Summary of RUN Period 26

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First part	26.4. – 18.5.1994
Second part	1.6. – 19.6.1994
People on shift:	50
Number of Spills:	≈ 380
Average beam rate:	530 kHz
Days without beam:	$11.6 \equiv 28\%$
$\Sigma \overline{p}$	$\approx 0.8 \cdot 10^{12}$
used $\overline{p}$	36%
Recorded events on tape	$481 \cdot 10^6$
$\pi\pi$ candidates	$24 \cdot 10^6$
$\pi^o\pi^o$ candidates	$2.1 \cdot 10^6$
Sum of written tapes:	5372
On Exabyte:	100%
Average number	
of tapes/shift	52
in best days	65
maximum	88

Contents

1 Summary of RUN Period 26

The run period 26 started officially on 26th April. Due to problems mainly in the PS we had the first beam in the detector on 1st May. In order to give us beam as soon as possible, LEAR had reduced the time foreseen for machine development and set up. This caused some losses of beamtime in the first days of running because of fine tuning of LEAR. The time without beam at all in the first half of the period (20 days) added up to 9.5 days. The losses in the second half of the period were about 2.1 days, mostly the result of a power failure which affected all the machines. Together with the additional problems in AA and LEAR (low intensity, short spills, not possible to have a large stack of antiprotons in LEAR) we lost more than 35% of our allocated beamtime.

In the first days we had some problems with the brandnew EB-tape software, zebra structure errors, wrong run numbers. Already in the first days the Slow Control monitoring of the CAEN HV crates didn't work reliable. This situation lasted until the expert arrived in June and solved the problem. Data taking with the full trigger (T605163323) started on 3rd of May. After a short test we changed the trigger to T507163323 for the rest of the period. This improved the number of good $\pi^o\pi^o$ candidates on tape by a factor of 2 by having only a loss of 20% on good $\pi^+\pi^-$ candidates. On the 8th May we did a test with improved lookup tables for the HWP1 processor where the wrong z-correction was removed, run 260712 - 260778. After analysing part of these tapes we decided to continue with the new version of lookup tables, > run 260968. A leak was found in PID 31 which caused an inefficient pion rejection in sector 31. On the 3th June (>R262552) we removed sector 31 from the $\overline{SCS}$ hitmap. On the 10th June it was found out that C1D9 and C2D9 were swapped at the input to the trigger. This was corrected for run 263844 on. On 14th June, six o'clock in the morning, there was a power cut which stopped all the machines at CERN and all the electronics in our experiment. As a result of this power cut one CPM module had to be replaced. During this intervention one CHI module broke. 12 hours later it was found out that the spare CPM module destroyed CHI modules. For 16 hours we had no calorimeter readout. This time was used to write tapes without HWP2 and KIN (R264681 - R264792).

Since the new EB-tape software introduced an additional deadtime of almost 1 ms (see fig.1), during most of the time of this period some R&D on the EB side was going on to solve the problem. We did several tests with PC0 and a small target.

2 PC0 Tests

The first insertion was done at the end of the first part of period 26, 18th June. During the insertion several problems were encountered. The target extraction tube was a few centimeters too short, the target couldn't be placed at the centre of the detector. The weight of the cables was 7.5 kg instead of the 2.8 kg for which the support system was designed. This altogether made it very difficult to centre the beam in the target. Due to a timing problem almost no wire information from PC0 was written on tape. The target had a small leak. During the two weeks break, the support system was modified. A second attempt to insert PC0 was done at the beginning of the second part of period 26, 1st June. When PC0 was installed it was found out that the target didn't hold the pressure of 30 bar. We took everything out again and started with the old target. A third attempt was made on 6th June with a repaired target. At this time the insertion was done in less than two hours, but it took almost 3 hours to centre the beam inside the target. A few hours later it was found out that the target is leaking with a rate of about 1.5 l/hour. After discussion with the safety group we took out PC0 on the 8th June. We wrote tapes with the small target from Run 263235 to Run 263554, part of these tapes contain PC0 information. During the test with PC0 some problems were found:

- The PC0 electronics caused a 5% inefficiency in the P_t cut processor.
- Noise on PC1 and PC2 was seen during the time when PC0 was switched on. It was only possible to run with a high threshold for PC1 and PC2. After touching the PC0 cables the problem disappeared, maybe be bad contacts ?
- DC decoding errors increased from about 1% to 6%, due to extremely long events caused by PC0 noise ?

Altogether we spent about 43 hours of beam time for PC0 tests without physics data taking.

3 DAQ Improvement

The ODL link was replaced by a VIC bus in order to have a more stable system and to improve the maximum data transfer rate from 50 blocks/sec to about 65 blocks/sec. A first version of the software was ready at the beginning of the period. It was soon found out that the new system introduced an additional deadtime of about 1 ms (see fig 1). The readout rate with and without tape differed by as much as 30%. The reason for this was that during the time ($\approx$ 10 ms) when a block ($\approx$ 8 events) was sent from the EB to the tape the EB was more or less blocked and couldn't work on the next events in parallel, as expected. The problem was finally solved in the last week of the run by sending single events to an upgraded VIC module with onboard memory, which autmatically relayed them to the tape. In this case the time to send one event to the tape is short enough that it can be done during the time when the detector root readouts are receiving the next event. With this solution we are now able to run with a maximum transfer rate of about 70 blocks/sec ($\equiv$ 700 events/sec, seen!). The readout rate with trigger T507163323 (rejection factor of $\approx$ 750) and a modest beam rate ($\approx$ 800 kHz) was 500 Hz.

4 KEF

KEF was completely installed and successfully tested in parallel to data taking. The execution time is 38 μsec per event. The rejection factor (2.0 for four-track events and 1.2 in total) for trigger T507163323 agreed with the simulation.

5 Problems in P26

- More $\bar{p}$ stopping in target entrance wall as before. Reason: new degrader ?
  No $\bar{p}$ counter in the first half of the period
  $\bar{p}/p$ counter ratio changes as function of $\bar{p}$ rate
  Beam control failed in the last 3 days of the run. Problem on LEAR side.

- Frequent crashes of DC Valet (see fig.2). Problem started after the two weeks break with insertion of PC0. No crashes in the first half of the period. Situation got worse towards the end of the run. Data losses at this time around 20%. The old readout version using cathlib seemed to be more stable, but caused decoding error "crazy sequence number". Future work:

  - Debug DC readout with cosmic and try to understand the problem
  - Compare decoding errors of new and old software
  - Write a minimal version of the readout which can be booted fast

- Some ToF channels were unstable. Leak in PID 31, had to be taken out from the EDL hitmap.

- ST had one problem with gas.

- A spare CPM was responsible for destroying two CHI's. This also caused some instabilities because of discabling one crate of CPM's. The close connection of the CALO and the EB-tape-MSP chain made it especially difficult to solve the CALO problem parallel to data taking.

- LEAR performance better than last year, interspill times are shorter due to working electron cooling. Still some ghosts from time to time.
- Implementation of new VIC bus caused additional dead time to the eventbuilder. Losses of statistic sums up to 20% over the whole period. Future work:
  - Backup version of EB software without calorimeter.
- The Slow control HV monitoring and the IDLE switch didn't worked reliable in the first half of the period. Bad contacts and wrong cabling may have caused the problem. After arrival of the expert the Slow control was stable all the time. Future work:
  - Independent monitoring of the CAEN HV crates over VME using the CALO Fic and VME-CAEN interface.

6 Achievements in P26

- New EB/tape hardware and software: maximum of 70 blocks/s
- Wrong z-correction removed in the program calculating the HWP1 look-up tables.

7 Tape summary

Trigger	no field	positve field	negative field
1	1	124	132
323	0	0	12
407163323	0	1	0
500063323	0	78	32
500163323	0	0	6
507163323	0	2055	2123
600163323	0	0	2
605163323	0	86	62
607163323	0	336	323

all tapes: 5372

8 Beamtime losses due to PS, AA or LEAR problems

day	beam loss (h)	day	beam loss (h)
26.4.	24	1.6.	1
27.4.	24	5.6.	1
28.4.	24	10.6.	8
29.4.	24	13.6.	3
30.4.	24	14.6.	18.5
1.5.	13	15.6.	17
2.5.	7	19.6.	3
3.5.	18		
5.5.	10		
6.5.	7		
7.5.	2.5		
8.5.	4		
10.5.	3		
11.5.	19		
12.5.	1		
13.5.	5		
14.5.	2		
16.5.	7		
17.5.	9		
Sum	227.5		51.5
11.6 days out of 42 days			

9 Conclusions

Due to the problems of the PS, AA and LEAR (35% inefficiency) and our data aquisition system (20% inefficiency) we have written only 50% of the tapes we would have been able to write. Nevertheless the data we wrote contains the least trigger biases we had so far.

10 Some histograms

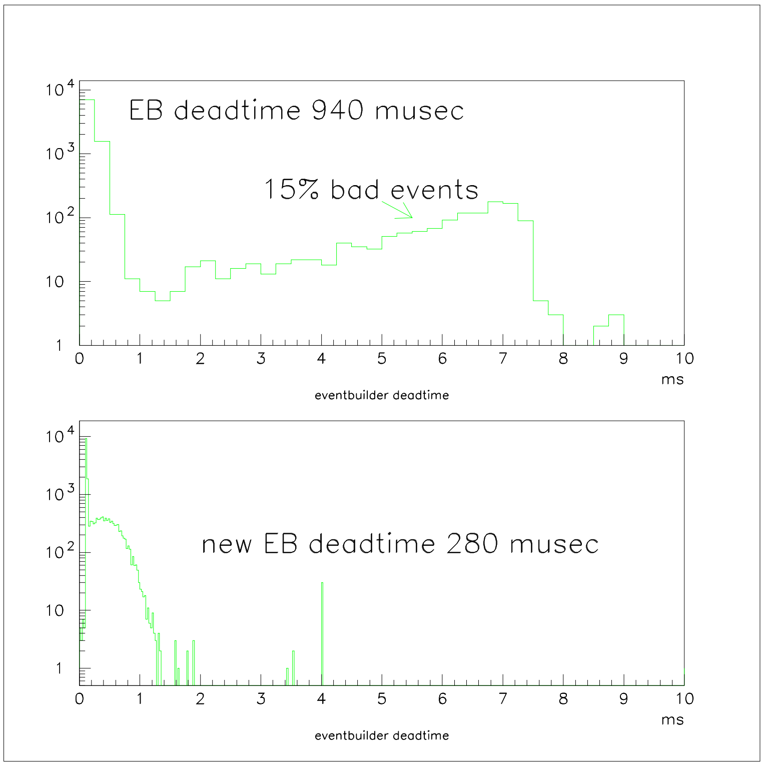

EB deadtime 940 musec
15% bad events
eventbuilder deadtime
ms
new EB deadtime 280 musec
eventbuilder deadtime
ms

