EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN - PS DIVISION

PS/AR/Note 94-23 (MD)

AAC

COMPTE RENDU DES MD EFFECTUES DE MARS A JUIN 1994

Editeur
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Geneva, Switzerland
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1. AA & AC STOCHASTIC COOLING SYSTEMS.

Participants: G. Carron, F. Caspers.
Spokesman: F. Caspers

a) Repair and maintenance jobs carried out during the winter shutdown 93/94.

AC:
- all power amplifiers checked and repaired when required;
- all AC stochastic cooling system filters checked and compensated for cable aging effects (compensation in order to increase average notch depth);
- all PU and Kickers mechanics have been greased;
- two broken PU position encoders for dynamic phase compensation repaired;
- variable delay for L2 system repaired;
- all cryogenic electronics for PUs checked (preampli, terminations).

AA:
- SMA connector contact pins checked in 4-8 Ghz PU and in all stochastic cooling kickers;
- all cables and connectors checked on PUs and Kickers;
- during last year nearly all frequency diplexers of the precooling kicker system have been changed or repaired;

b) Jobs carried out during the MD session of weeks 14 to 16 (5 to 22.04.94).

AC:
- the Schottky PU was also checked after having been shielded. The re-calibration did not show a significant change compared to previous data.
- as one source of fluctuations in beam measurement, the FFT analyser has been identified;
- the tendency of the preamplis of the AC Schottky PU to oscillate has been completely suppressed, as a consequence of the proper shielding mentionned above.

AA:
- a problem linked to the beam blow up has been identified. As for hardware, the blow up works correctly, but from time to time a peak search routine in the program locks to an incorrect peak in the spectral distribution of the AA beam.

AA & AC:
- the delay attenuator settings have been carefully evaluated for all systems (BTF measurements, check of reference data, etc..).
- a parasite from the AC band II cooling system propagating into the AA 2-4 Ghz PU has been identified and eliminated by tuning all AC power amplifiers.

2. CENTRE ELECTRIQUE DE LA PICK-UP 4-8 Ghz.

(MD du 16 et 17 avril 94)
Participants: S. Maury, C. Metzger.
Rapporteur: C. Metzger.

Le signal vertical de la pick-up 4-8 Ghz est affecté par un mode commun important qui se compose:

- d'un signal parasitaire provenant de modes microondes se propageant dans le tank,
- du signal de position vertical du faisceau dû au décentrage de la pick-up par rapport à l'axe du faisceau.

Il est difficile d'éliminer les modes microondes sans un travail important sur le tank mais par contre, on peut supprimer le signal de position en centrant les électrodes sur l'axe électrique du faisceau.

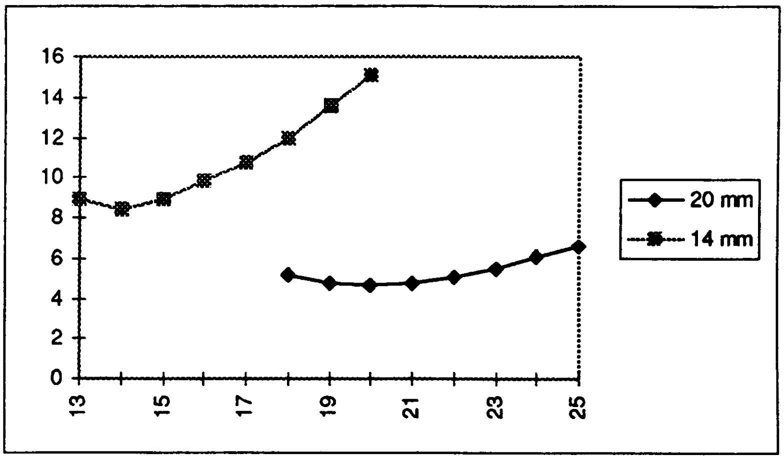
Pour ce faire, l'électrode inférieure a été déconnectée du mécanisme de positionnement et gardée en position fixe en dehors du faisceau. Puis, on a determiné la position de l'axe du faisceau en mesurant l'acceptance pour différentes positions de l'électrode supérieure:

Lecture de la position de l'électrode sup. (mm)	Acceptance sur la fréquence centrale (π mm mrad)	Rayon du faisceau ($\beta_v = 8.5$) (mm)	Différence entre les axes du faisceau et des électrodes (mm)
13	13.5	10.7	+2.3
14	16.3	11.8	+2.2
15	19.1	12.7	+2.3
16	22.6	13.9	+2.1
17	25.0	14.6	-
18	25.6	14.7	-
19	27.6	15.3	-
20	23.3	14.1	-

On a mesuré ainsi:

- une différence de 2.3 mm entre l'axe du faisceau et la lecture de la position des électrodes;
- la demi-ouverture optimum des électrodes, qui est de 14.7 mm (lecture 17 mm) pour l'acceptance actuelle de la machine.

