SM/afm

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AAC ME SUMMARY, 13TH NOVEMBER - 17TH NOVEMBER 1989

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Introduction

During Period 3, 5 days were devoted to AAC machine experiments (ME) before starting antiproton accumulation and transferring them to LEAR. This ME period started with 30 hours PS machine development (MD) during which no beam was available for the AAC. ME's used the $\bar{p}$ stacked and then the production beam and the protons through the loop. Here is a short description of the machine experiment.

ME1: VERTICAL STACK TAIL

(G. Carron, F. Caspers and L. Thorndahl)

Due to a too high common mode in the vertical stack tail PU, the beam transfer function could not be measured. A connexion was wrong on the PU and we should be able to measure the BTF during the next ME.

ME2: RUSSIAN EJECTION

(J. Kuczerowski, S. Maury, F. Pedersen, L. Soby and S. van der Meer)

This ejection consists of ejecting all the stack in 100 shots. As usual, this experiment takes place just before closing the AAC machine. For a second test we have to build a new $\bar{p}$ stack which is very long. So, we build a proton stack with the TST beam through the loop. The main advantage is to make a new stack of $2 \cdot 10^{11}$ p (rf stacking in momentum) in 3 minutes. The total width of the stack obtained is 400 Hz (4.5 eVs). However, there are 2 disadvantages:

- No cooling is available due to the anticlockwise rotation of the beam, but the stack width can be adjusted by the number of injected shots.
- The equalizing using 200-500 MHz kicker does not work because the kicker is directional, but the rf stacking produces a reasonably flat momentum distribution.

To do that, a special AA rf file for stacking was made to obtain the stack at normal position. For the ejection an unstacking rf file was modified to unstack with a bucket of 0.12 eVs to increase the longitudinal density. The frequency displacement between shots corresponds to 0.05 eVs. To obtain the 0.12 eVs the Γ was increased to 0.34 without going below 5 V. Finally, the unstacking program adjusts the frequency (SEQ 2, 3, 5) to maintain the difference in frequency between sequences with the full bucket constant (Fig. 1). Successful adjustments were made after these adjustments (Fig.2).

AA **5 UNSTACKING FUNCTION FOR 66 SHOTS**

NO PHASE LOCK

SYNC DISABLED

SAVED	USED
89-11-15	89-11-15

adjusted each pulse (5Hz)

δf = 200Hz

min Γ for V ≥ 5V

SEQ	TYPE	Δt	VALUES AT END OF SEQUENCE						
			t-tini	f	A eVs	Γ	V	fs Hz	VECT
1	INI	0	-2.29	1843	.2128	0	5	9	1
2	DHS	.05	-2.24	1854.44	.2308	0	5	8	2
3	DHS	.02	-2.22	1855.06	.2363	0	5	8	3
4	MAT	.15	-2.046	1855.05	.12	.34	5	8	6
5	MOV	1.107	-.939	1854.86	.12	.34	5	8	13
6	MAT	1	-.708	1854.49	1.1	.34	460	81	23
7	MOV	.635	-.072	1843	1.1	.34	544	96	34
8	MAT	1	.117	1842.71	.23	0	5	10	44
9	DHS	.04	.157	1843	.2128	0	5	9	45

Figure 1

LOST	UNST	BUCKT	LOST	UNST	BUCKT	LOST	UNST	BUCKT	LOST	UNST	BUCKT	LOST	UNST	BUCKT
0	224	.12	0	212	.12	1	199	.12	1	186	.12	1	183	.12
0	192	.12	0	193	.12	0	197	.12	2	190	.12	2	198	.12
0	198	.12	0	197	.12	1	192	.12	1	187	.12	0	188	.12
0	137	.12	0	134	.12	0	132	.12	1	121	.12	0	125	.12
1	135	.12	0	143	.12	1	147	.12	0	147	.12	-2	149	.12
0	149	.12	0	147	.12	3	147	.12	1	143	.12	0	157	.12
0	163	.12	0	162	.12	0	160	.12	1	152	.12	0	161	.12
0	167	.12	-1	164	.12	-1	169	.12	35	144	.12	0	180	.12
0	179	.12	-1	158	.12	0	154	.12	2	161	.12	1	175	.12
0	174	.12	179	0	.12	0	186	.12	0	184	.12	0	174	.12
1	168	.12	0	169	.12	0	166	.12	0	198	.12	0	188	.12
0	191	.12	0	190	.12	1	194	.12	0	188	.12	0	185	.12
0	182	.12	0	191	.12	0	199	.12	1	201	.12	0	191	.12
1	186	.12	0	190	.12	0	190	.12	0	185	.12	2	199	.12
0	206	.12	0	208	.12	0	190	.12	0	174	.12	1	169	.12
1	175	.12	0	184	.12	0	176	.12	0	171	.12	1	174	.12
1	162	.12	0	152	.12	0	138	.12	0	137	.12	0	146	.12
0	146	.12	-1	140	.12	0	132	.12	0	126	.12	2	122	.12
0	121	.12	0	118	.12	1	109	.12	0	116	.12	0	114	.12
0	107	.12	0	104	.12	0	97	.12	0	95	.12	2	92	.12