Fig.1

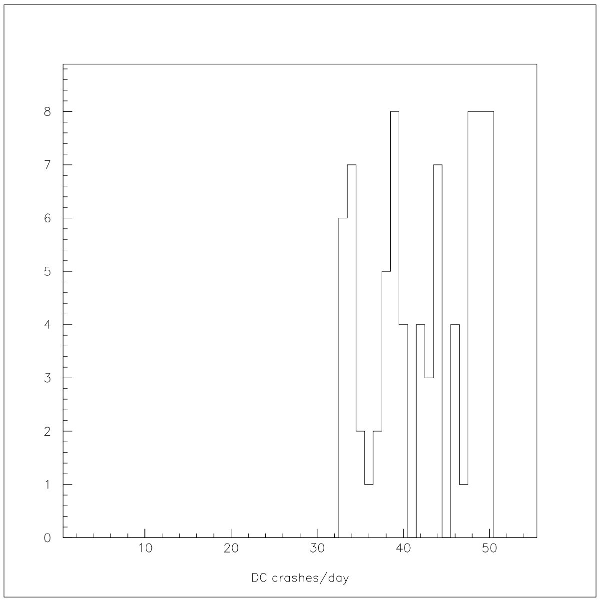
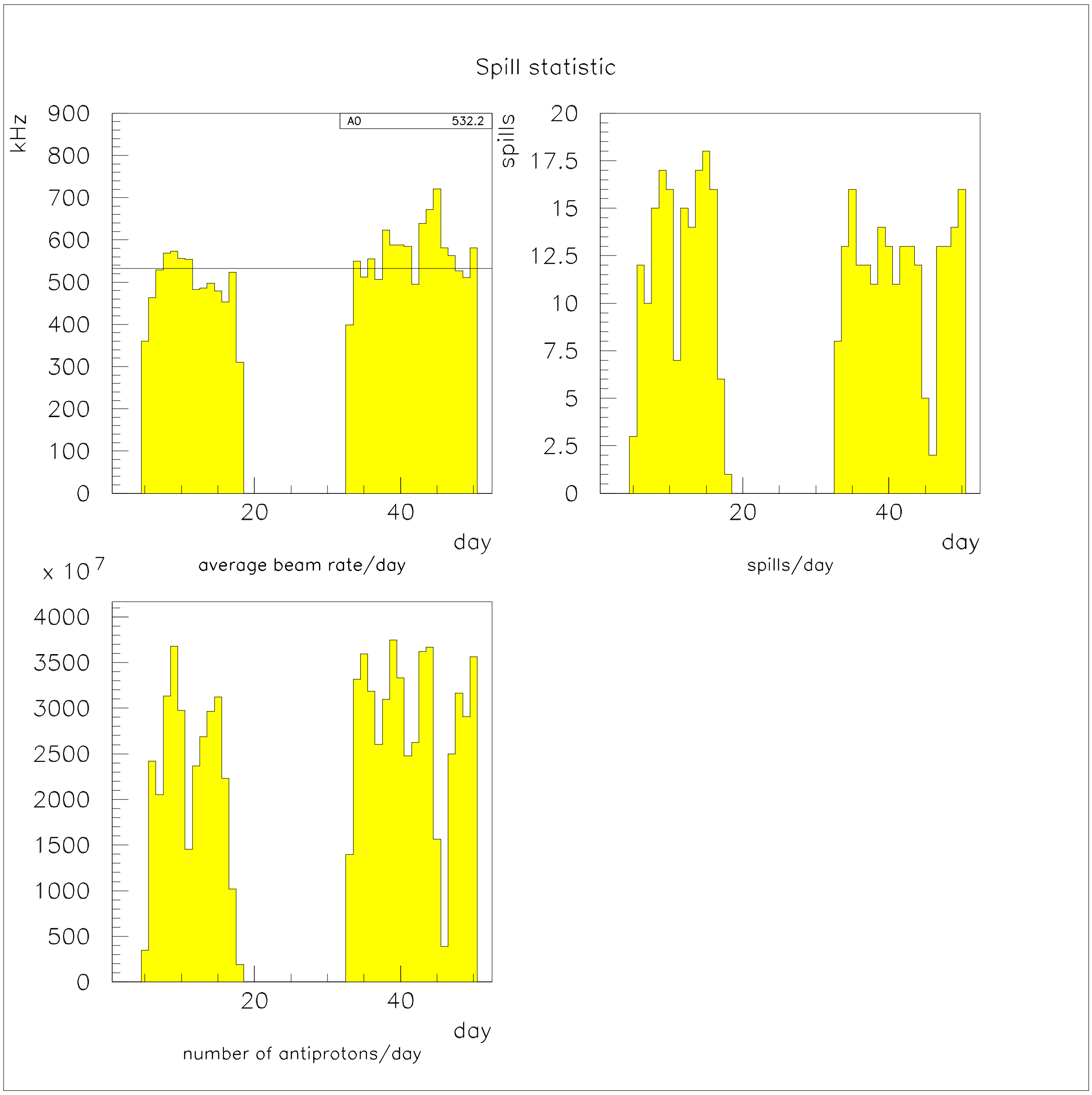
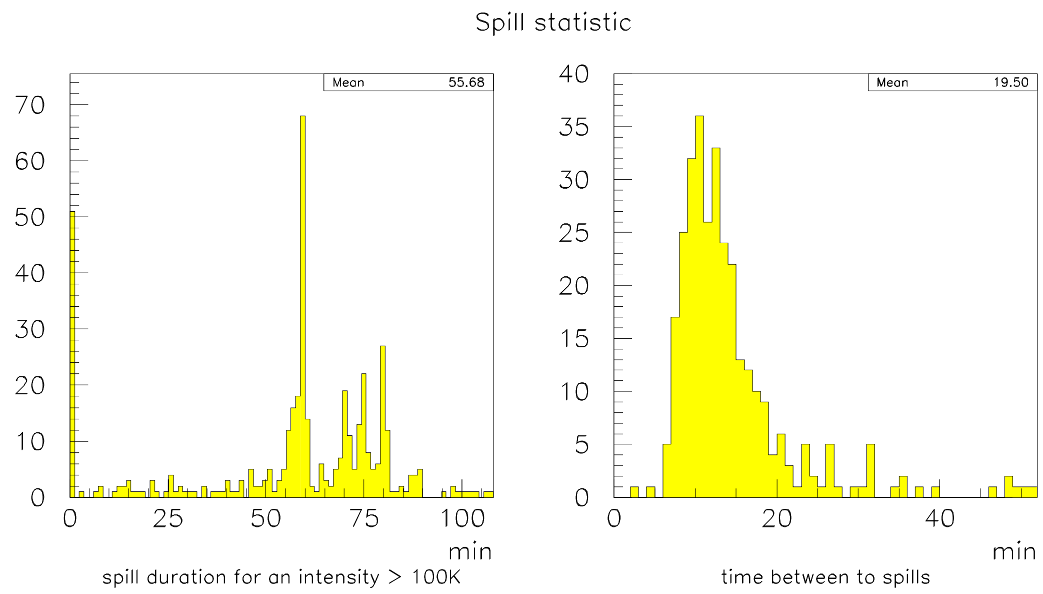
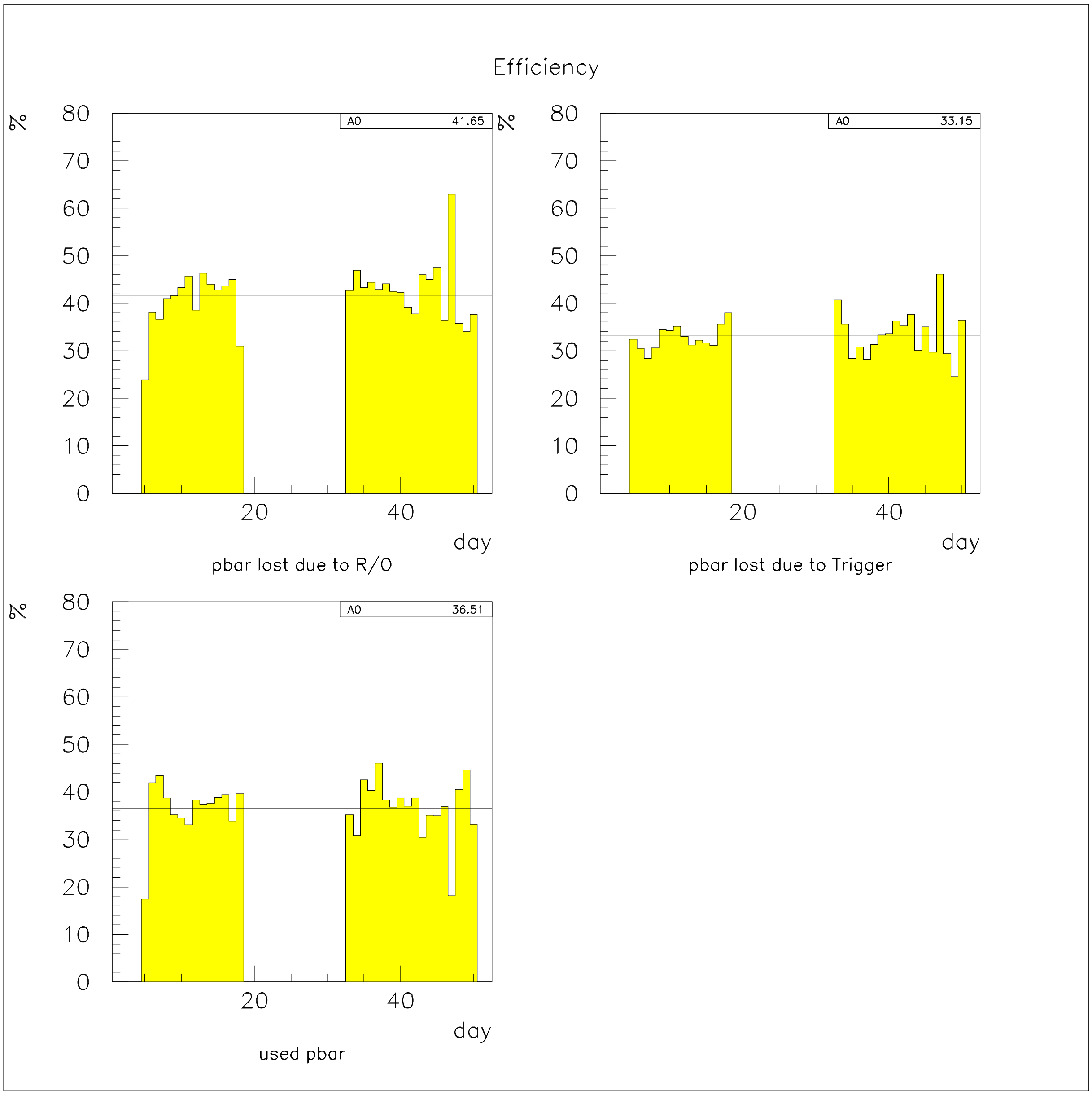

