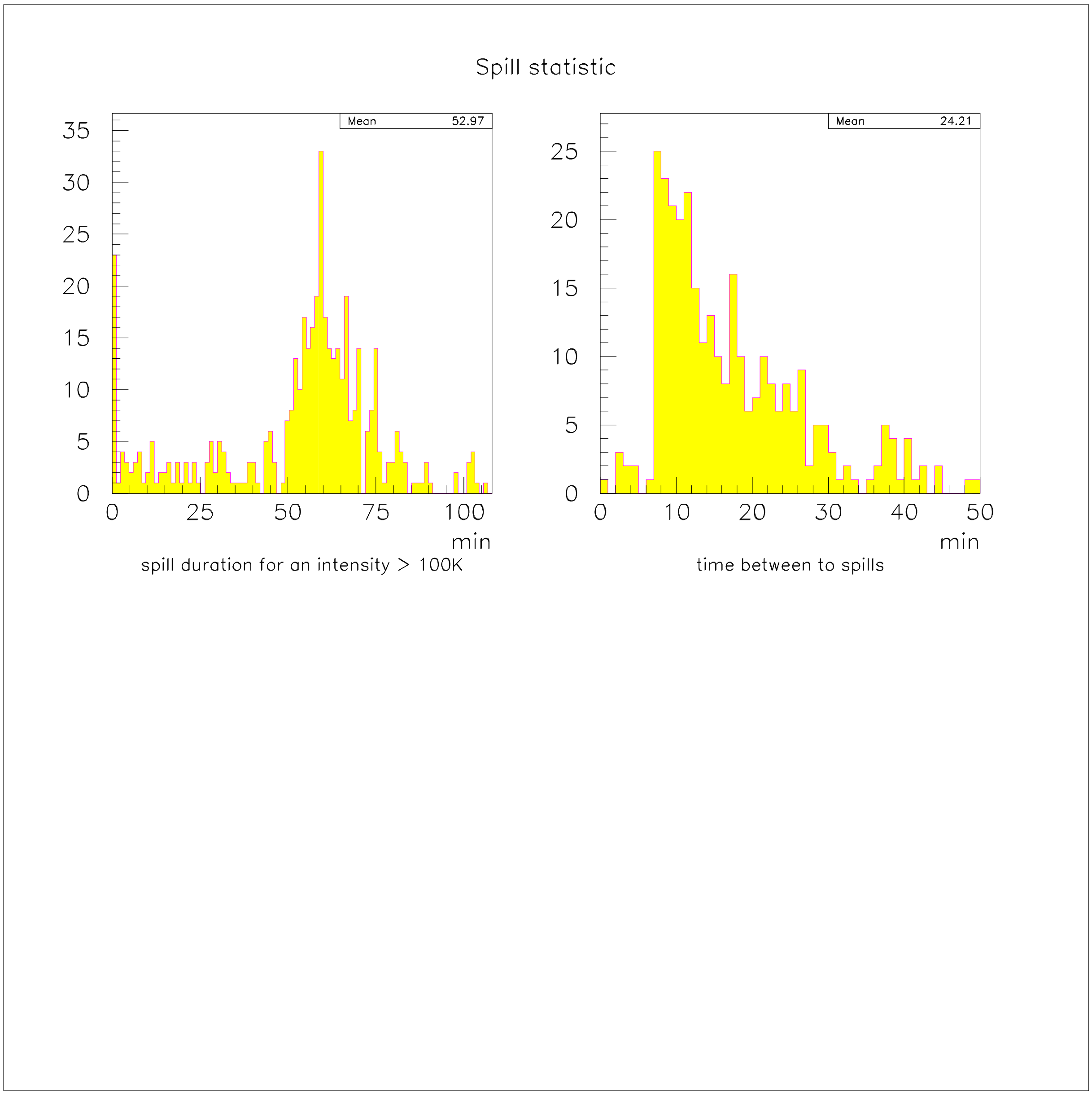
6 Tape summary

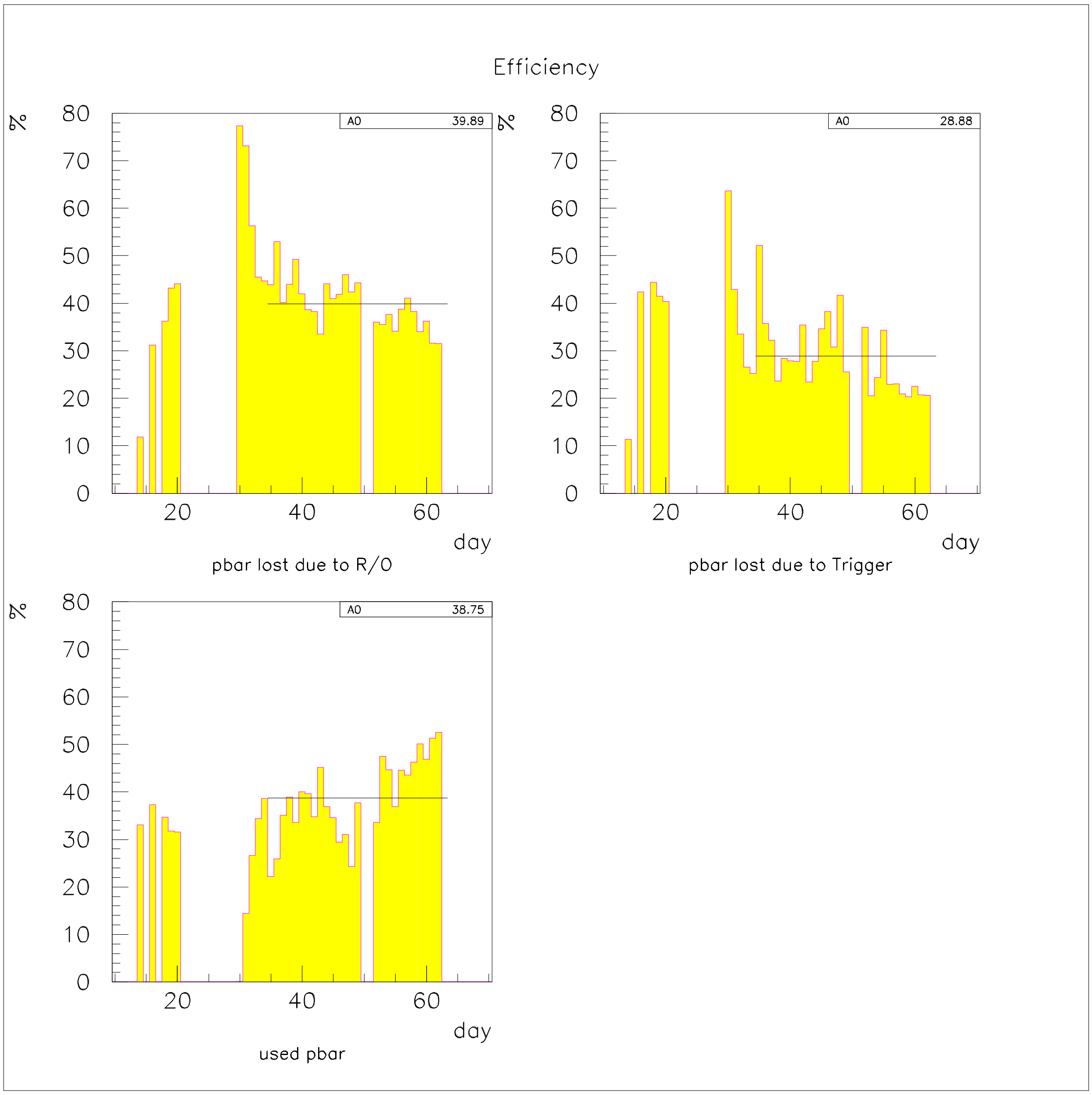
Trigger	no field	positve field	negative field
1	4	112	198
2	0	1	3
3	0	1	0
323	0	1	2
401	0	86	78
44401	0	23	12
163323	0	2	2
7163323	0	1	2
500163323	0	2	0
505063323	0	3	0
505163323	0	1436	1403
507163323	0	7	5
600063323	0	16	12
600163323	0	30	50
605163323	0	1097	1244
607163323	0	178	218
705163323	0	65	0
	all tapes: 6293		