STACK, START: 19983, AFTER 66 SHOTS: 8499, AFTER 100 SHOTS: 3401

acquisition timing problem.

Figure 2

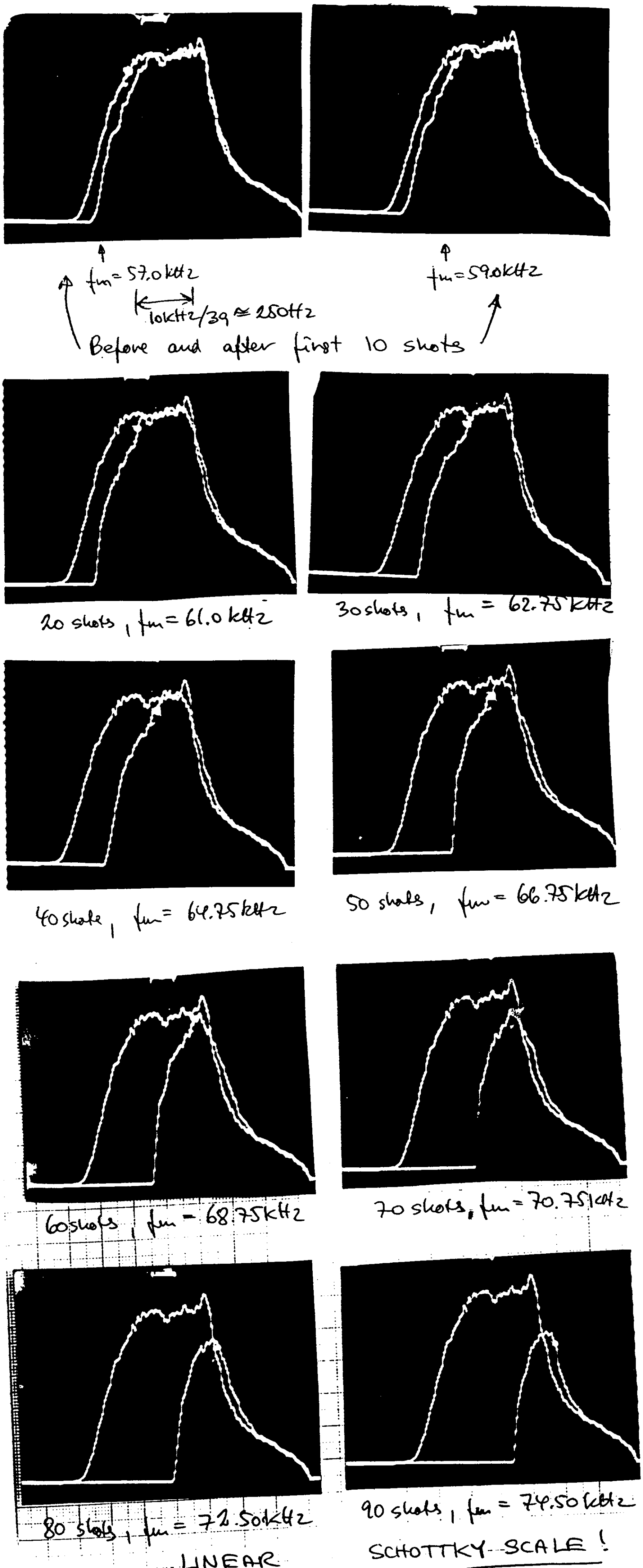

fm = 57.0 kHz
10kHz/39 ≅ 250Hz
fm = 59.0 kHz
Before and after first 10 shots
20 shots, fm = 61.0 kHz
30 shots, fm = 62.75 kHz
40 shots, fm = 64.75 kHz
50 shots, fm = 66.75 kHz
60 shots, fm = 68.75 kHz
70 shots, fm = 70.75 kHz
80 shots, fm = 72.50 kHz
90 shots, fm = 74.50 kHz
LINEAR SCHOTTKY SCALE !