DC crashes/day

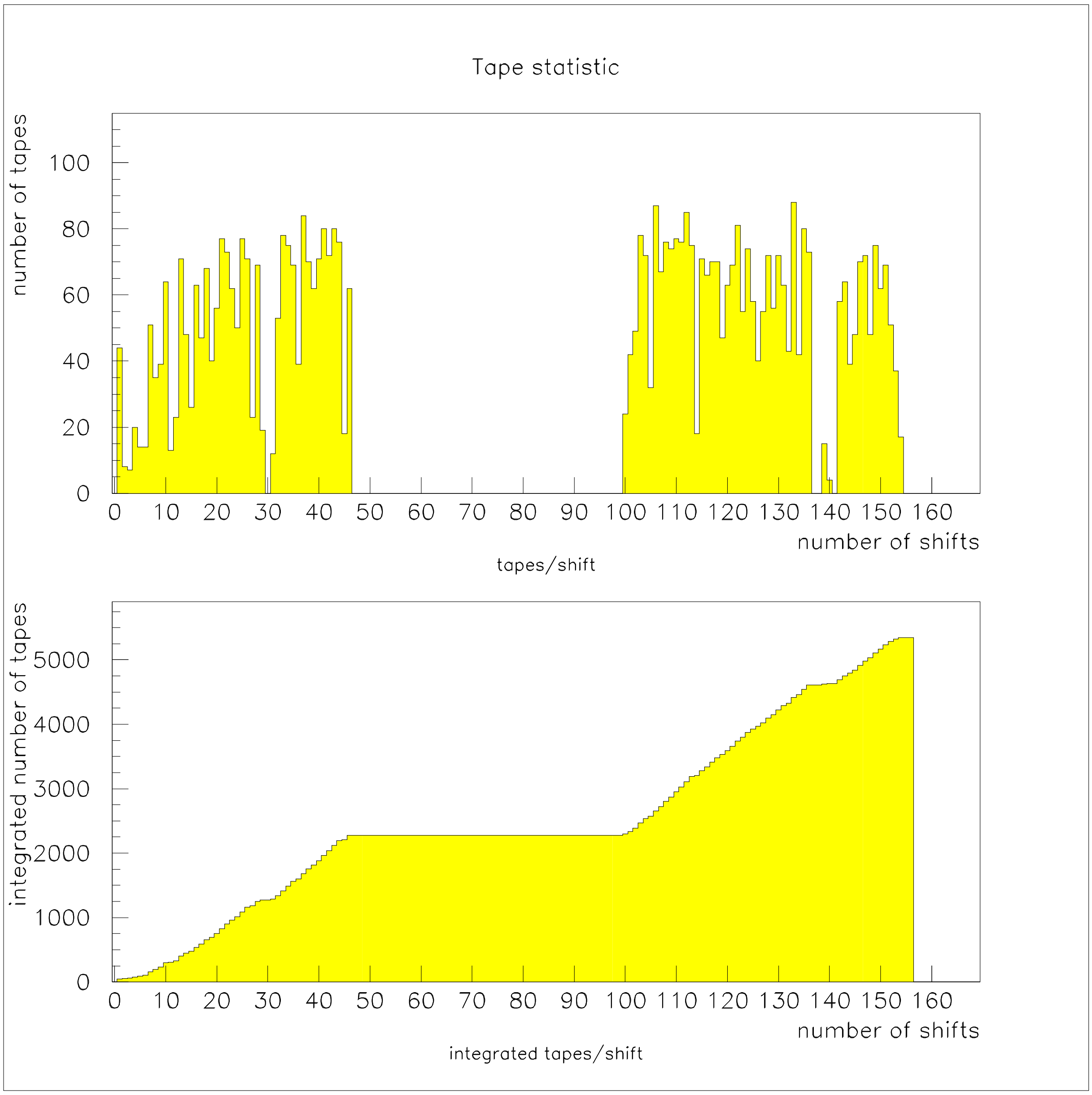
Fig.2

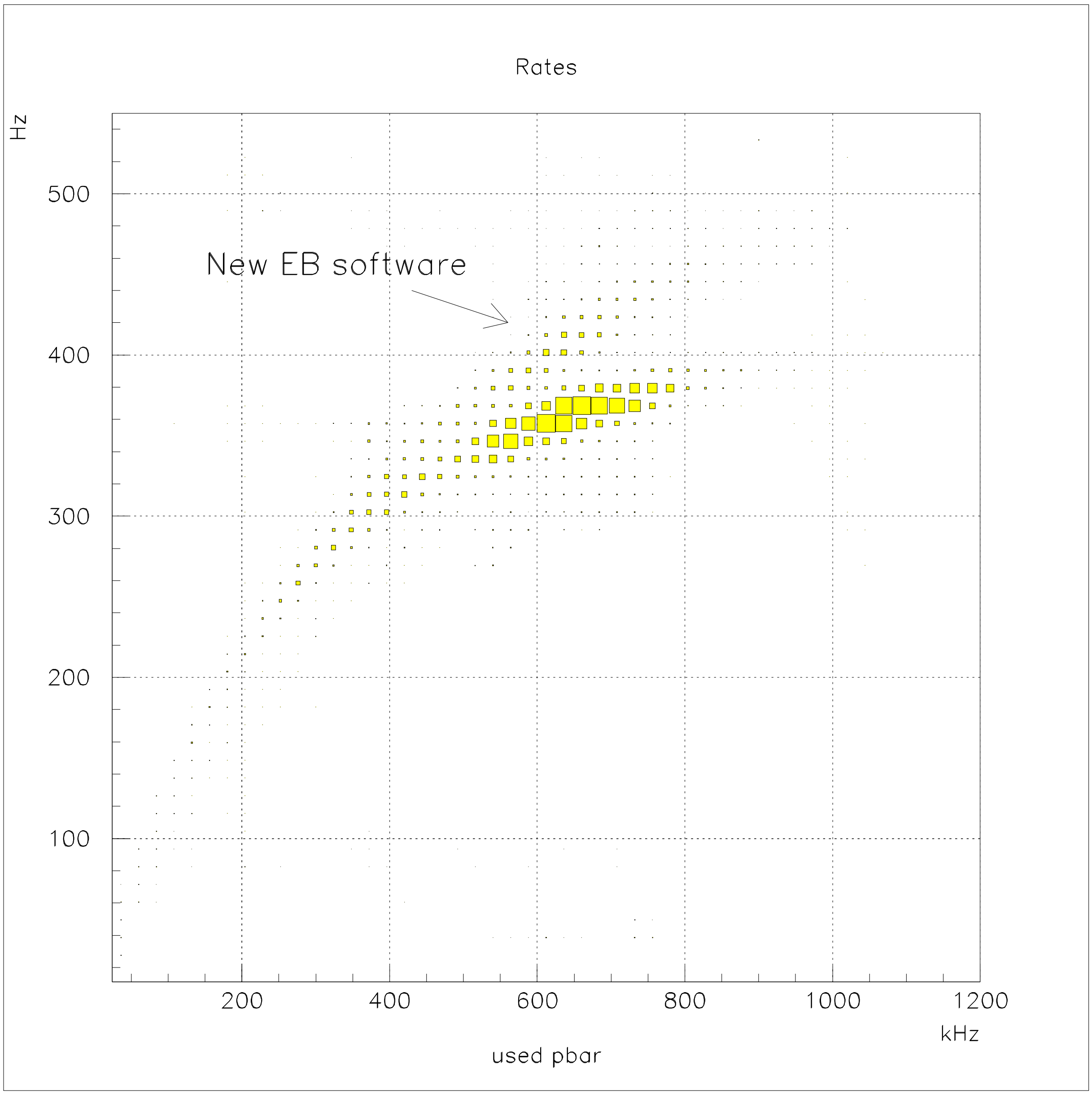

Spill statistic
kHz
A0 532.2
average beam rate/day
spills
spills/day
x 10^7
number of antiprotons/day
day
day
day

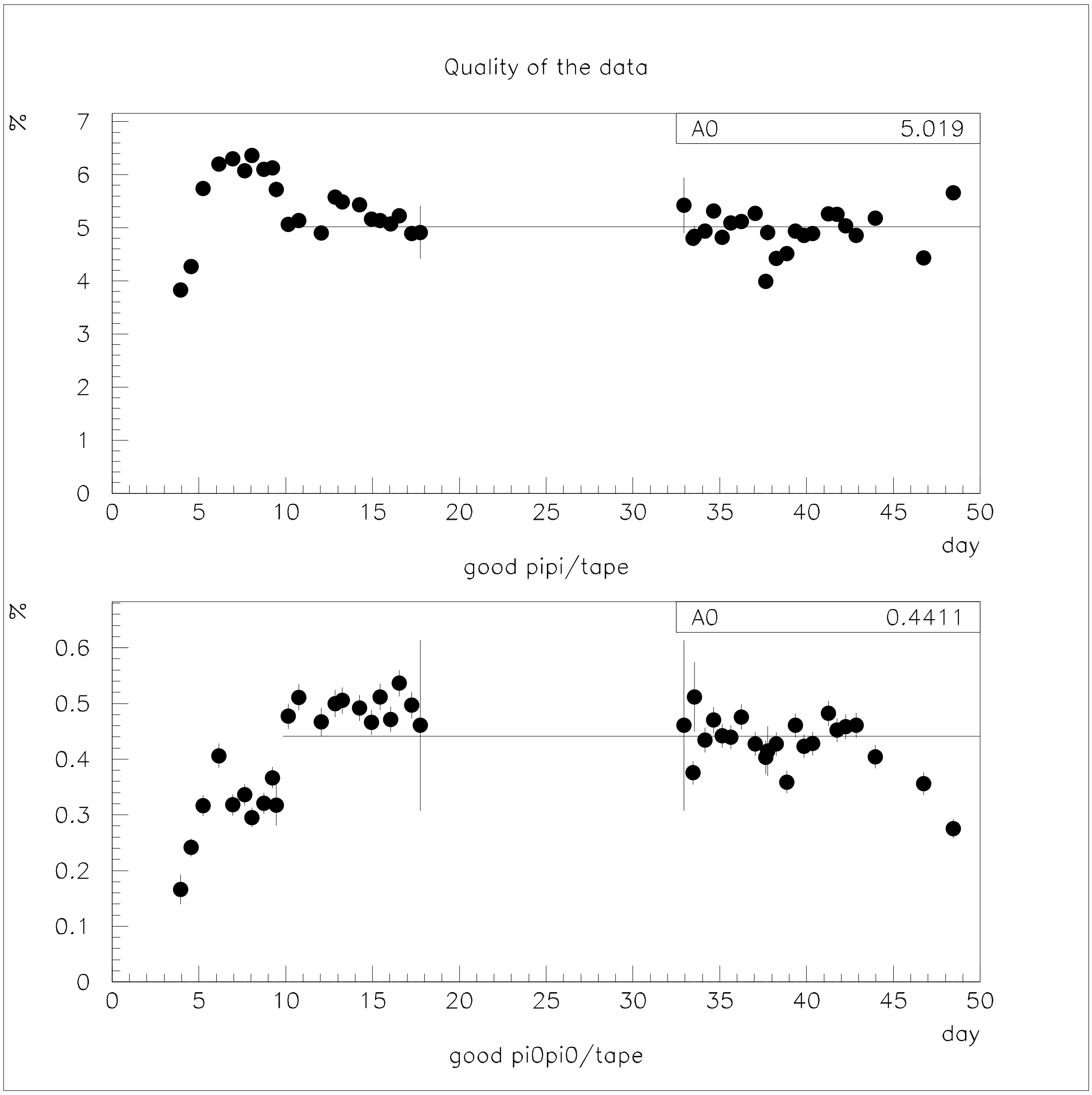

Spill statistic
Mean 55.68
spill duration for an intensity > 100K
min
Mean 19.50
time between to spills
min