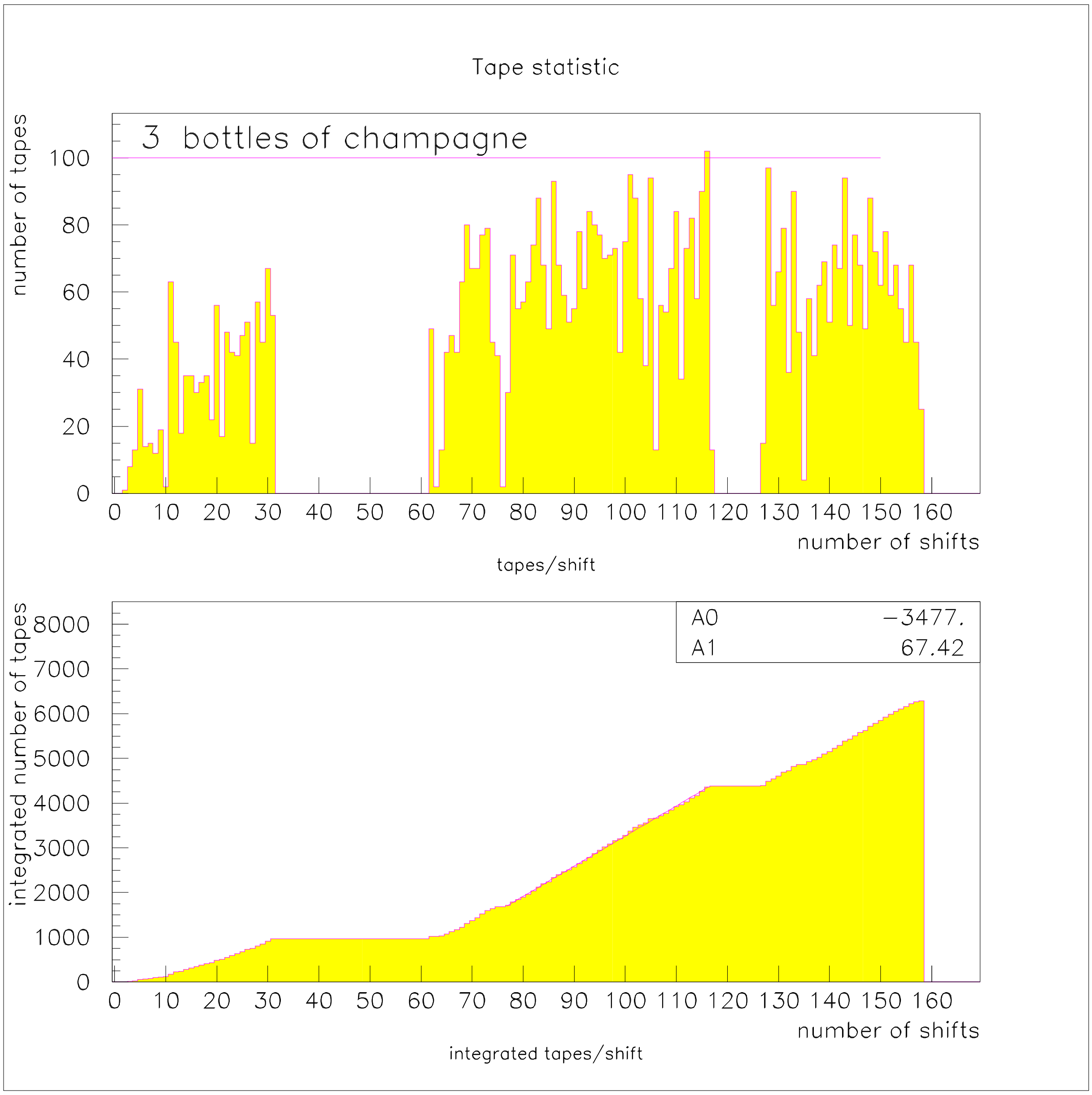
7 Some histograms

Page 10	Fig.1:	Average beam rate during a day
	Fig.2:	Total number of $\overline{p}$ received during a day
	Fig.3:	Number of spills during a day
Page 11	Fig.1:	Spill duration for intensities > 100 kHz average 53min, last year 85min.
	Fig.2:	Time between two spills
Page 12	Fig.1:	Percentage of antiprotons lost due to readout deadtime
	Fig.2:	Percentage of antiprotons lost due to trigger deadtime
	Fig.3:	Percentage of used antiprotons
Page 13	Fig.1:	Number of tapes per shift
	Fig.2:	Integrated number of tapes as a function of shifts The fit was applied to a period when the LEAR performance was best.
Page 14	Fig.1:	Readout time as a function of the $\overline{p}$ rate
Page 15	Fig.1:	Percentage of $K^o \rightarrow \pi^+\pi^-$ candidates over the period High values are due to using ToF in the trigger low values might be the result of wrong online calibration
	Fig.2:	Percentage of $K^o \rightarrow \pi^o\pi^o$ candidates over the period Large fluctuations are due to the CPM/HWP25 communication problem
Page 16	Fig.1:	Mean shift of the S1-ADC over the period
Page 17	Fig.1:	PC1 and PC2 efficiency as function of time
Page 18	Fig.1:	DC1,DC2 and DC3 efficiency as function of time
Page 19	Fig.1:	DC4,DC5 and DC6 efficiency as function of time
Page 20	Fig.1:	ST1 and ST2 efficiency as function of time
Page 21	Fig.1:	Overall hardware processor pseudo-efficiency
	Fig.2:	Overall hardware processor rejection factor
Page 22	Fig.1:	Overall HWP1 pseudo-efficiency
	Fig.2:	Overall HWP1 rejection factor
Page 23	Fig.1:	Overall HWP2 + HWP25 pseudo-efficiency The large fluctuations are due to the known CPM problem The problem was solved around day 202
	Fig.2:	Overall HWP2 + HWP25 rejection factor
Page 24	Fig.1:	Fraction of two and four track events seen by the processor
	Fig.2:	Mean number of clusters seen by the HWP25
Page 25	Fig.1:	EDL pseudo-efficiency
	Fig.2:	EDL recjection factor
	Fig.3:	PT pseudo-efficiency
	Fig.4:	PT recjection factor
Page 26	Fig.1:	IDL pseudo-efficiency
	Fig.2:	IDL recjection factor
	Fig.3:	Config+Register+Kinematic pseudo-efficiency
	Fig.4:	Config+Register+Kinematic recjection factor
Page 27	Fig.1:	The curvature resolution
	Fig.2:	The epsilon resolution
	Fig.3:	The phi resolution

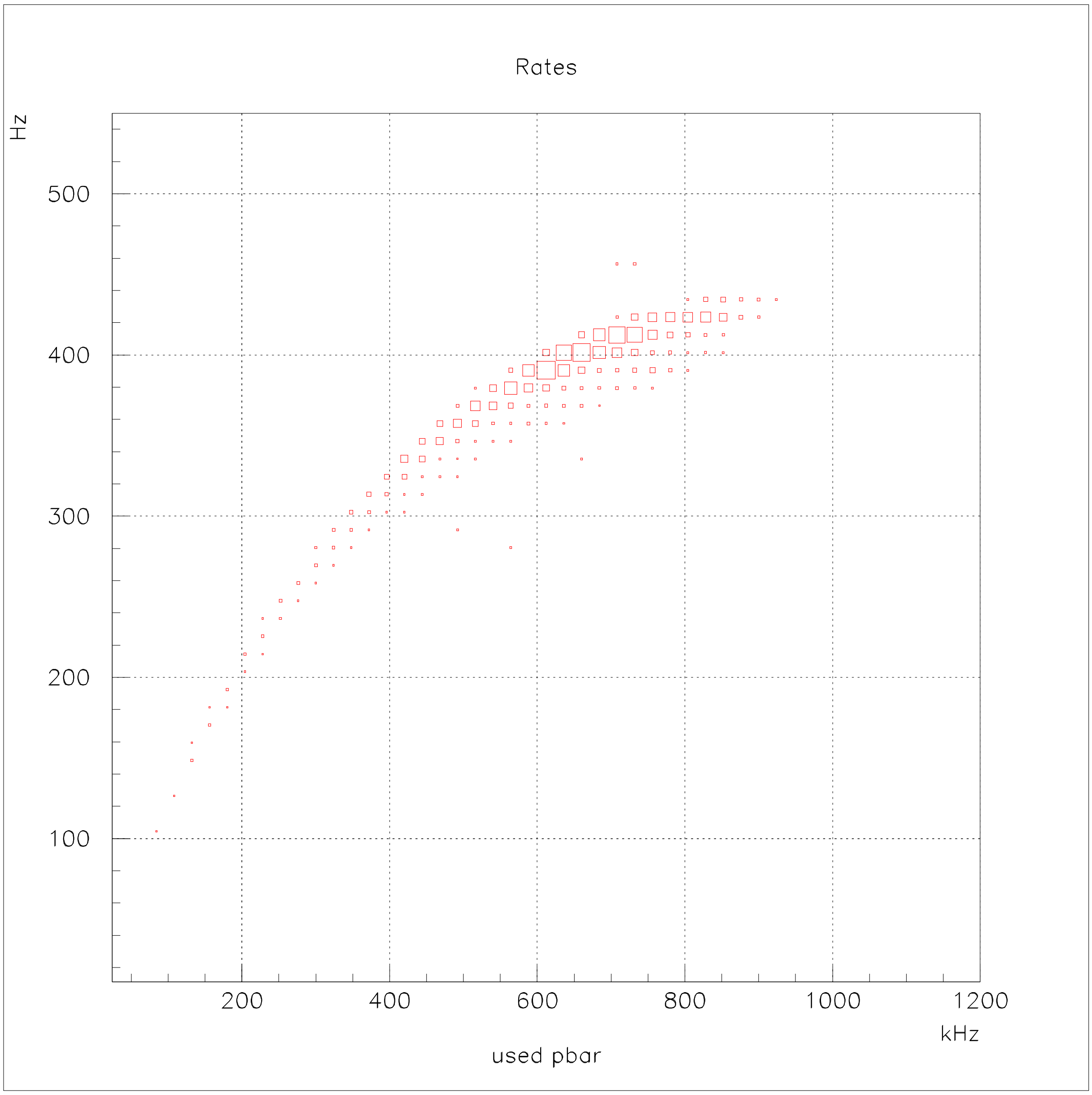

Spill statistic
kHz
A0 595.2
day
average beam rate/day
x 10^7
day
number of antiprotons/day
spills
day
spills/day