Dans une deuxième phase, l'électrode inférieure a été positionnée manuellement à -14mm de l'axe du faisceau et on a déterminé la position de l'électrode supérieure correspondant au minimun de la puissance du signal à la sortie du TOP vertical. Pour ce minimum l'électrode supérieure est à +14 mm comme l'indique le graphique ci-dessous.



Puissance du signal en mW à la sortie du TOP vertical en fonction de la position en mm de l'électrode supérieure pour deux positions de l'électrode inférieure.

Le centrage des deux électrodes a permis de réduire le mode commun de 2 dB et de rapprocher les électrodes - *demi-ouverture de 14 mm (au lieu de 20 mm précédemment) pour l'acceptance actuelle de la machine* - ce qui a eu pour effet d'augmenter la vitesse de cooling par l'amélioration du rapport signal/bruit.

3. ACCEPTANCES VERTICALES.

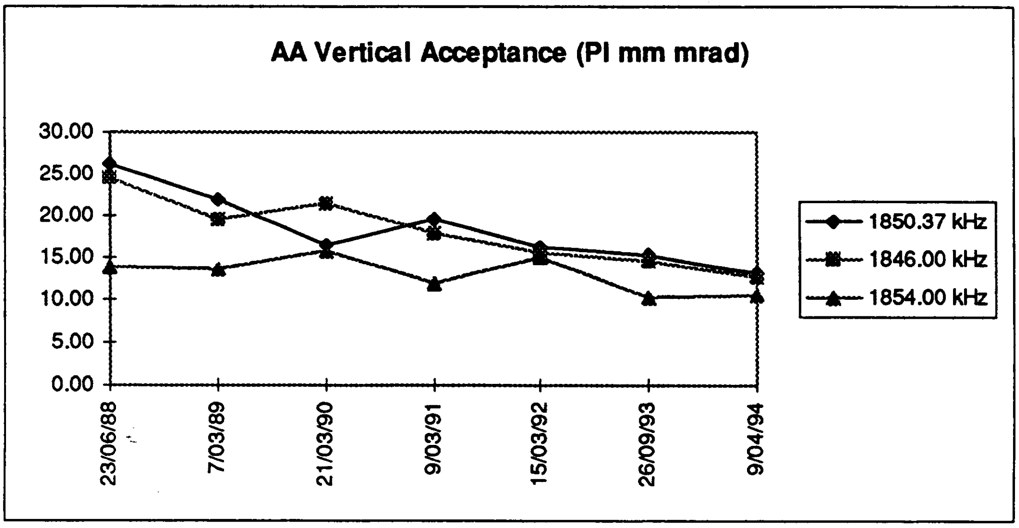
Participants: M. Church (Fermi-Lab), T. Eriksson, M. Martini, J.L. Mary, S. Maury.
Rapporteur: C. Metzger.

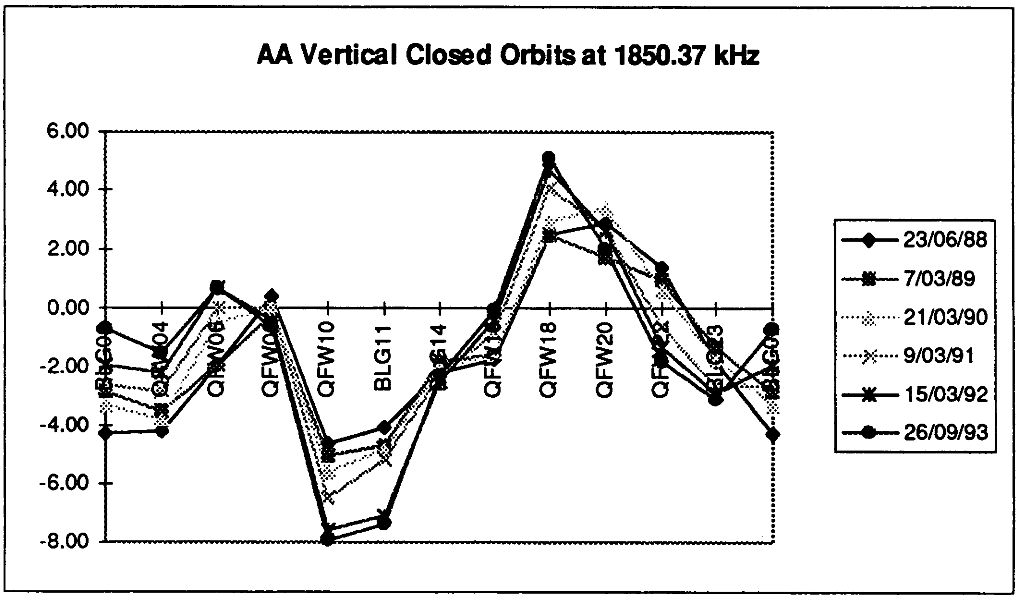
Depuis 1988, un tassement progressif et irrégulier du sol détériore les orbites fermées verticales du collecteur et de l'accumulateur entraînant une réduction des acceptances verticales de ces machines.