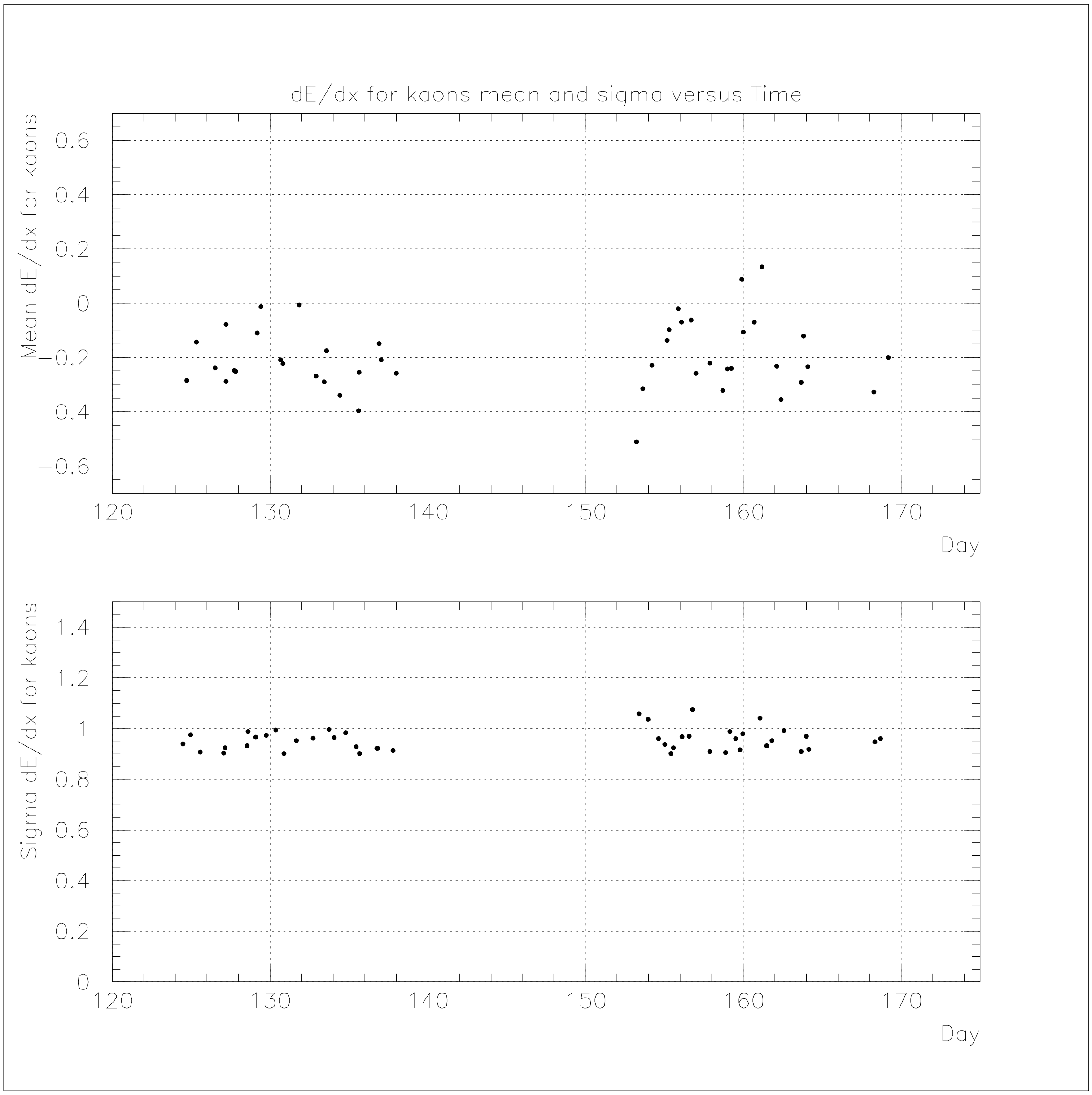


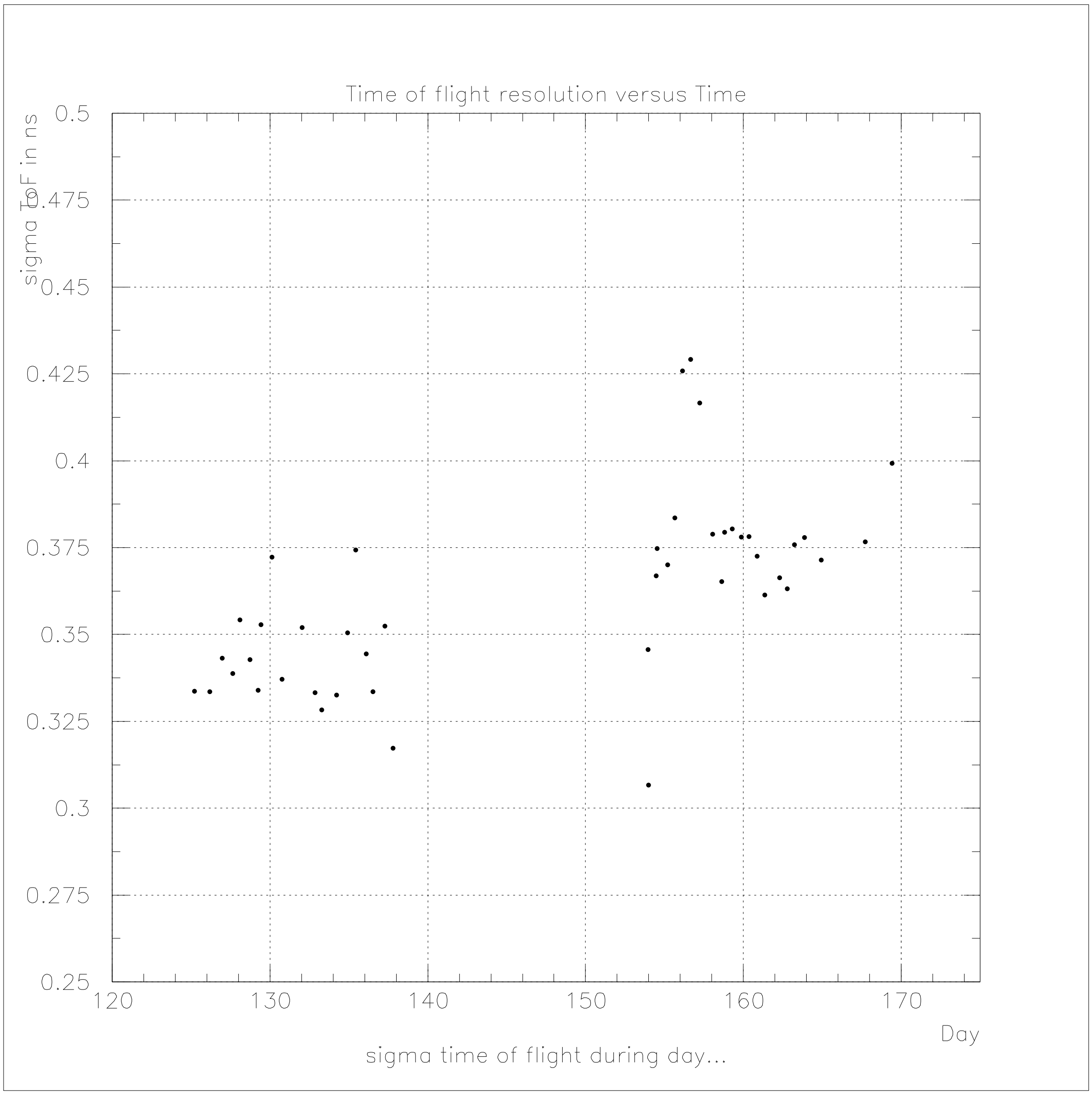
Efficiency
%
80
70
60
50
40
30
20
10
0
A0 41.65
20
40
day
pbar lost due to R/O
A0 33.15
pbar lost due to Trigger
A0 36.51
used pbar


Tape statistic
number of tapes
0
20
40
60
80
100
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
number of shifts
tapes/shift
integrated number of tapes
0
1000
2000
3000
4000
5000
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
number of shifts
integrated tapes/shift

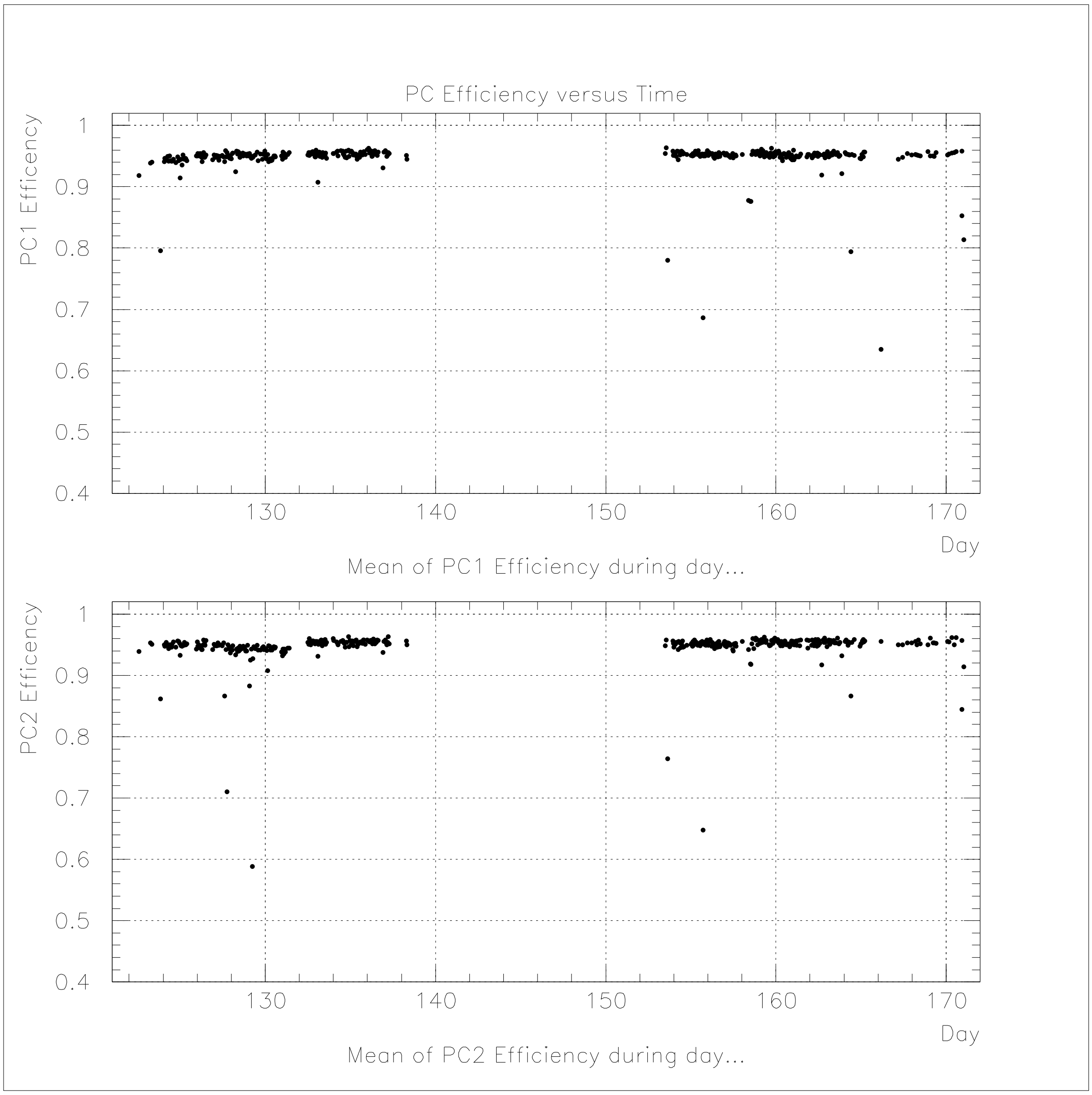

Rates
Hz
500
400
300
200
100
New EB software
200
400
600
800
1000
1200
kHz
used pbar