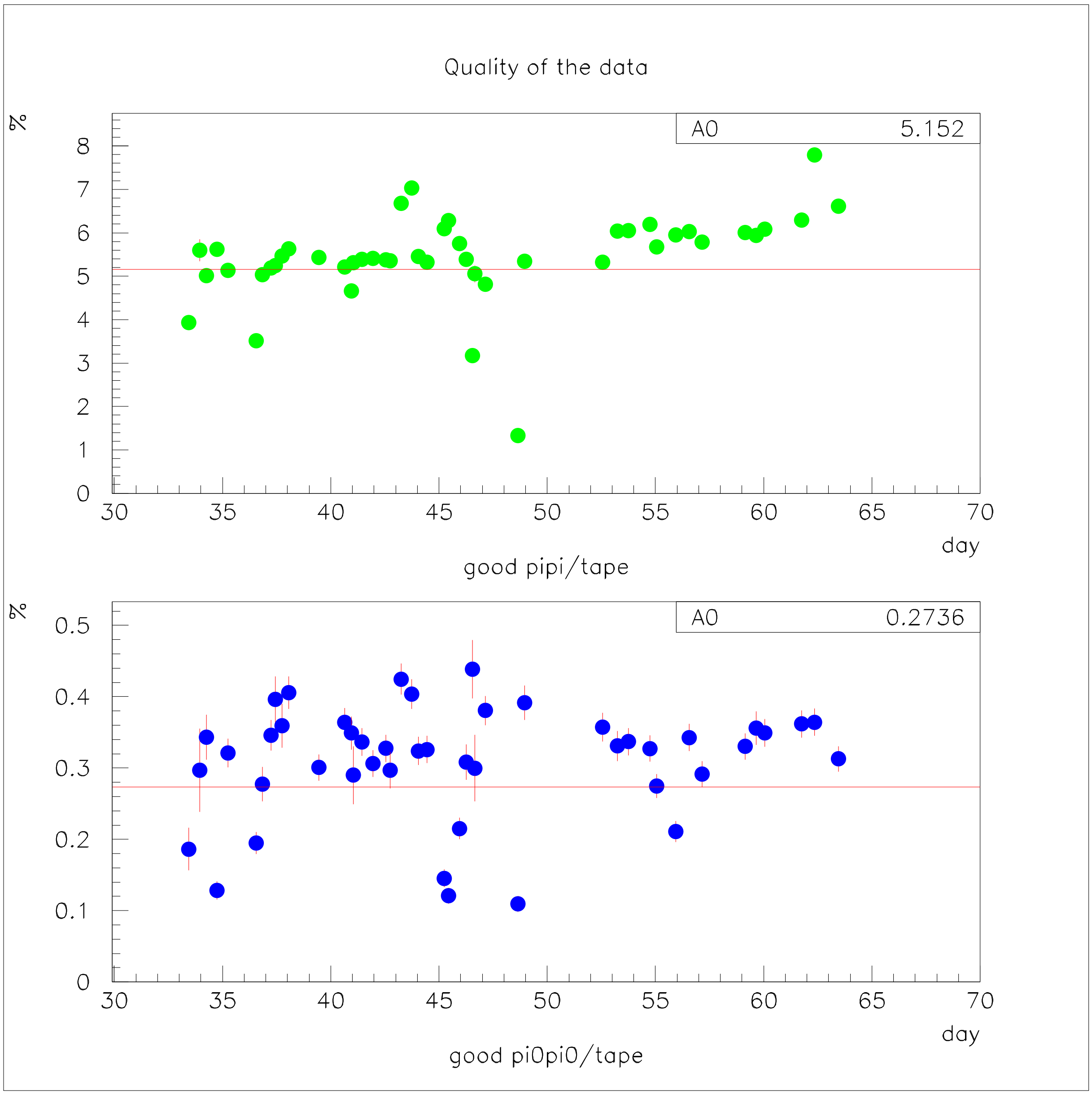

Spill statistic
Mean 52.97
35
30
25
20
15
10
5
0
0 25 50 75 100
min
spill duration for an intensity > 100K
Mean 24.21
25
20
15
10
5
0
0 10 20 30 40 50
min
time between to spills

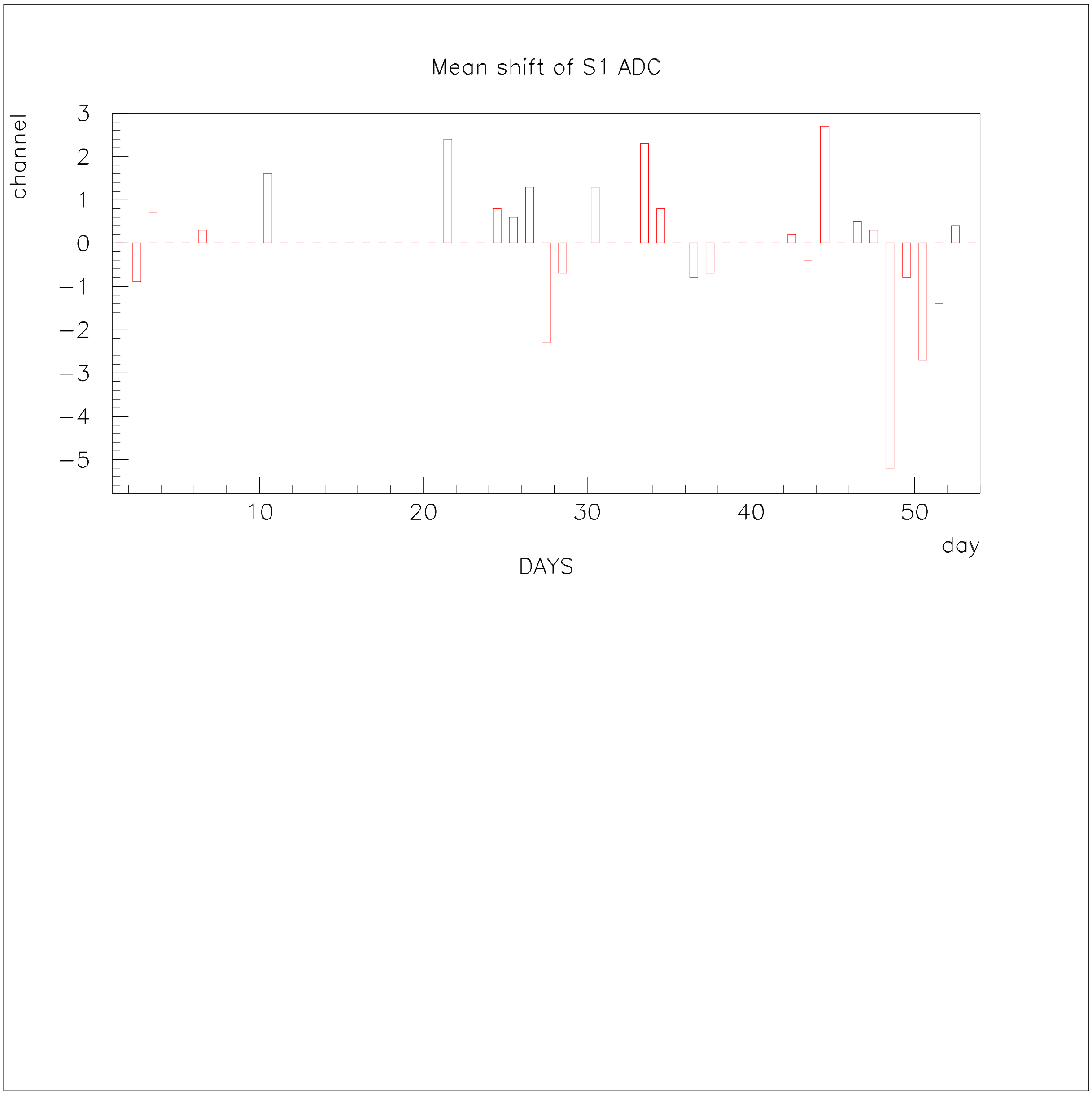

Efficiency
%
A0 39.89
day
pbar lost due to R/O
A0 28.88
pbar lost due to Trigger
A0 38.75
used pbar