a) Accumulateur d'antiprotons:

(MD du 9 avril 94)

Les figures suivantes nous montrent l'évolution des acceptances verticales et de l'orbite fermée à 1850.37 Mhz (orbite centrale) depuis 1988. L'acceptance, pour la fréquence centrale, est tombée de 25.4 à 14.5 π mm mrad tandis que les amplitudes des orbites fermées ont varié de +3 mm dans BLG02 et de -4 mm dans QFW10 et QFW18 durant cette période.





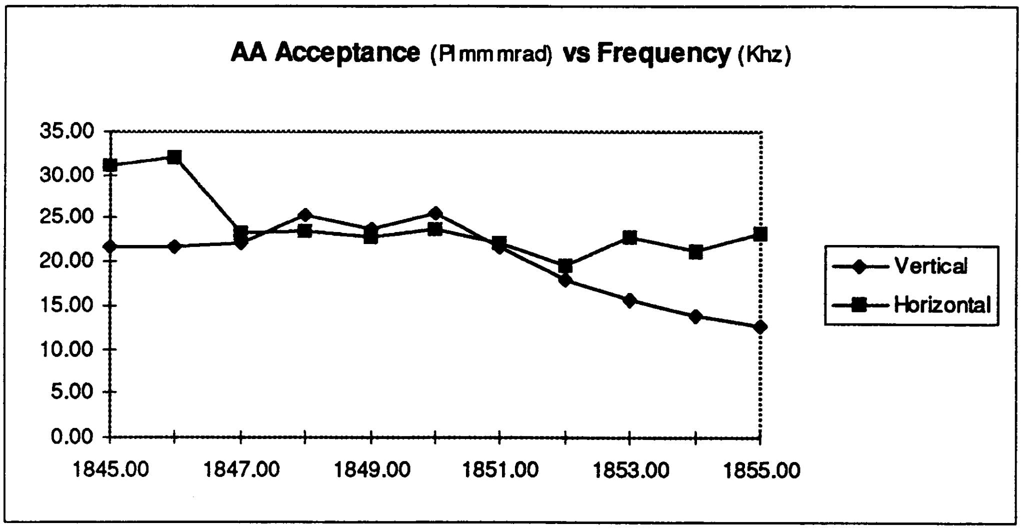
Le contrôle de l'alignement, effectué lors du dernier shut-down, a montré des différences de plusieurs millimètres de la position des éléments par rapport aux références, corroborant ainsi les mesures d'orbites fermées.