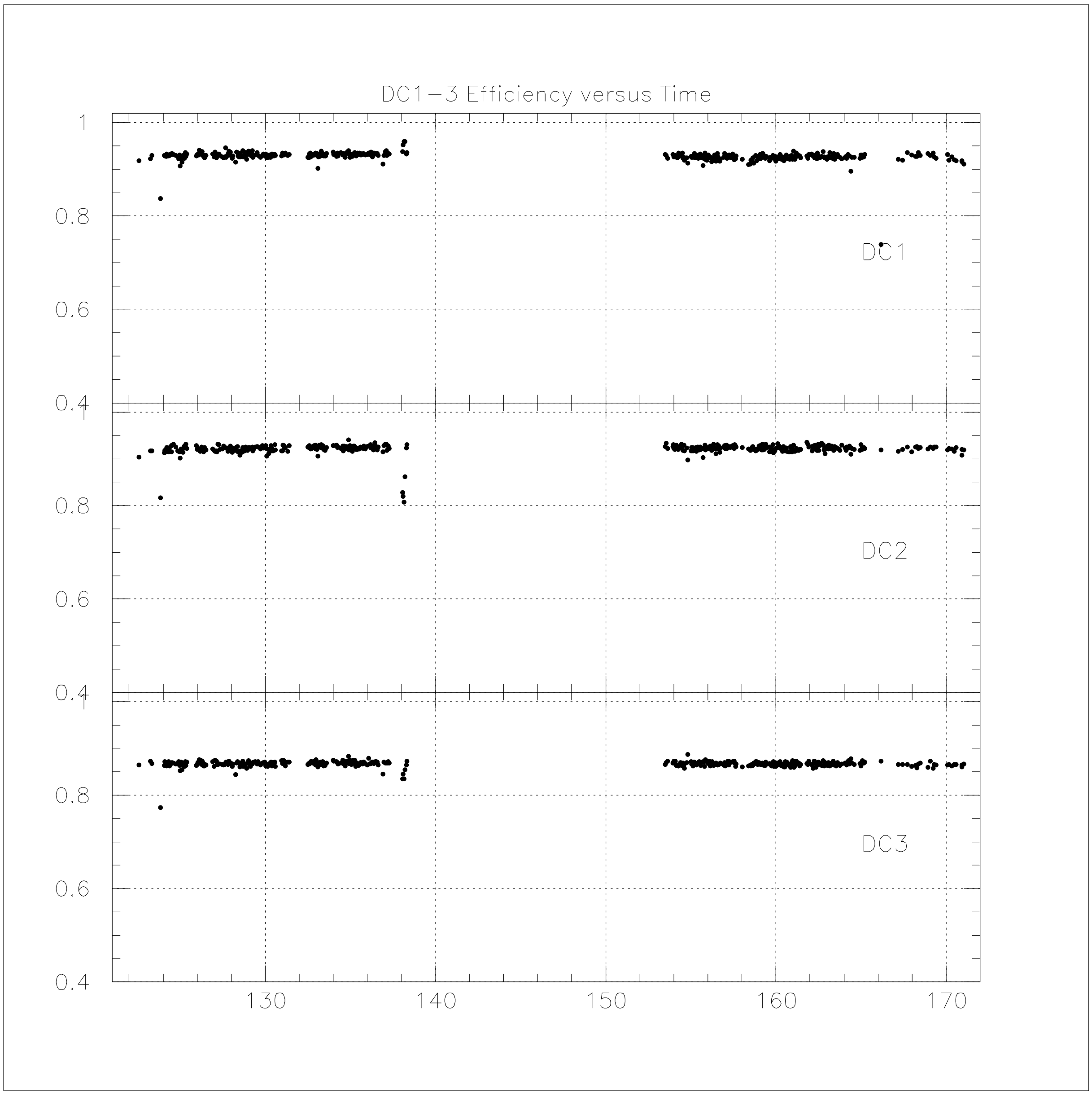

Quality of the data
%
A0 5.019
0
1
2
3
4
5
6
7
0
5
10
15
20
25
30
35
40
45
50
day
good pipi/tape
%
A0 0.4411
0
0.1
0.2
0.3
0.4
0.5
0.6
day
good pi0pi0/tape

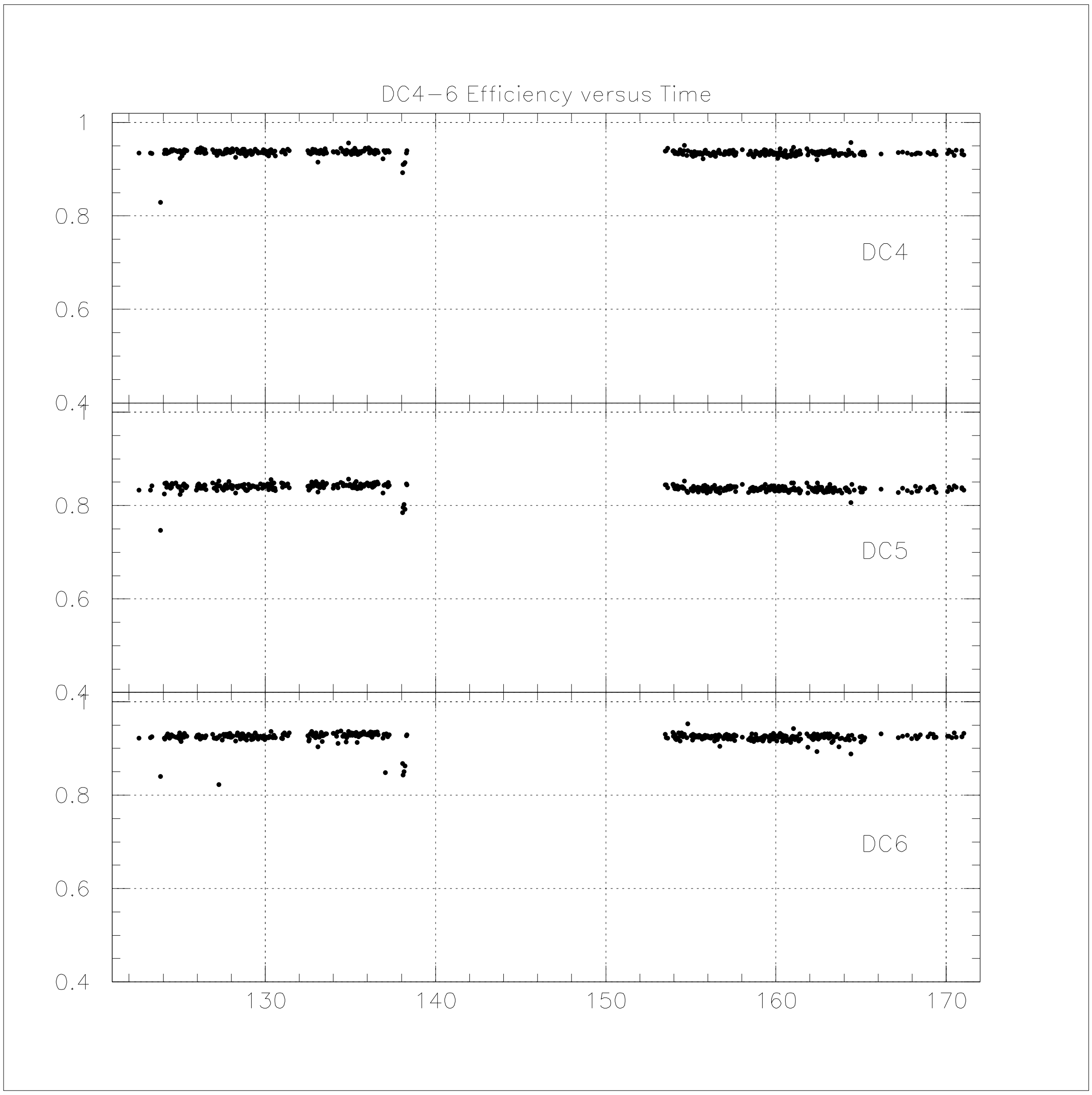

dE/dx for kaons mean and sigma versus Time
Mean dE/dx for kaons
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
120
130
140
150
160
170
Day
Sigma dE/dx for kaons
1.4
1.2
1
0.8
0.6
0.4
0.2
0
120
130
140
150
160
170
Day