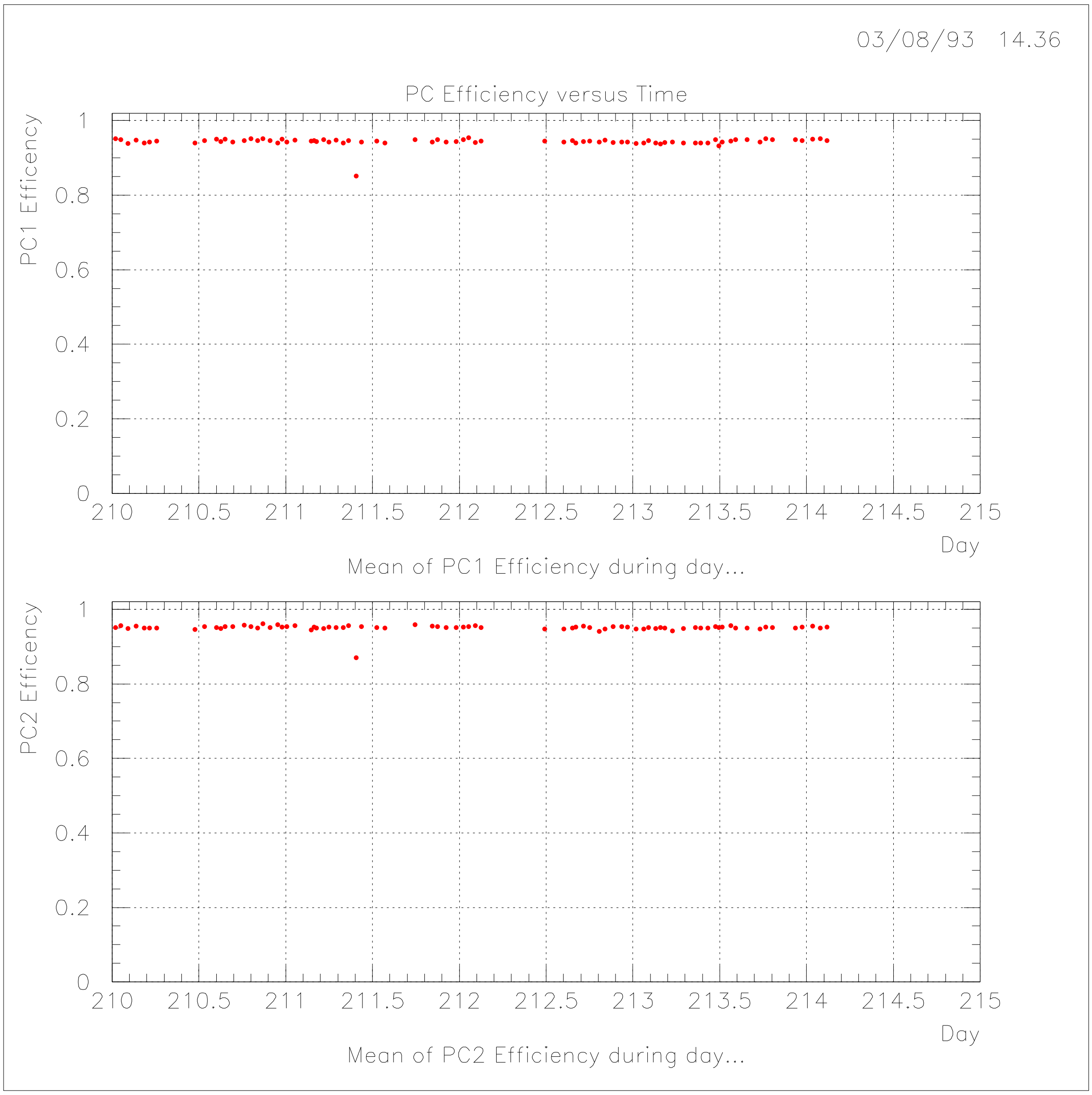
Tape statistic
3 bottles of champagne
number of tapes
number of shifts
tapes/shift
integrated number of tapes
A0 −3477.
A1 67.42
number of shifts
integrated tapes/shift