Figure 3

The shape of the stack on linear Schottky scale after unstacking interrupted every 10 shots is shown in Fig. 3. We can see that the density at the marker location is pretty constant for the first 70 shots and the slow increase towards 60-70 shots is due to higher density followed by drop when constant density part is finished.

Two intermittent equipment or software problems encountered:

- the first one on the GFA frequency programs, probably due to the false GPPC triggers when it is used in asynchronous trigger mode,
- the second one was an occasional faulty intensity acquisition due to the interrupted software timing. This was improved by stopping the ALARM program.

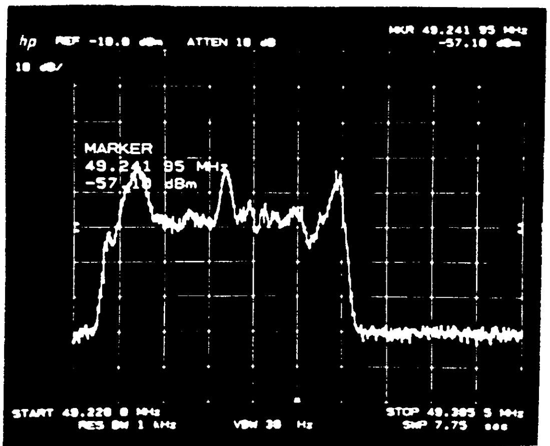
Nevertheless, after many unsuccessful attempts, a few successful unstackings were managed and the intensity variations could be reduced by a slow bucket area feedback loop.

ME3: NEW FILTERS FOR AC COHERENT OSCILLATION
(V. Chohan, D. Williams)

To use good signals from AC pick-ups for $\bar{p}$ coherent oscillations, filters were added and a new program was tried out. However, the signal was too weak and some amplification was needed. This involved some new cabling and will be organised later on.

ME4: AC DAMPERS
(K. Schindl, L. Soby, D. Williams)

The bell-shaped frequency distribution is required to enable the damper phase to be measured correctly. Though we tried to get a test beam, ranging from 1.0 to 5 · 10^{10} p (via the loop) with a bell-shaped longitudinal frequency distribution, we did not succeed. Longitudinal Schottky scan shows an uneven distribution with 2 or 3 peaks (Fig. 4). So, it was impossible to measure the damper phase. Trying with the bunched beam did not help and gave multiple amplitude and phase responses.



$4 \cdot 10^{10}$ p coast in AC

Figure 4

ME5: FAST BEAM BLOW-UP IN AC AND AA
(S. van der Meer)

The fast beam blow-up works by measuring the exact Schottky sideband frequency on the spectrum analyser, with the low frequency resonant pick-up in AA and the non-resonant Schottky pick-up in AC and then, setting the synthetizer to this value, with reduced bandwidth..

The reduced bandwidth appears to be at least 5 kHz for the AA and 25 kHz for the AC because of the strong dependence of Q on amplitude in the AC. If a smaller bandwidth is used for the fast blow-up, only a fraction of the particules is excited, the low amplitude ones remain.

Below a beam intensity of $5 \cdot 10^9$ the fast blow-up is not used because the frequency measurement is not sufficiently precise.

ME6: HORIZONTAL AA ACCEPTANCE
(T. Eriksson, S. Maury)

During the last ME period a horizontal AA aceptance showed a very sharp hole at f = 1851.7 kHz, also reported in PS/AR/ME Note 85. We measured again the same phenomenon. Now, we tried to see if this phenomenon disturbs the accumulation. The hole disappeared when we changed the vertical tune by $+1 \cdot 10^{-3}$. So, for two different values of Q_v (operation and a new one) and for different horizontal emittances we recorded the stacking rate per shot (Table 1).

This horizontal hole in the AA acceptance does not affect the $\bar{p}$ accumulation.

SR/shot	AC $\varepsilon_H=4\pi$ $\varepsilon_V=3\pi$	$\varepsilon_H=7\pi$ $\varepsilon_V=3\pi$ (Band 1 off)	$\varepsilon_H=15\pi$ $\varepsilon_V=3\pi$ (B.1+2 off)	$\varepsilon_H=22\pi$ $\varepsilon_V=3\pi$ (1+2 off, B.3=9dB)
$\Delta Q_v = \pm 0$	56	54.5	37	26
$\Delta Q_v = +1E-3$	57	55	39	26

Table 1

ME7: SEM-GRIDS FOR $\bar{p}$ IN AC/AA TRANSFER LINE
(V. Chohan, C. Dutriat)

Antiproton beam profiles were measured on Sem-grids in AC/AA transfer line with an intensity of $6 \cdot 10^7$ $\bar{p}$ per pulse. Successful profiles were measured (Fig. 5) with a new version of software in the SMACC which removed the noise. All the software will be operational after the shutdown.