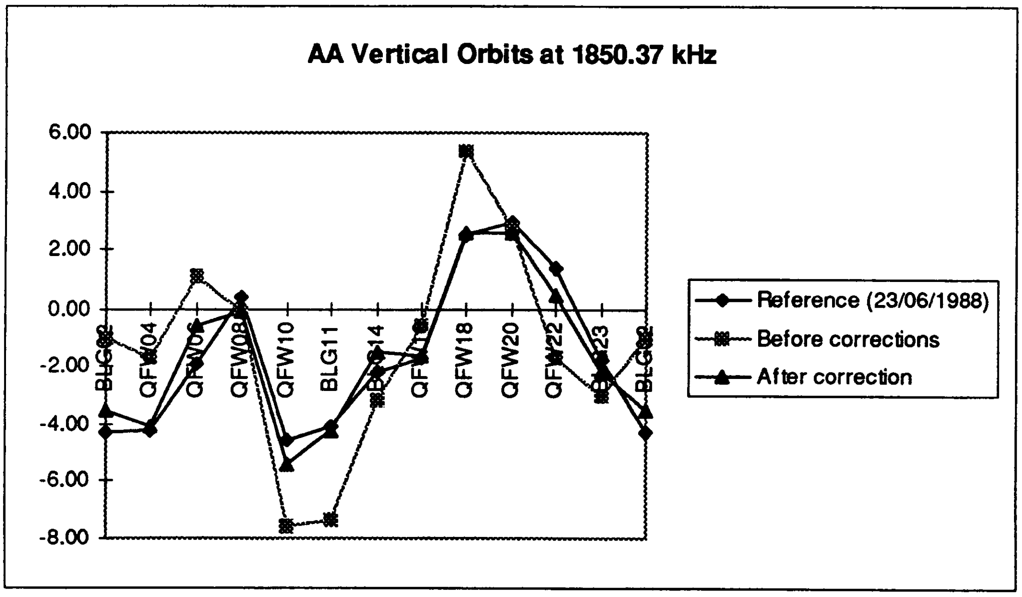
Un réalignement de la machine n'étant pas envisageable pour le moment, un calcul de correction avec le code "Mathematica-Beam Steering" nous a montré qu'il est possible de retrouver l'orbite de référence (23/06/88) en déplaçant verticalement, au moyen des vérins motorisés, quelques éléments seulement.

Elément	Correction de la position verticale (mm)
QDN11	+1.41
QDN05	-2.41
QDN21	-1.69

Les figures suivantes indiquent les effets de ces déplacements soit:

- acceptance verticale supérieure à 20 π mm mrad pour les fréquences inférieures à 1851 kHz;
- une orbite centrale à 1850.37 kHz. proche de l'orbite de référence.





b) Collecteur d'antiprotons:
(MD du 20 avril 94)

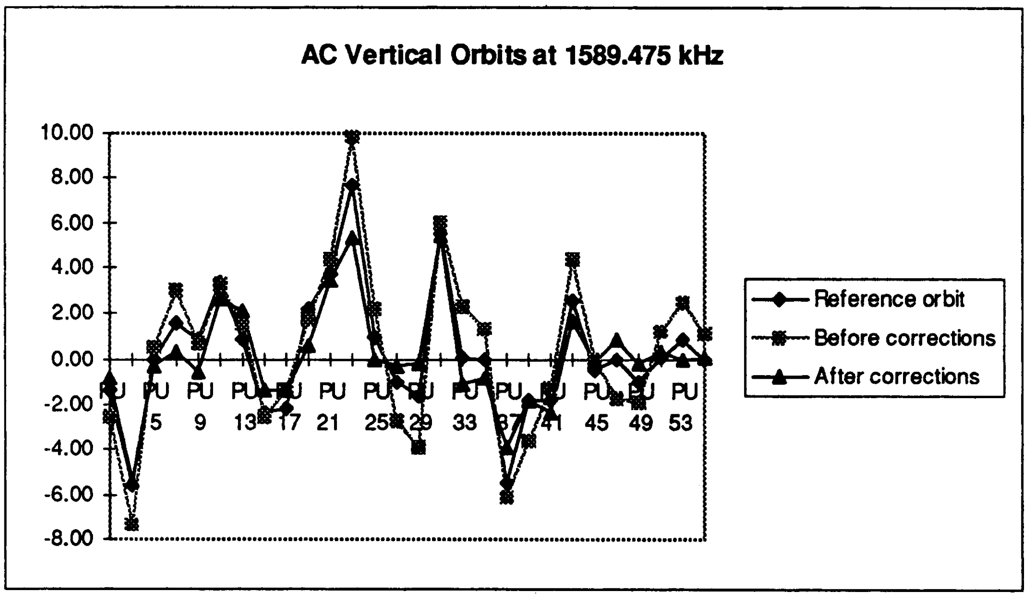
De même que pour l'accumulateur, l'acceptance verticale du collecteur est tombée de 200 à 180 π mm mrad avec les pick-ups et les kickers des systèmes de cooling ouverts au maximum. Les amplitudes de l'orbite fermée se sont, quant à elles, amplifiées par rapport à l'orbite de références du 30 mai 92 et ont atteint des extensions de +10 mm en PU23 et -7 mm en PU03.

Les corrections suivantes également calculées avec le code "Mathematica-Beam steering":

Elément	Correction de la position verticale (mm)
QDN21	-1.754
QDW37	-1.005
QDW09	-0.8858

ont donné une orbite fermée proche de l'orbite de référence et permis de retrouver l'acceptance initiale soit:

Acceptance (π mm mrad)	Ouverture des pick-ups et kickers (π mm mrad)
213	240
196	200



4. CLEARING ELECTRON CURRENT.

(MD session of weeks 14 to 16)
Participants: F. Pedersen, L Soby.
Spokesman: C. Metzger.