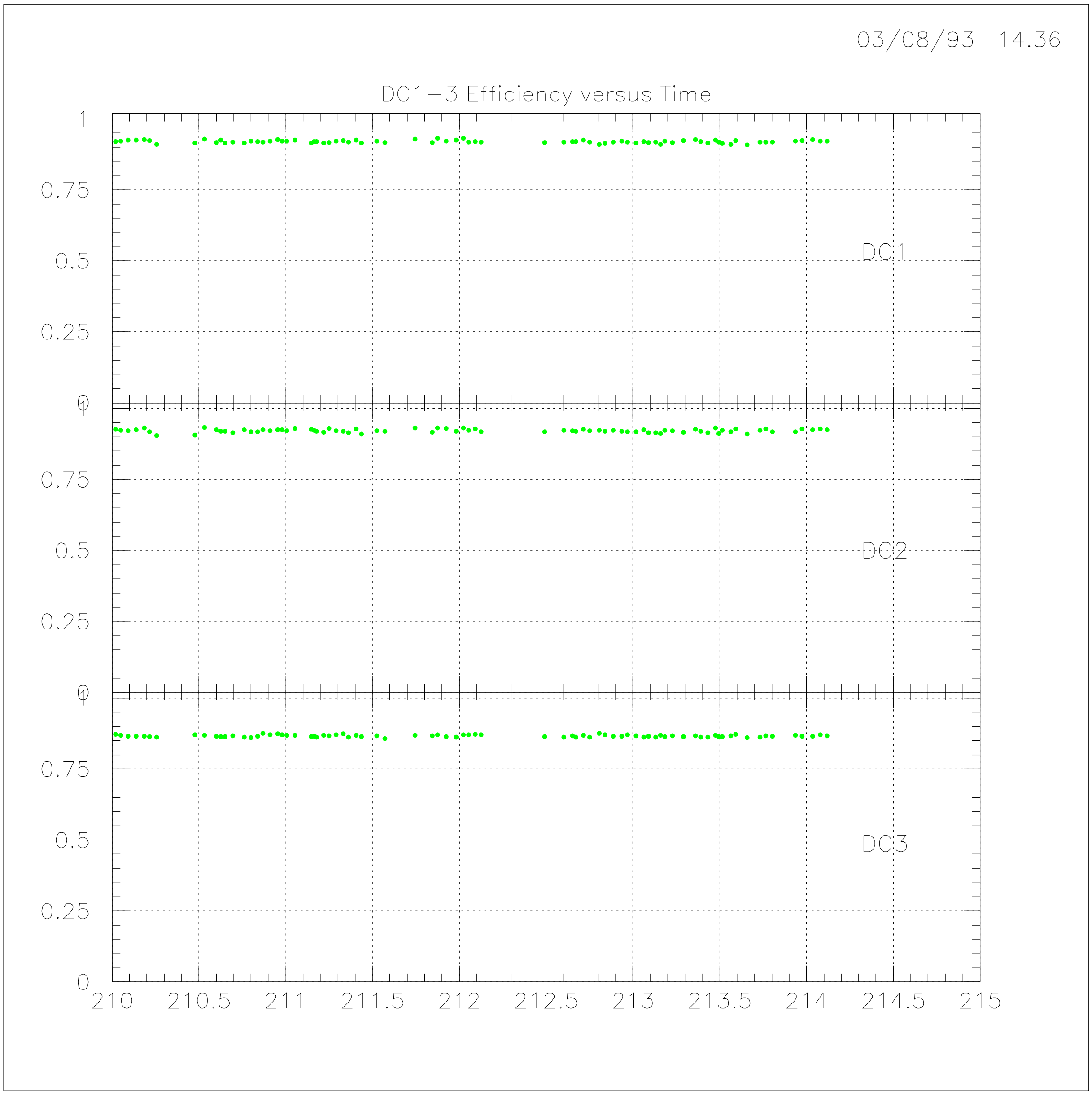

Rates
Hz
500
400
300
200
100
200
400
600
800
1000
1200
kHz
used pbar

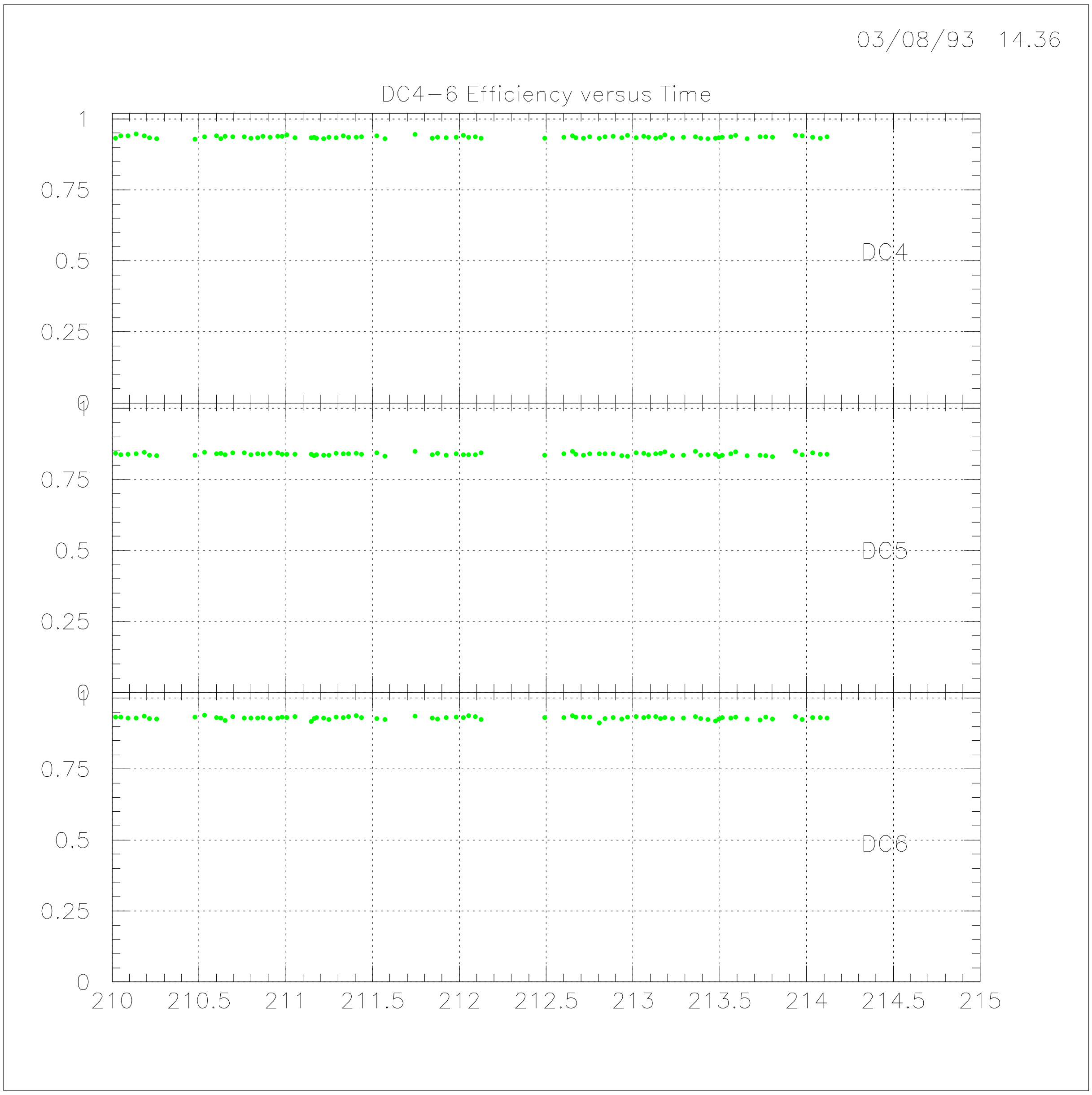

Quality of the data
%
A0
5.152
day
good pipi/tape
%
A0
0.2736
day
good pi0pi0/tape

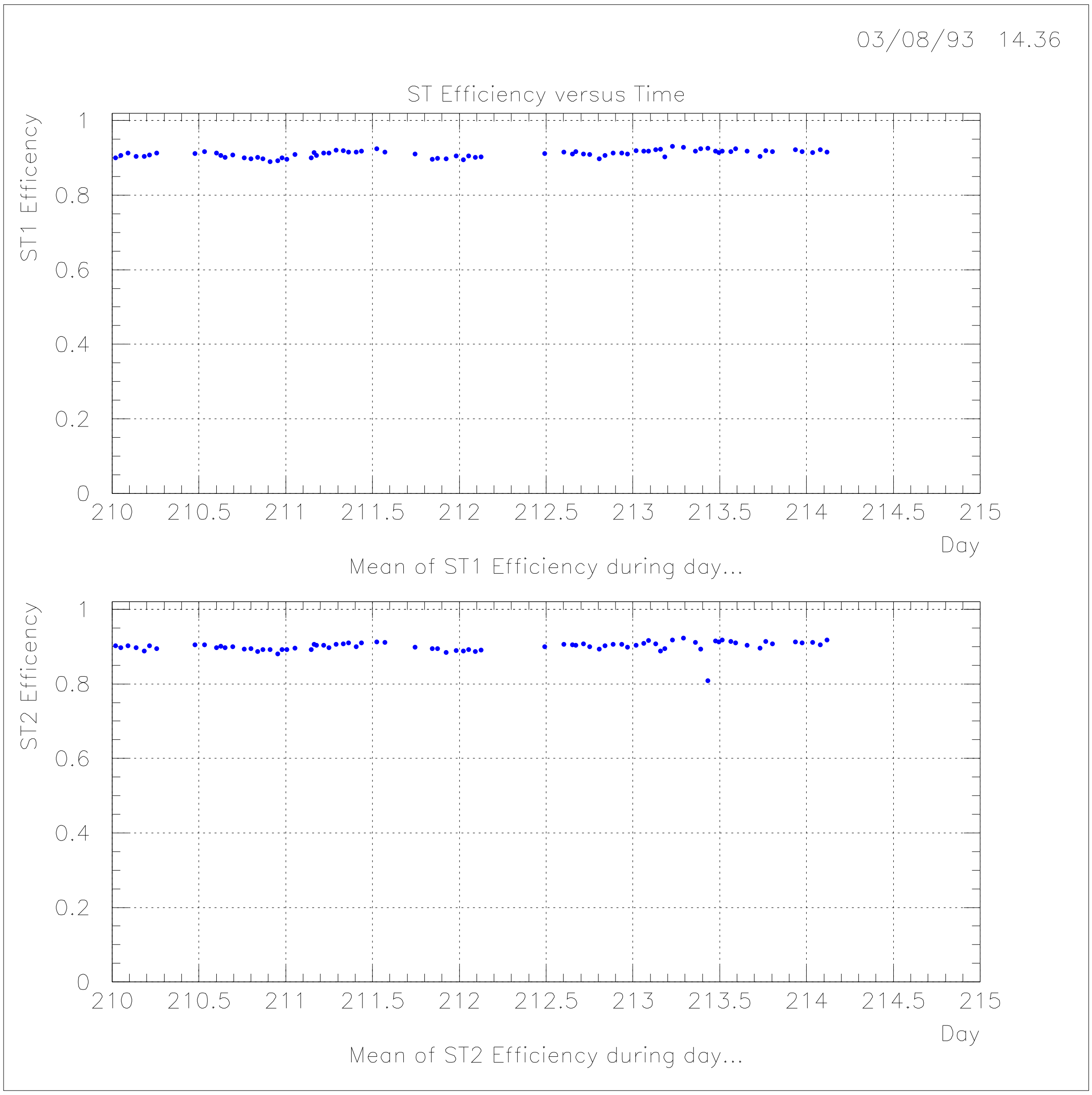


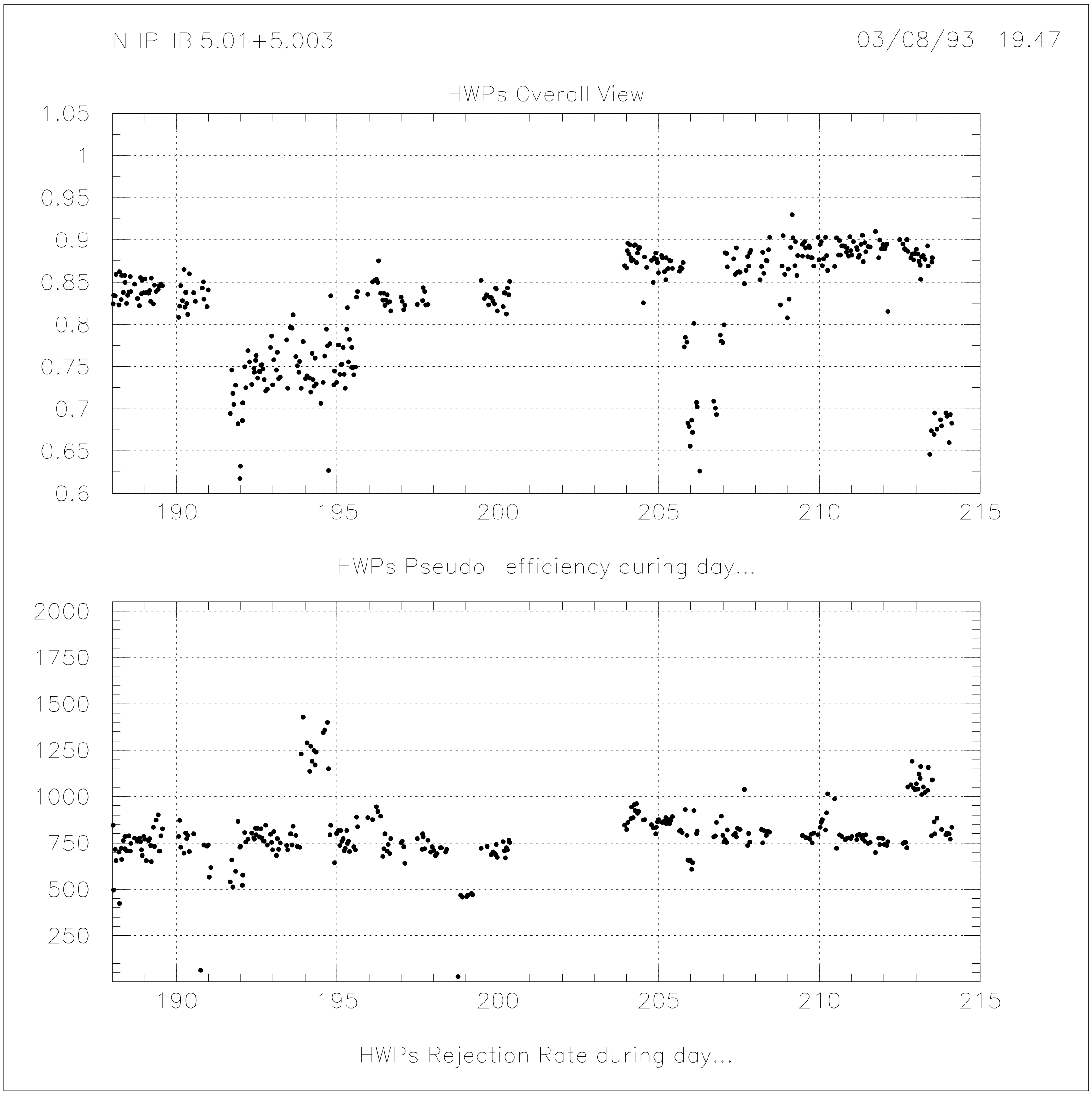
Mean shift of S1 ADC
channel
3
2
1
0
−1
−2
−3
−4
−5
10
20
30
40
50
day
DAYS