What Was Done But Not Scheduled

- Fast beam blow-up in AC and AA.

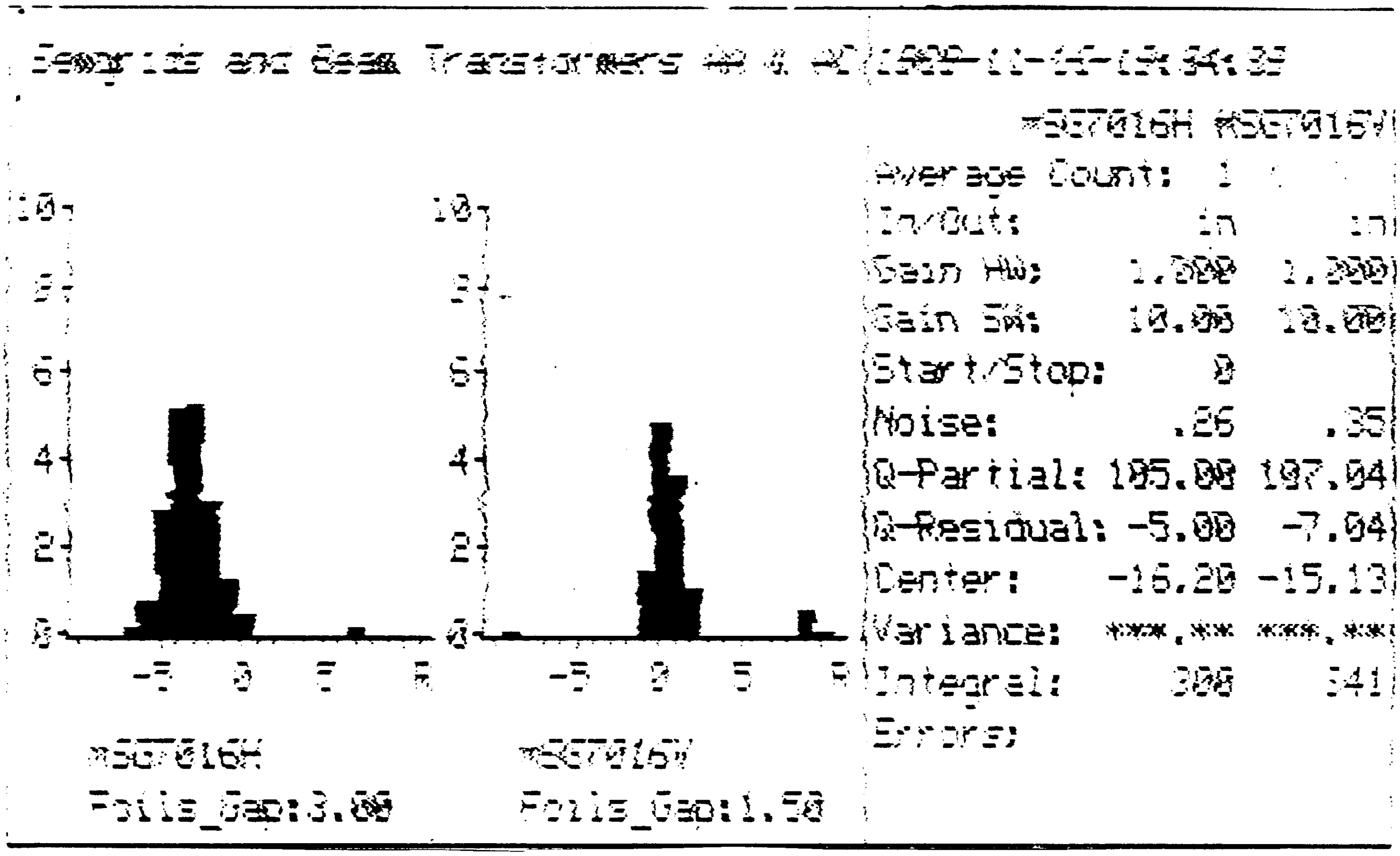


Figure 5

What Was Not Done But Scheduled

- p stack transversally blow-up due to p via the loop.
- rf transverse heating during p stacking.
- PS/AA/AC rf matching.
- Quadrupolar coherent oscillation loop/AA.

Conclusion

It was a 5-day long ME session including a PS MD (30 h) and a setting-up for the p accumulation. After the PS MD it was very long (7 h) before retrieving a good beam through the loop to start AAC-ME. Anyway, antiprotons in the AA were ready to be sent to LEAR on Friday morning, Nov. 17.

S. Maury