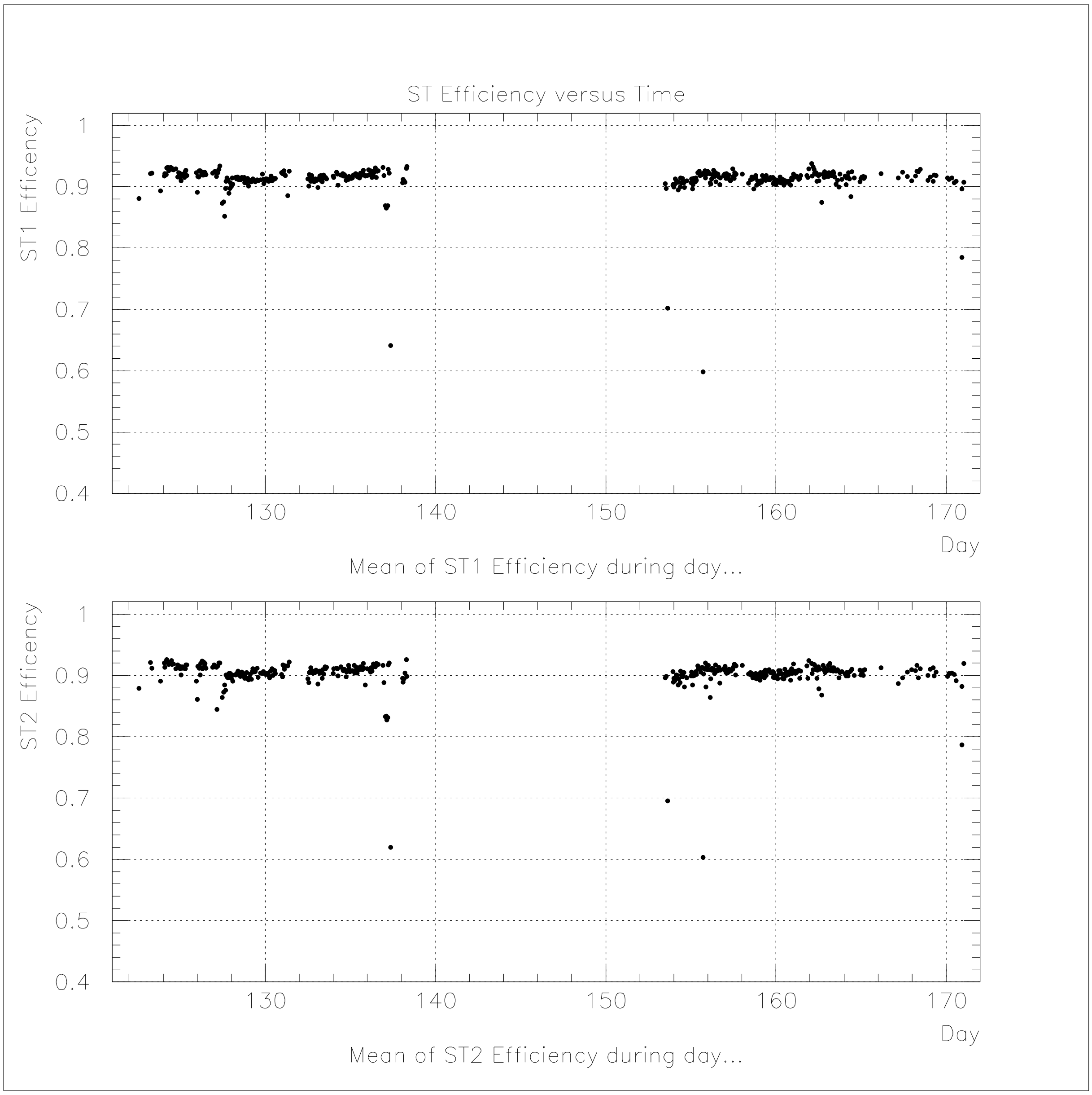


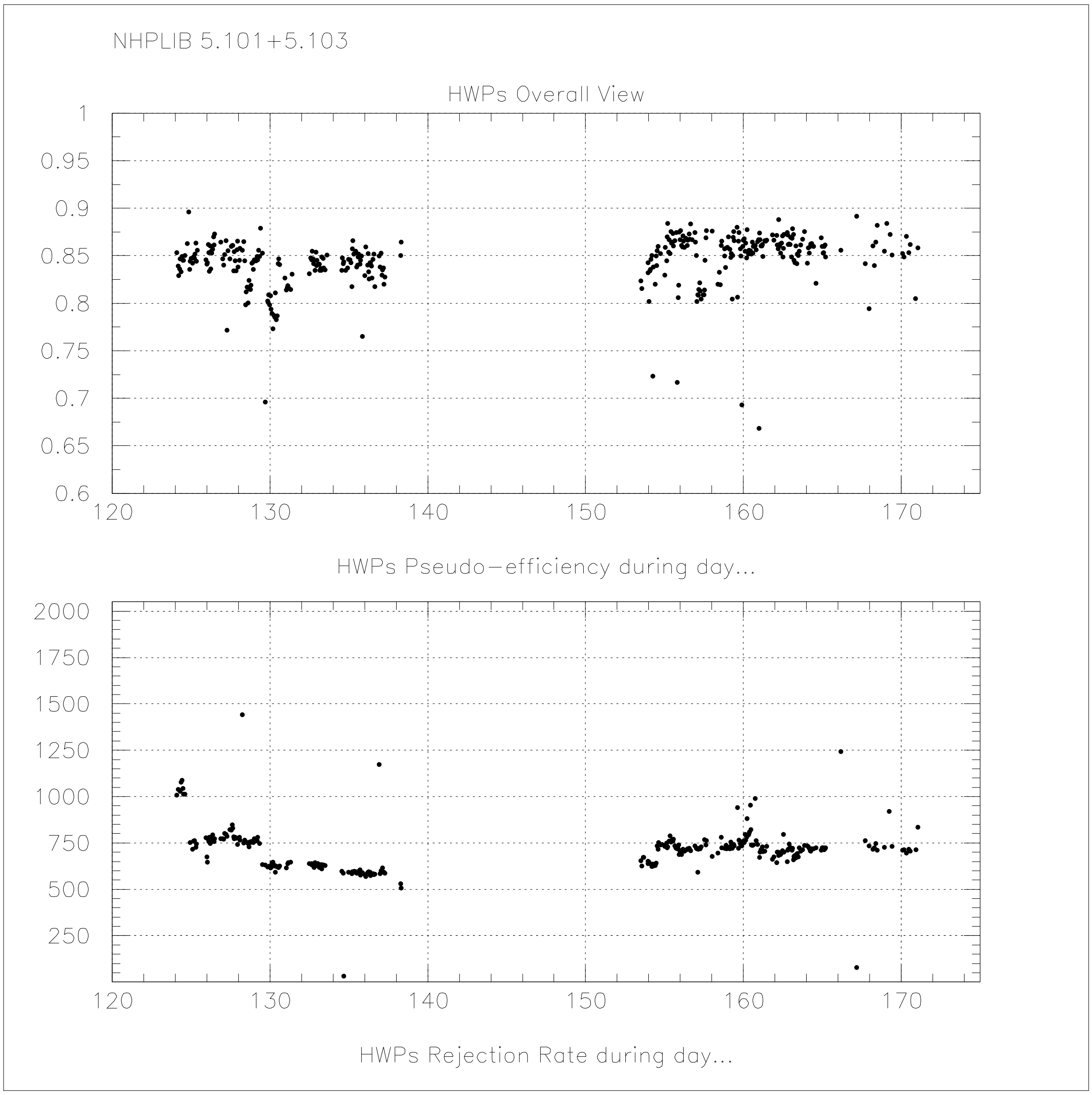
Time of flight resolution versus Time
sigma ToF in ns
0.5
0.475
0.45
0.425
0.4
0.375
0.35
0.325
0.3
0.275
0.25
120
130
140
150
160
170
Day
sigma time of flight during day...

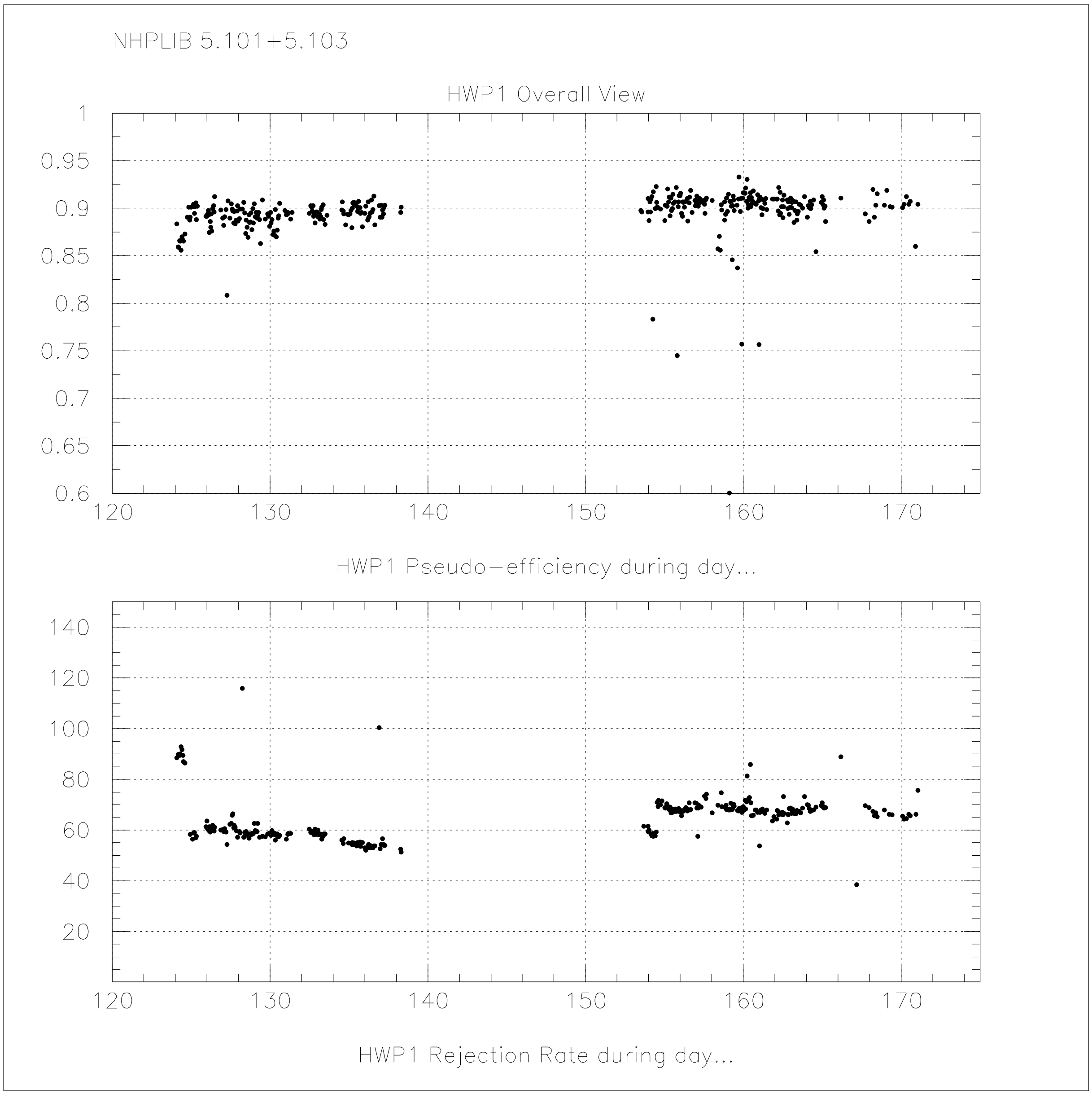

PC Efficiency versus Time
PC1 Efficency
1
0.9
0.8
0.7
0.6
0.5
0.4
130
140
150
160
170
Day
Mean of PC1 Efficiency during day...
PC2 Efficency
1
0.9
0.8
0.7
0.6
0.5
0.4
130
140
150
160
170
Day
Mean of PC2 Efficiency during day...