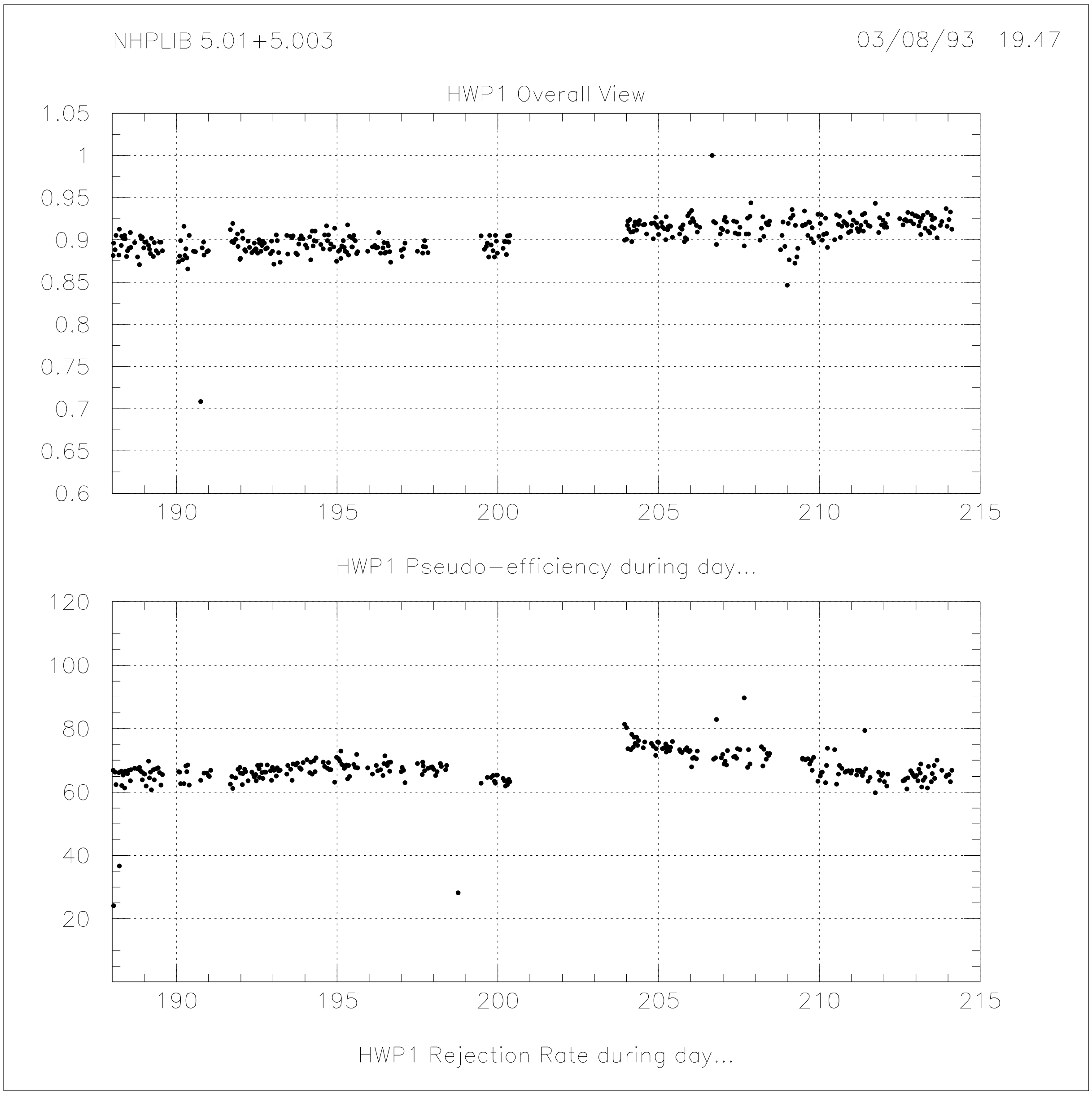

03/08/93 14.36
PC Efficiency versus Time
PC1 Efficency
1
0.8
0.6
0.4
0.2
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215
Day
Mean of PC1 Efficiency during day...
PC2 Efficency
1
0.8
0.6
0.4
0.2
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215
Day
Mean of PC2 Efficiency during day...

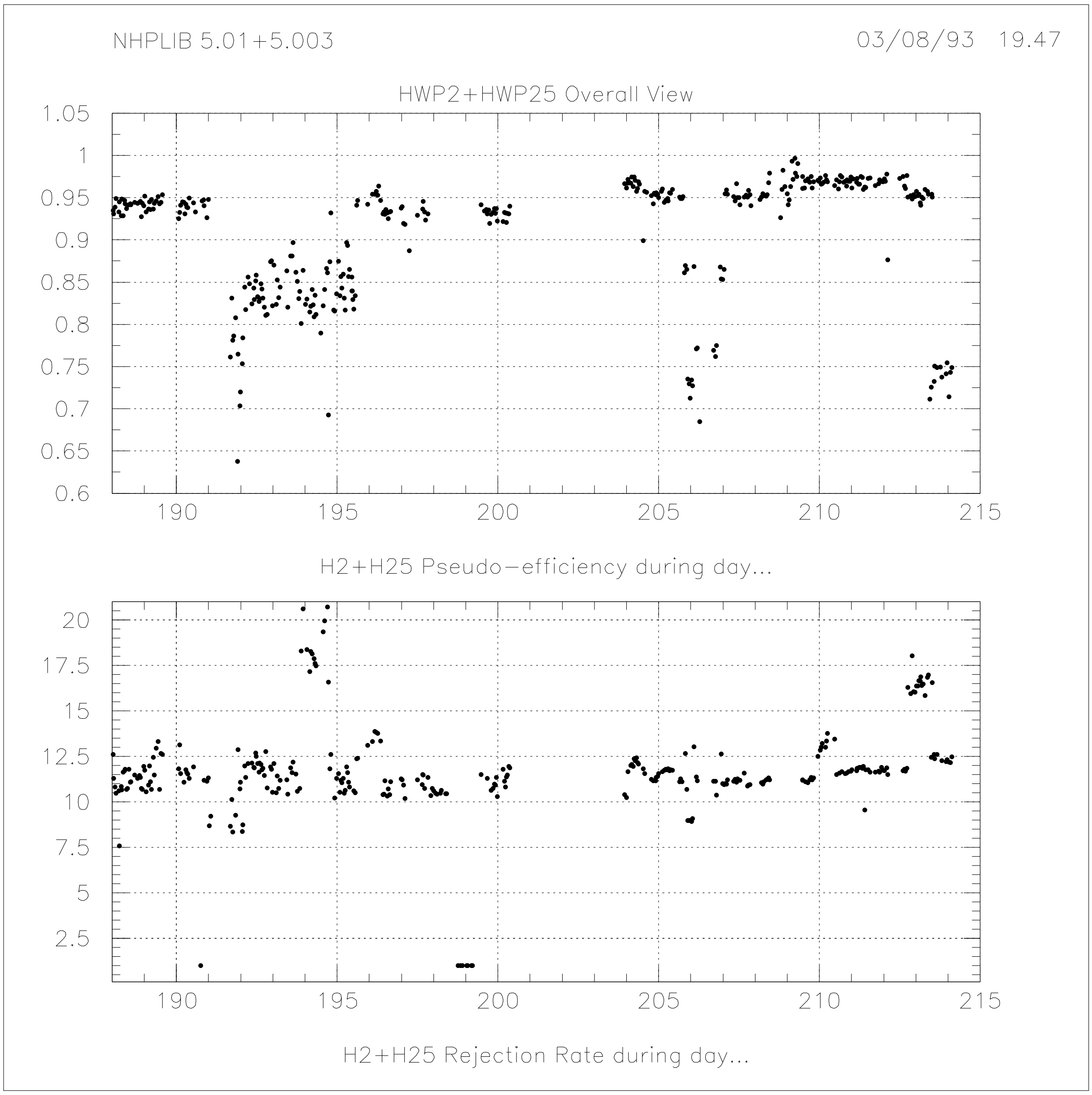

03/08/93 14.36
DC1−3 Efficiency versus Time
DC1
DC2
DC3
1
0.75
0.5
0.25
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215