The vacuum system for the planned LHC will be at cryogenic temperatures (between 1.9 and 20 °K). At these temperatures gas from leak will condense and thus, due to the "frozen" vacuum pipe conductance, the standard methods for leak detection are any longer useful. As a new means, it has been proposed to collect and to measure the current of the atomic electrons *scattered by the proton beam from the molecules of residual gases; this clearing electron current, which is proportional to the beam intensity and to the pressure of residual gases, could be a good way to detect a local increase of gas density.*

These measurements are the continuation of previous experiments aiming at a better understanding of the electron clearing process. In prevision of this MD the hardware of the vacuum control has been checked and improved during the last shut-down. The measurements were carried out in two segments including respectively the sections 4 to 10 and sections 14 to 23 of the AA machine set in reverse polarity with protons beams of different intensities up to 6.10^{11} particles. The particles were injected in a direct way, target and Li-Lens out in order to avoid energy dispersion and the AC injection frequency was set to 1589.38 kHz (nominal value without target and Li-Lens).

During the measurements, it was noticed that the two ionic pumps VPI2204 and VPI2210 were producing parasitic currents and consequently they were switched off. The mean result of this session is that, for each segment, the total collected current is quasi independent of the number and of the position of the collecting electrodes. The two electrodes VEC1710 and VEC2010 have an unexplained lower collecting efficiency than the other ones. The whole results will be published in a future note.

5. BUNCHED BEAM STOCHASTIC COOLING.

(parasite MDs during normal operation)
Participants: F. Caspers, S. Maury, C. Metzger, D. Mohl.
Spokesman: F. Caspers.

Several bunched beam stochastic cooling experiment have been carried out on the Antiproton Collector. The purpose is to gain experience on the distribution of coherent signals in the bunch spectrum at high frequencies. In previous bunched beam cooling experiment on LEAR it has been observed that the amplitude of the coherent signals for short bunches decays much slower towards higher frequencies than to be expected from a the Fourier transform of a Gaussian shaped bunch. This observation has been reconfirmed in the course of the AC test mentioned above. The experiments were carried out with antiproton beams of about 5.10^{7} particles and rf bucket sizes (h=1) between 1 and 15 eVs and $\delta p/p$ values between less than 0.1% and 3 %. The time structure of the bunch was observed by means of a fast scope connected via a 30 dB preamplifier to the AC longitudinal beam PUs. Spectral distributions have been monitored using the AC Schottky PU and also the stochastic cooling bands (1-3 Ghz). For bunch length of about 50 ns in a 12 eVs bucket strong longitudinal coherent signals have been observed up to 3 Ghz (limited by the PU). Also the cooling process itself (on the bunched beam) could very well be observed both in the time and frequency domain. Furthermore a tendency to produce very fast longitudinal blows-ups on cold bunch beams was noted with a subsequent turbulence like behaviour extending over several minutes. Leaving the longitudinal cooling systems on, has a stabilizing effect with respect to the above mentioned instabilities (comparable to longitudinal damper). Also bunched beam cooling in the tranverse plane has been tested. Future experiments in this context are aimed to further investigate the coherent signal distribution beyond 1 Ghz in the time domain.

6. AA CONTINUOUS EMITTANCE SURVEY

Spokesman: F. Caspers

As it was found by the operational experience during the years 92 and 93 the old spectrum analyser (Type HP...) for AA emittance monitoring showed problems in terms of frequency stability. Subsequent investigations gave the result, that part of this stability problems were due to incorrect settings (tuning stabilizer not on) but later it was found repeatedly that even with correct settings substantial frequency drifts occurred which caused meaningless readings on the emittance display. Attempts to fix the problem by internal reajustements in an repair laboratory (done by G. Carron) did not give satisfactory results. In consequency two new, synthesizer based, remotely programmable relatively cheap(13 KSFr/each) spectrum analysers (Type FIR..) were bought as replacements. In order to be compatible with the data acquisition system connected to the video outputs an analog adapter box for level and offset correction has been built and installed. During summer 94 the AA emittance monitoring was done using one old spectrum analyser and one of the new units in order to compare their performance. As a results the new unit was found to fulfil all the requirements in terms of amplitude and frequency stability and it is foreseen to replace the second old spectrum analyser soon.

AAC-MD Minute
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N.	Gaillard	PS/DI
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