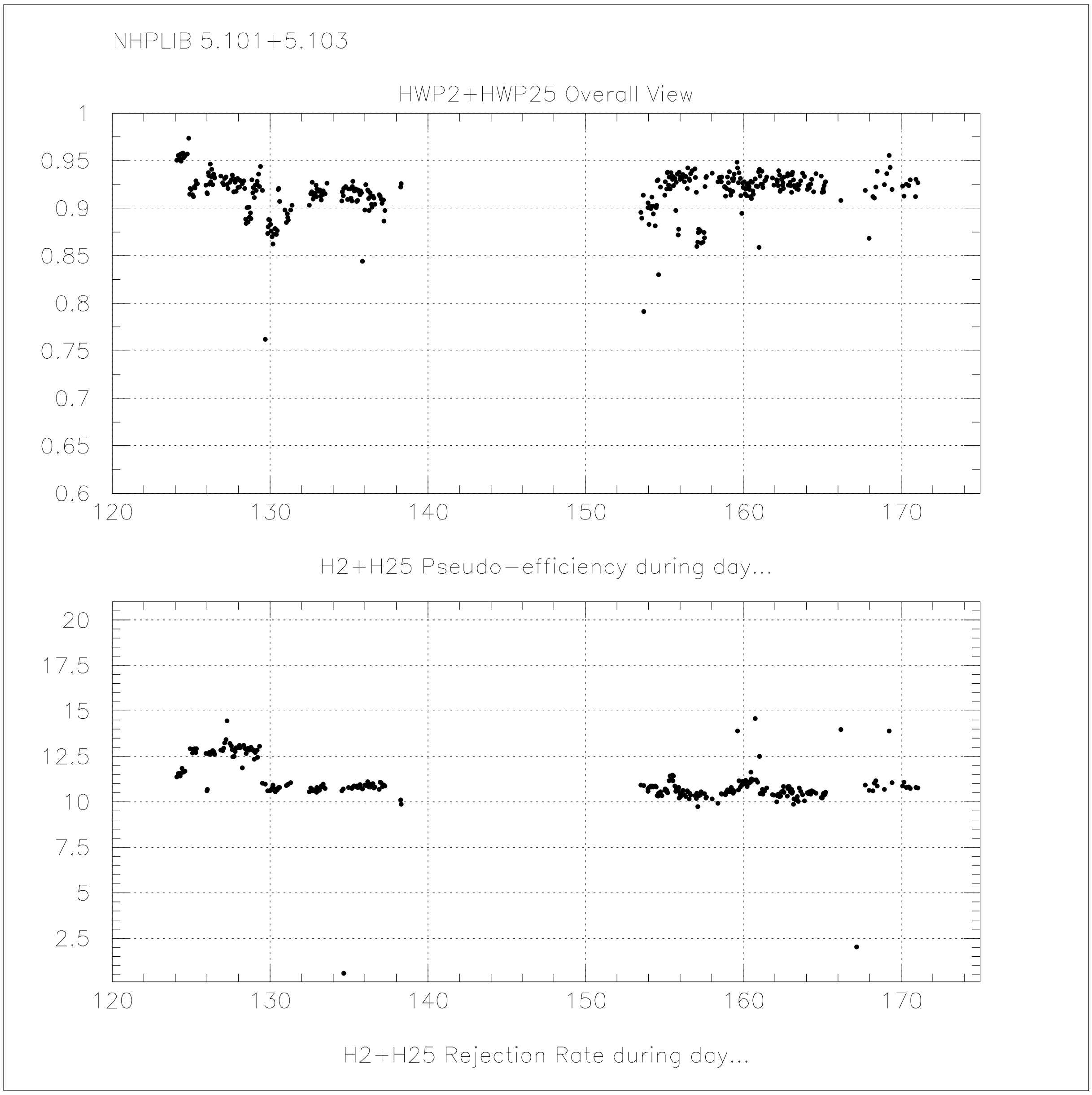

DC1−3 Efficiency versus Time
DC1
DC2
DC3
1
0.8
0.6
0.4
130
140
150
160
170

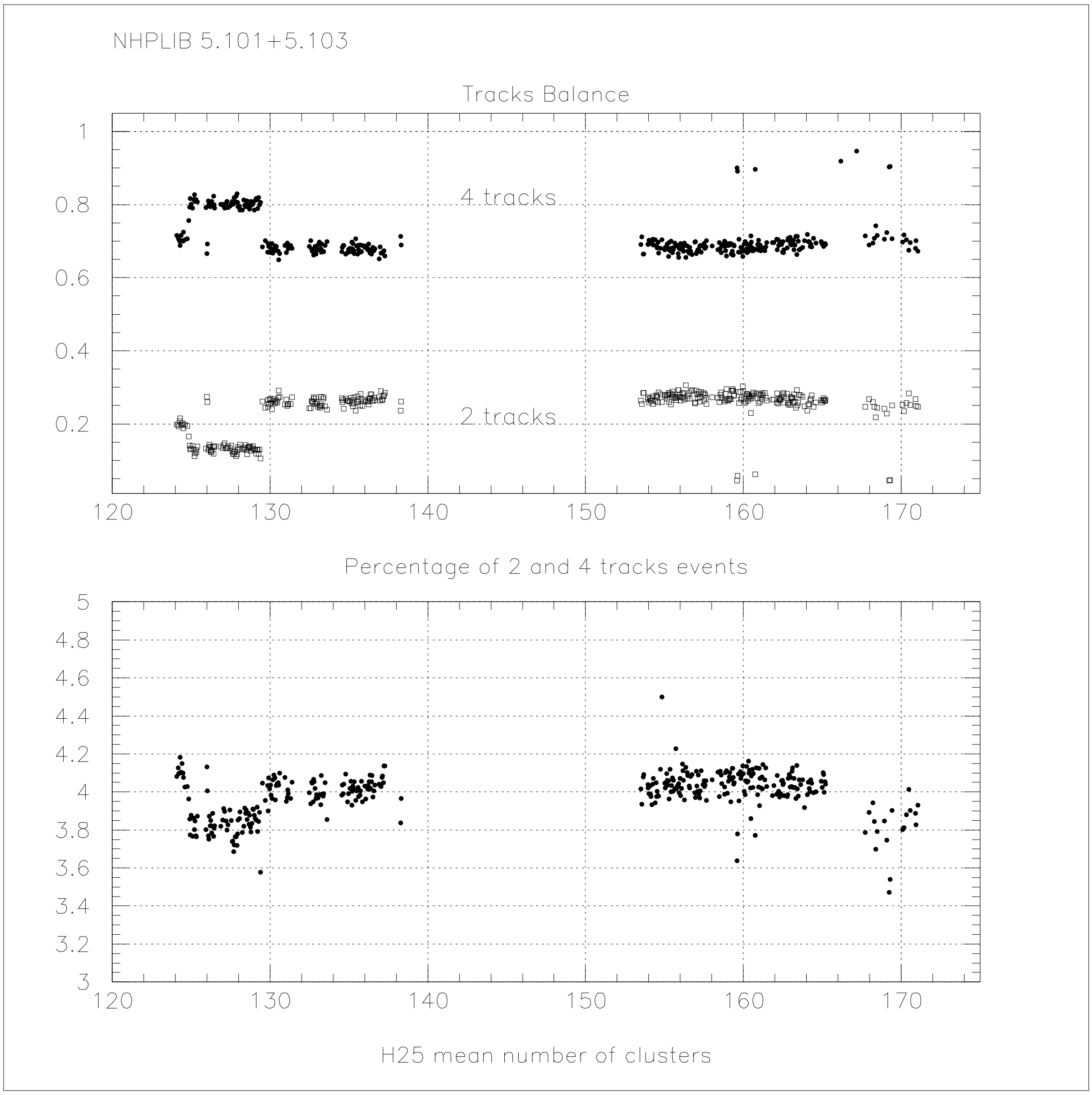

DC4−6 Efficiency versus Time
DC4
DC5
DC6
1
0.8
0.6
0.4
130
140
150
160
170

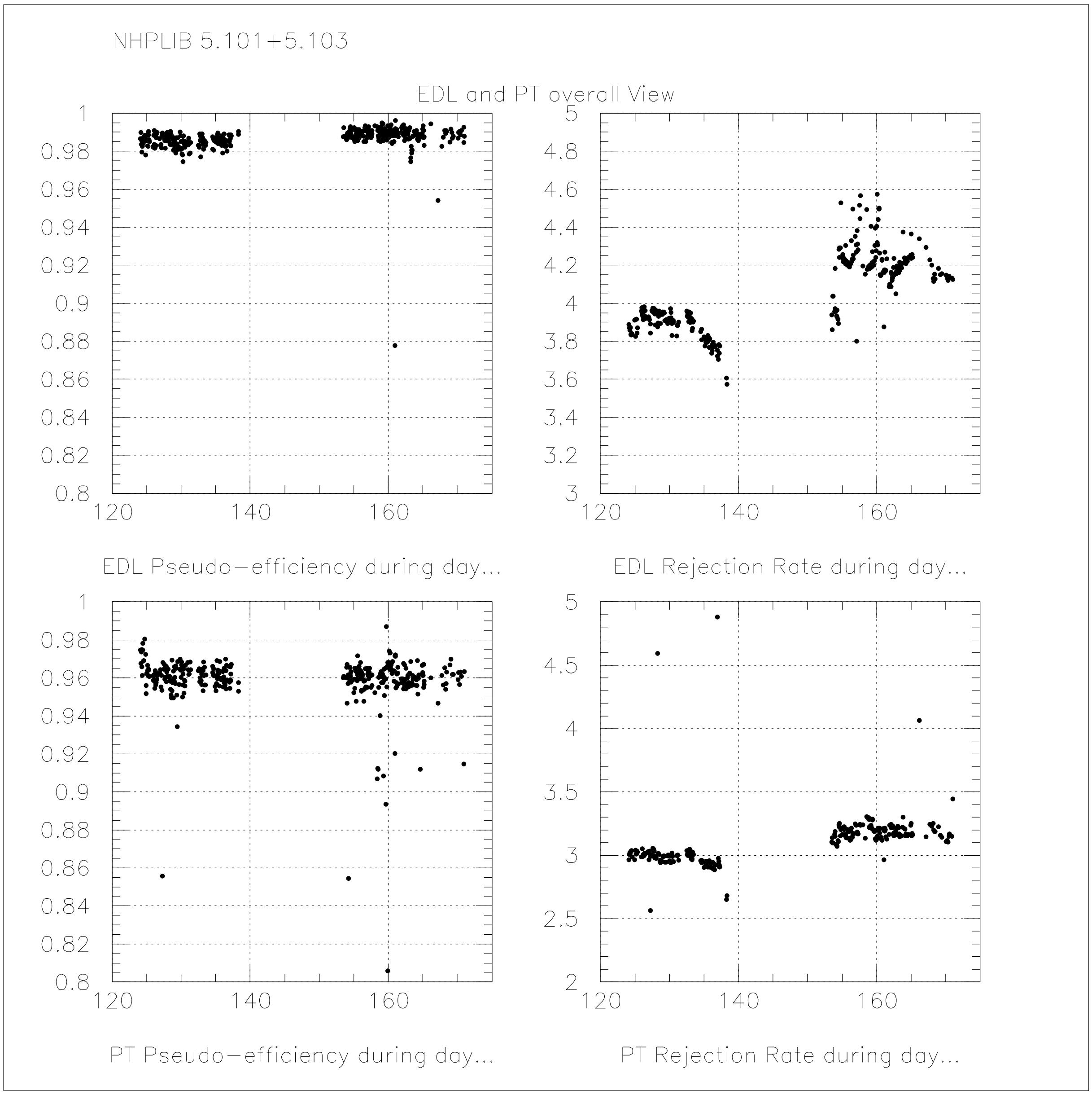

ST Efficiency versus Time
ST1 Efficency
1
0.9
0.8
0.7
0.6
0.5
0.4
130
140
150
160
170
Day
Mean of ST1 Efficiency during day...
ST2 Efficency
1
0.9
0.8
0.7
0.6
0.5
0.4
130
140
150
160
170
Day
Mean of ST2 Efficiency during day...


NHPLIB 5.101+5.103
HWPs Overall View
HWPs Pseudo−efficiency during day...
HWPs Rejection Rate during day...