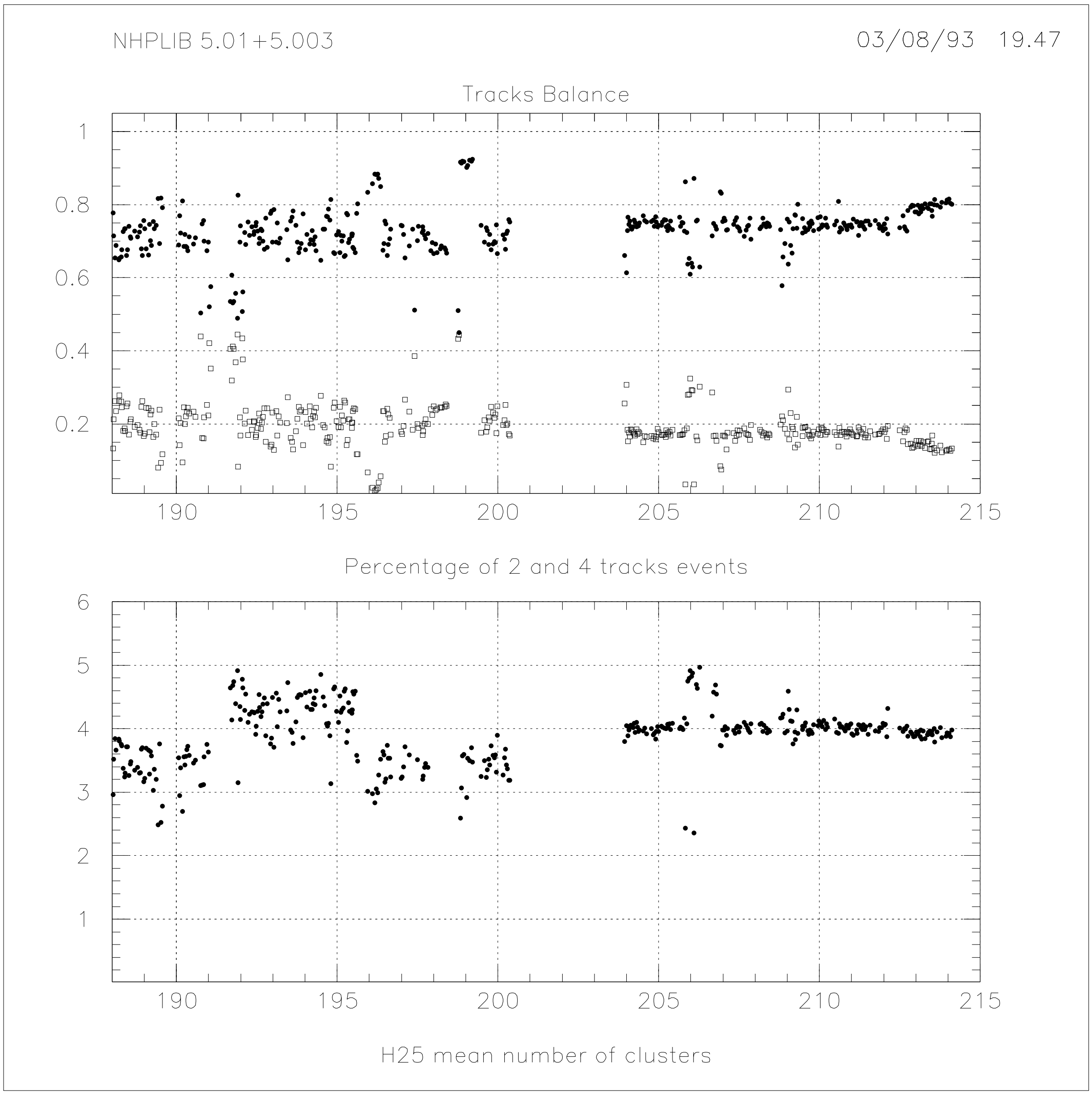

03/08/93 14.36
DC4−6 Efficiency versus Time
DC4
DC5
DC6
1
0.75
0.5
0.25
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215


03/08/93 14.36
ST Efficiency versus Time
ST1 Efficency
1
0.8
0.6
0.4
0.2
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215
Day
Mean of ST1 Efficiency during day...
ST2 Efficency
1
0.8
0.6
0.4
0.2
0
210
210.5
211
211.5
212
212.5
213
213.5
214
214.5
215
Day
Mean of ST2 Efficiency during day...

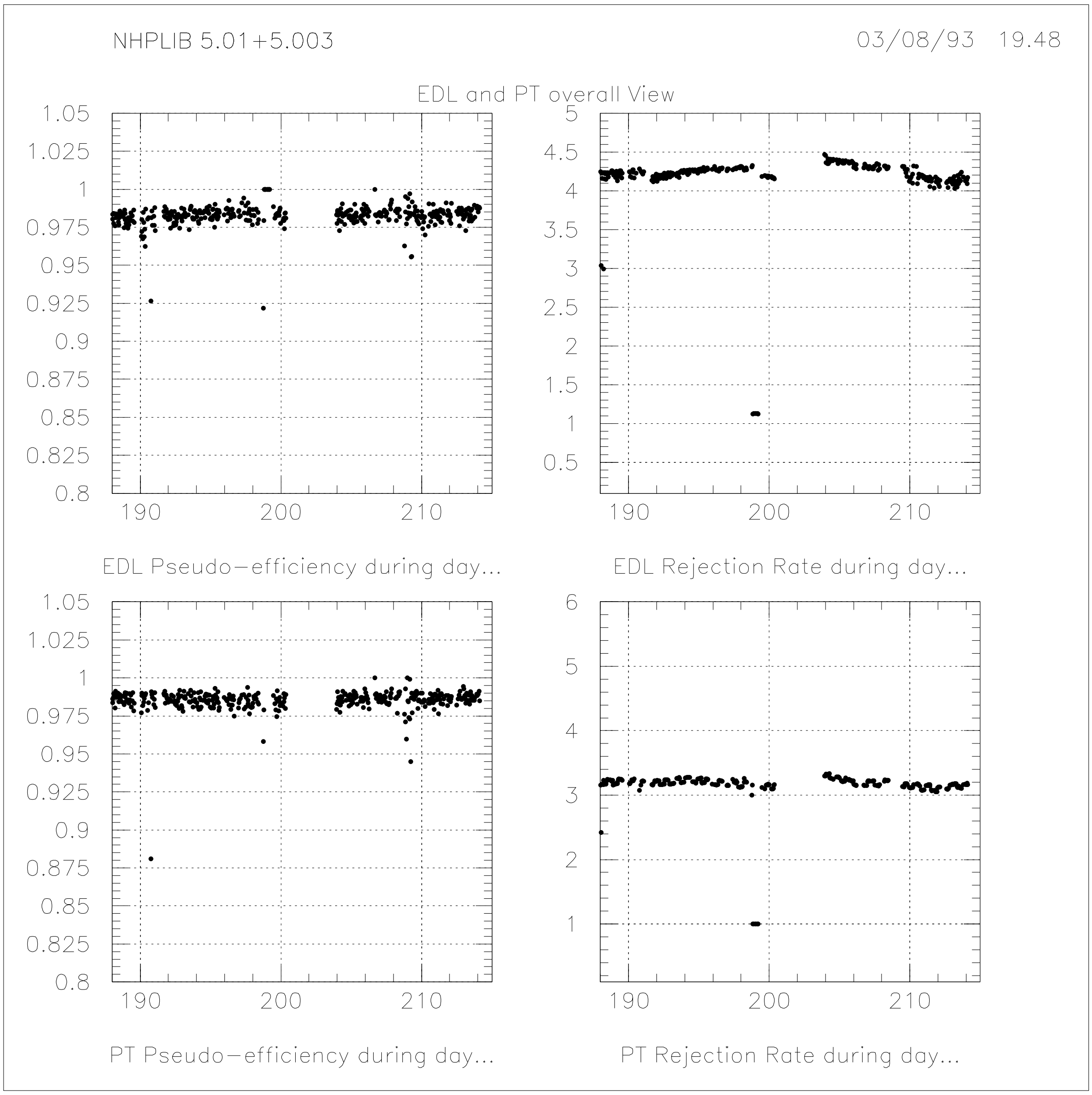

NHPLIB 5.01+5.003
03/08/93 19.47
HWPs Overall View
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
190
195
200
205
210
215
HWPs Pseudo−efficiency during day...
2000
1750
1500
1250
1000
750
500
250
190
195
200
205
210
215
HWPs Rejection Rate during day...

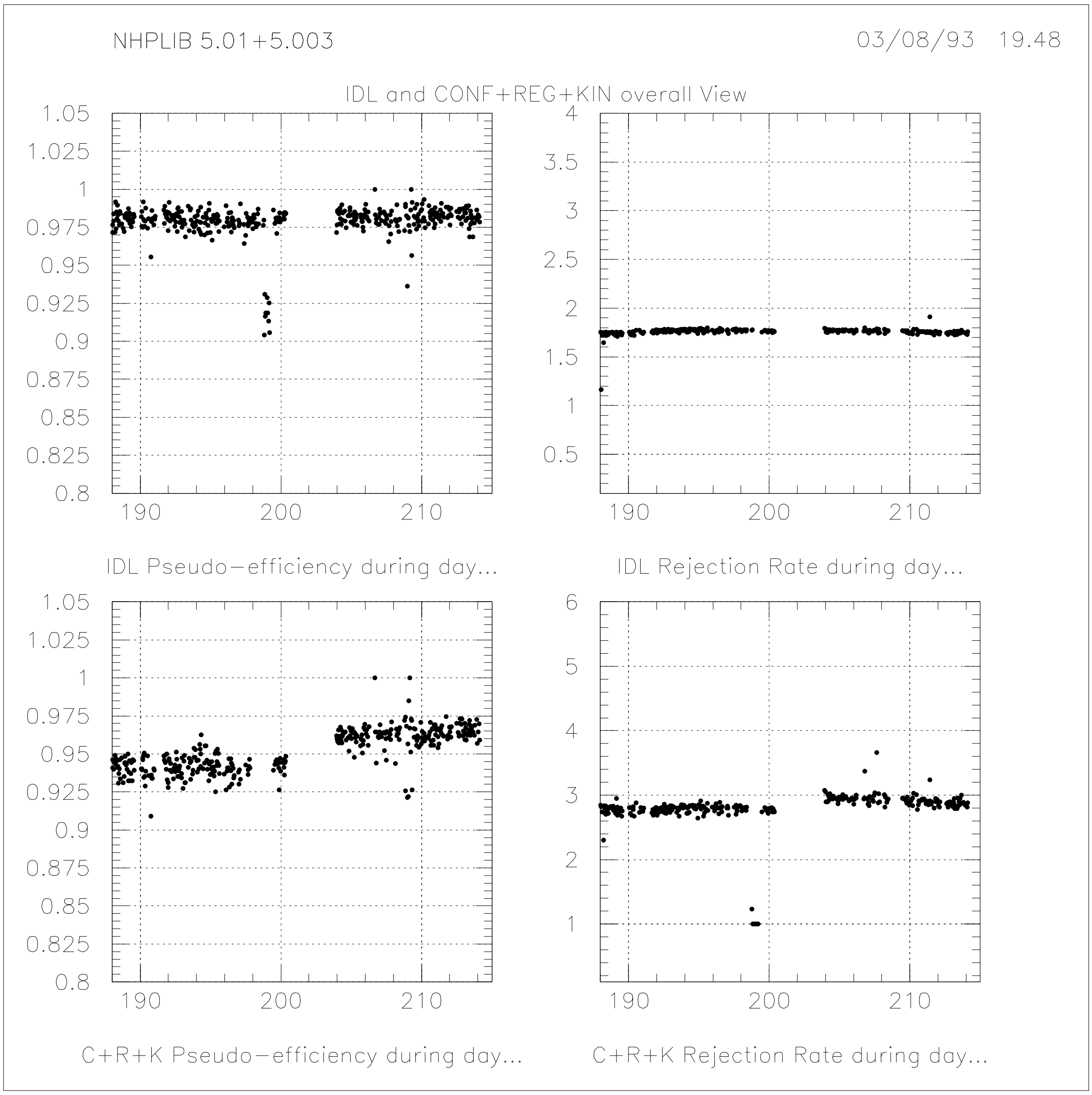

NHPLIB 5.01+5.003
03/08/93 19.47
HWP1 Overall View
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
190
195
200
205
210
215
HWP1 Pseudo−efficiency during day...
120
100
80
60
40
20
190
195
200
205
210
215
HWP1 Rejection Rate during day...

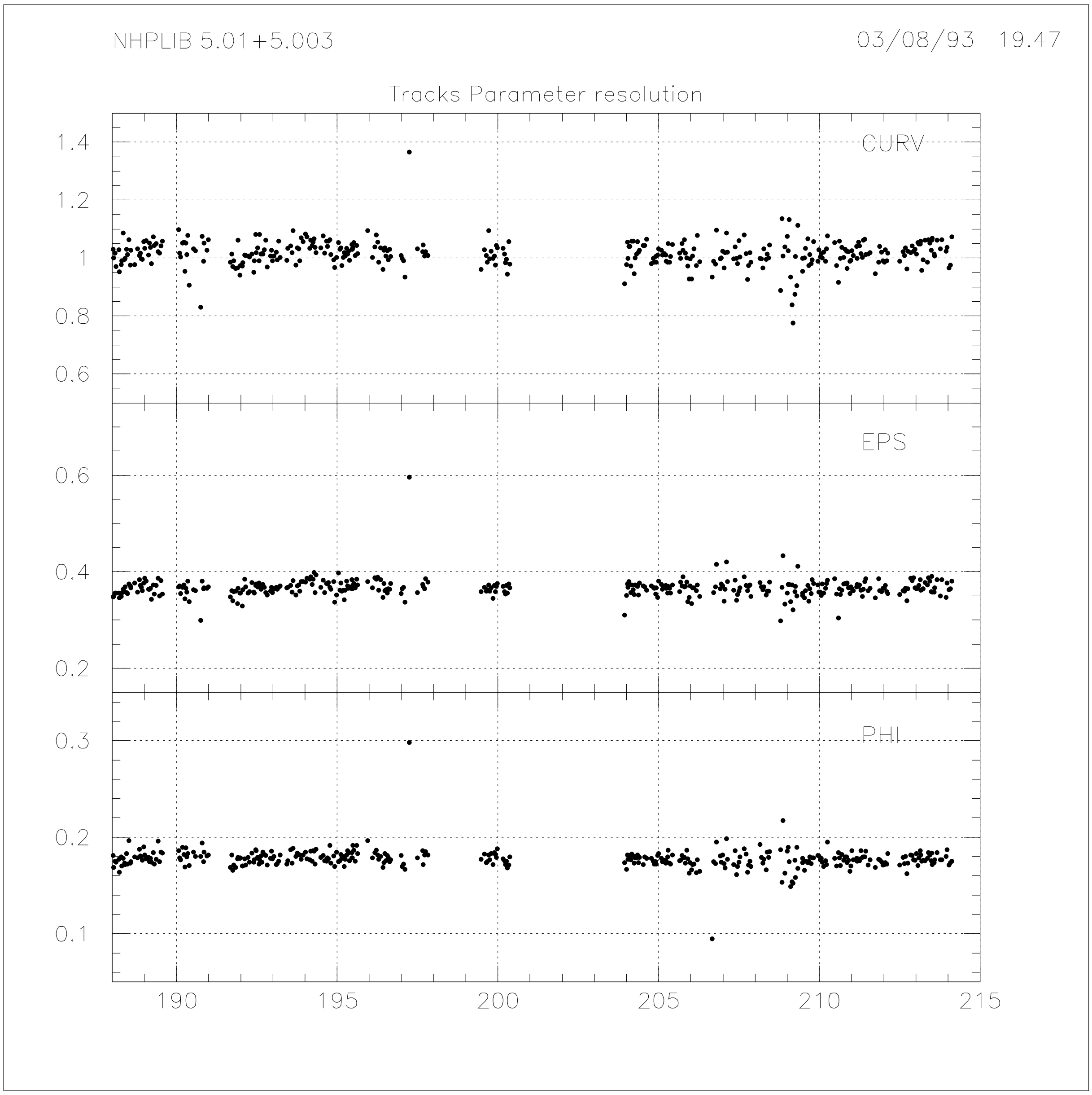

NHPLIB 5.01+5.003
03/08/93 19.47
HWP2+HWP25 Overall View
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
190
195
200
205
210
215
H2+H25 Pseudo−efficiency during day...
20
17.5
15
12.5
10
7.5
5
2.5
190
195
200
205
210
215
H2+H25 Rejection Rate during day...



NHPLIB 5.01+5.003
03/08/93 19.47
Tracks Balance
1
0.8
0.6
0.4
0.2
190
195
200
205
210
215
Percentage of 2 and 4 tracks events
6
5
4
3
2
1
190
195
200
205
210
215
H25 mean number of clusters


NHPLIB 5.01+5.003
03/08/93 19.48
EDL and PT overall View
EDL Pseudo−efficiency during day...
EDL Rejection Rate during day...
PT Pseudo−efficiency during day...
PT Rejection Rate during day...


NHPLIB 5.01+5.003
03/08/93 19.48
IDL and CONF+REG+KIN overall View
IDL Pseudo−efficiency during day...
IDL Rejection Rate during day...
C+R+K Pseudo−efficiency during day...
C+R+K Rejection Rate during day...


NHPLIB 5.01+5.003
03/08/93 19.47
Tracks Parameter resolution
CURV
EPS
PHI
1.4
1.2
1
0.8
0.6
0.4
0.2
0.3
0.1
190
195
200
205
210
215

8 Copies of transparencies

The following pages contain the copies of transparencies presented during the run by each detector group including DAQ, TRIGGER and OFFLINE.