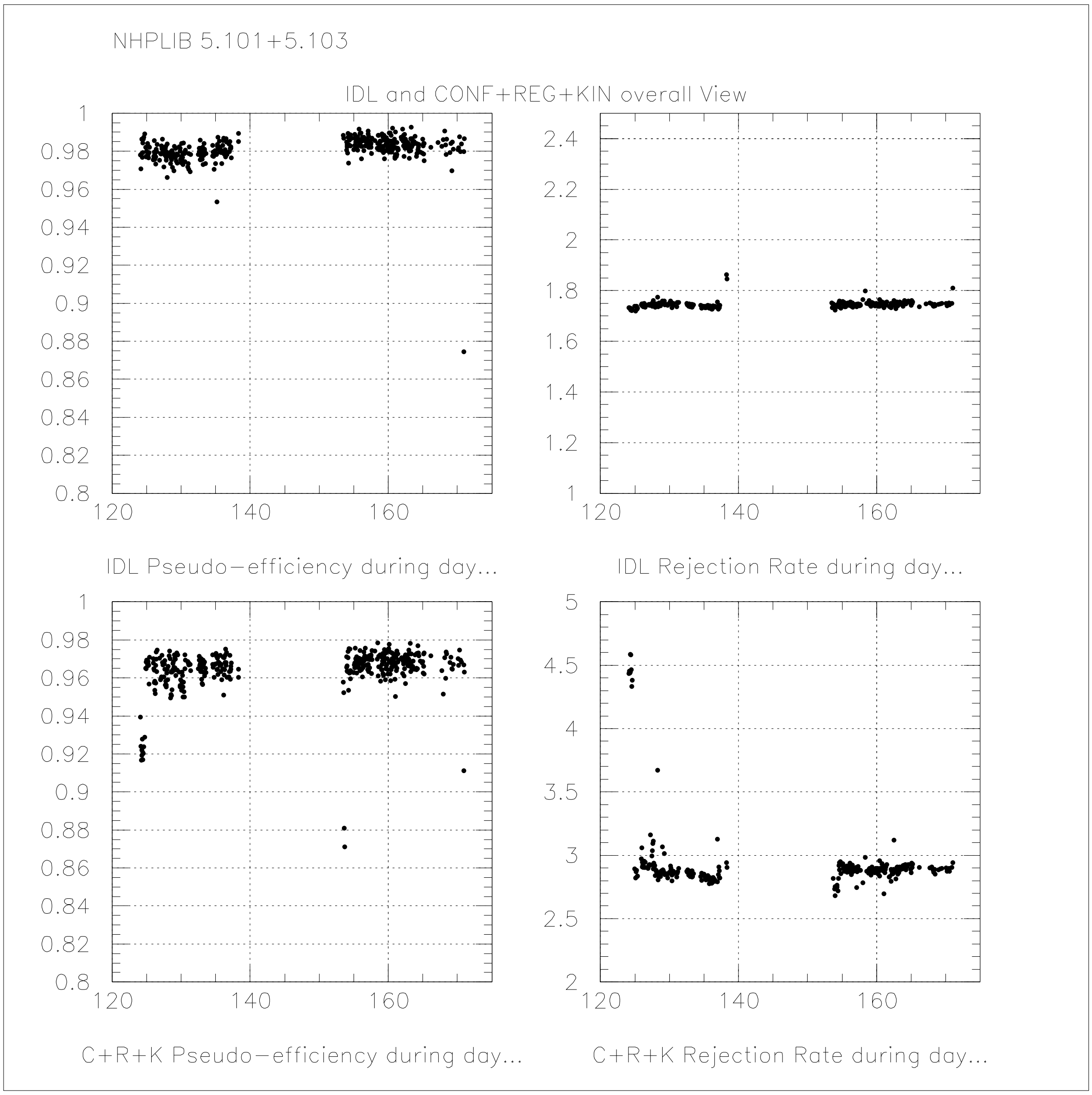

NHPLIB 5.101+5.103
HWP1 Overall View
HWP1 Pseudo−efficiency during day...
HWP1 Rejection Rate during day...

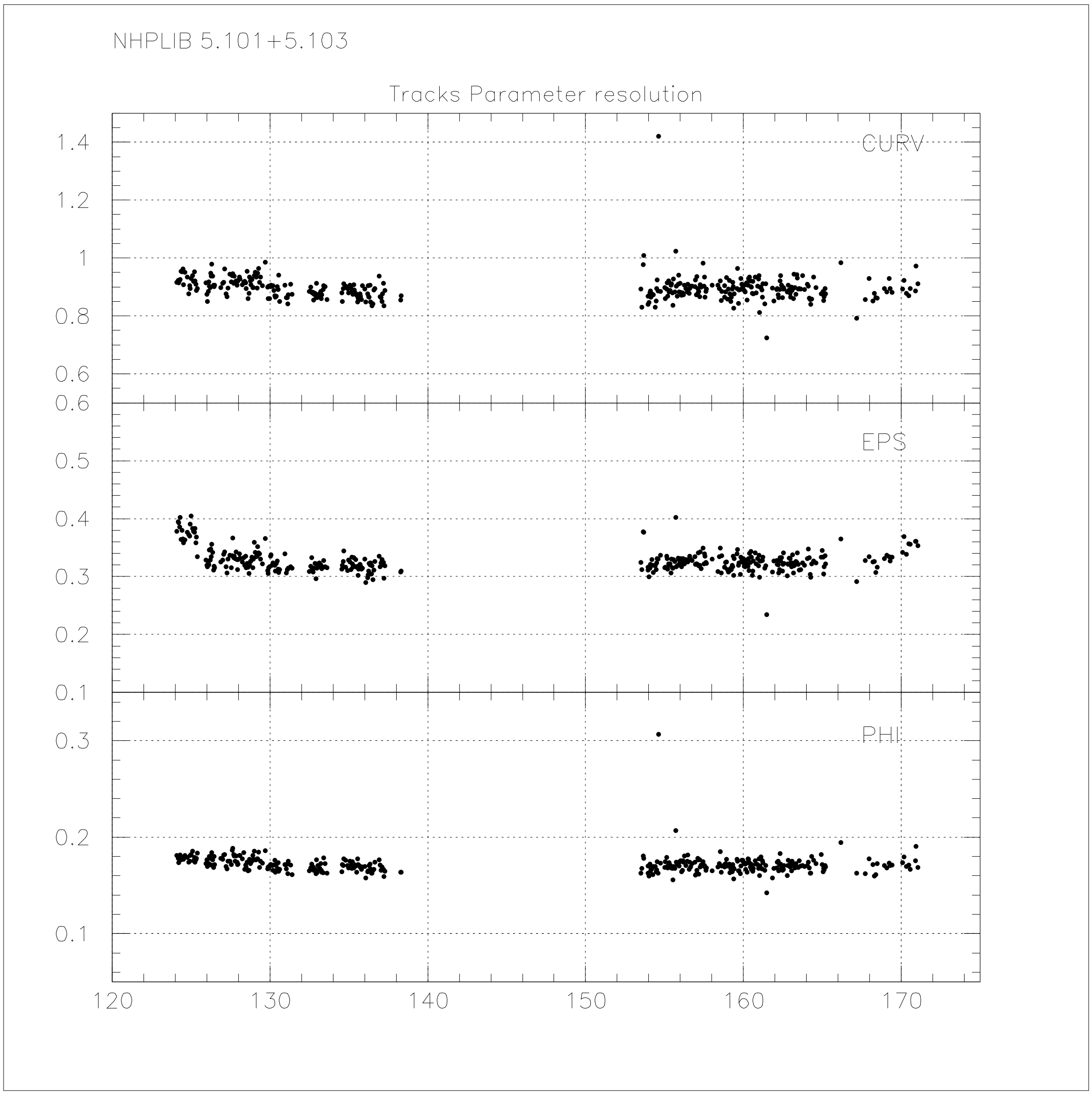

NHPLIB 5.101+5.103
HWP2+HWP25 Overall View
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
120
130
140
150
160
170
H2+H25 Pseudo−efficiency during day...
20
17.5
15
12.5
10
7.5
5
2.5
120
130
140
150
160
170
H2+H25 Rejection Rate during day...

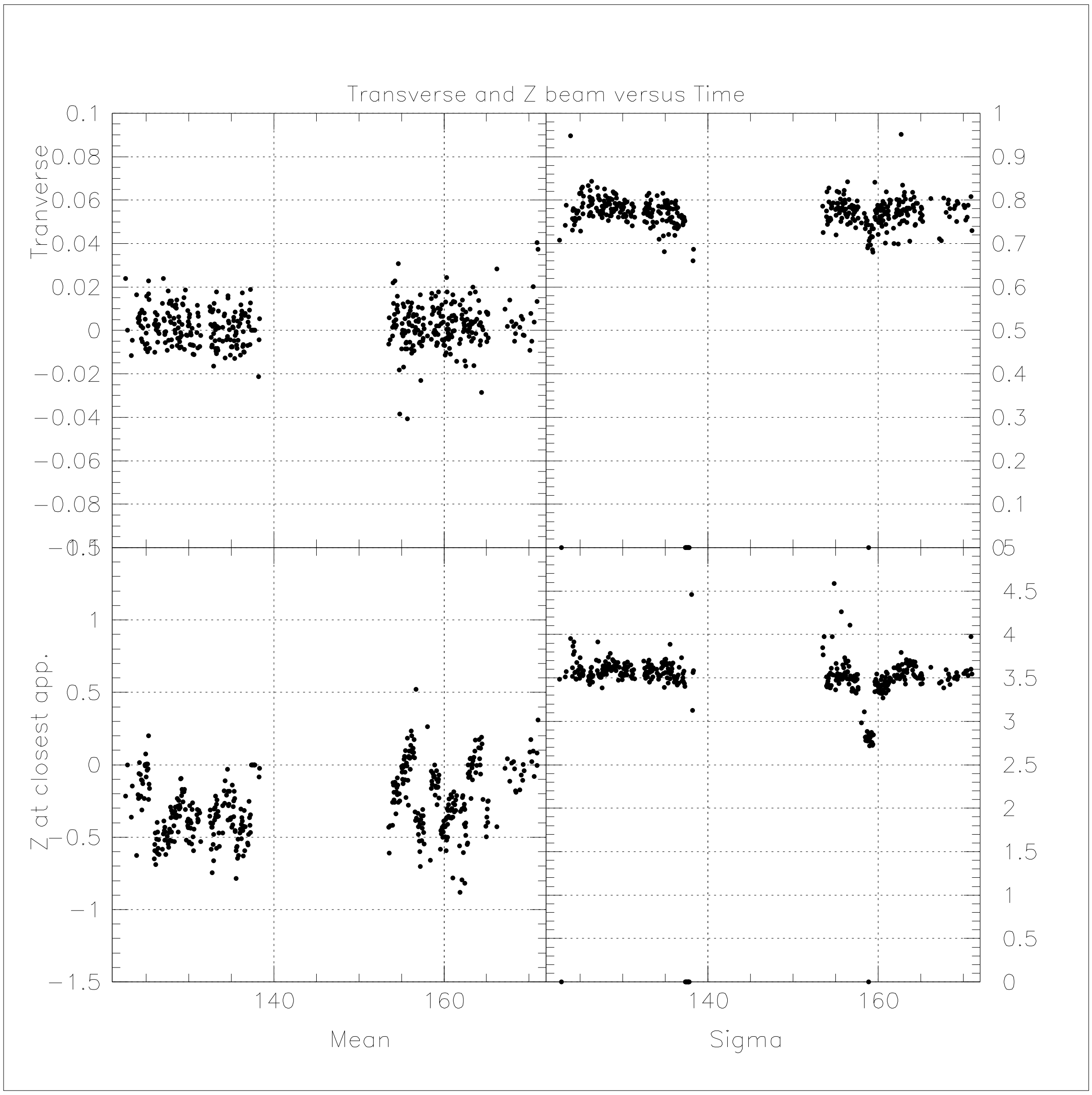

NHPLIB 5.101+5.103
Tracks Balance
4 tracks
2 tracks
Percentage of 2 and 4 tracks events
H25 mean number of clusters



NHPLIB 5.101+5.103
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 5.101+5.103
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 5.101+5.103
Tracks Parameter resolution
CURV
EPS
PHI
1.4
1.2
1
0.8
0.6
0.6
0.5
0.4
0.3
0.2
0.1
0.3
0.2
0.1
120
130
140
150
160
170


Transverse and Z beam versus Time
Tranverse
Z at closest app.
Mean
Sigma
0.1
0.08
0.06
0.04
0.02
0
−0.02
−0.04
−0.06
−0.08
−0.1
1.5
1
0.5
0
−0.5
−1
−1.5
140
160
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0