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ISR-MA/LR/rh 7th April 1971

ISR RUNNING-IN

Run 45 - 5 April 1971 - part time from 20.15 to 24.00 h

15 GeV/c, 20 bunches, Q-jumps, both rings

Lifetime observations on stacks in Ring 2

At 20.15 h, a 2.5 A stack was made in Ring 2 at the working line "straightened FATA, 1.5, 1" (Fig. 1), with vertical bumps at I_2, I_4, I_5 and I_6, as set for maximum luminosity during run 44 (all current settings are in file RS15, R2). During stacking the dump was at +6 mm. Meanwhile a ~ 3 A beam was circulating in Ring 1.

During the first two minutes after stacking, the beam decayed only from 2.4526 to 2.4517 A (i.e. at a rate of $2 \cdot 10^{-4}$ min^{-1} (plateau)), but then decay became much faster, reaching 1.1 % min^{-1} after 7 minutes. Withdrawing the dump halved the decay rate for a minute, but soon it went up again to the same value. A substantial improvement in decay rate was obtained after thorough scraping from inside as far as centreline (with dump up again at +6 mm, and then withdrawn).

At the level of 1.79 A, the average decay rate from 20.58 h to 21.23 h was then $3 \cdot 10^{-4}$ min^{-1}. During this time, there was a stack of about 3 A in Ring 1.

An increase in decay rate to $2 \cdot 10^{-3}$ min^{-1} was observed while a stack was being made in Ring 1 (21.23 to 21.26 h), but the decay slowed down again after the stacking operation, while the stack was circulating in Ring 1 (21.26 to 21.29 h).

Two sudden losses of about 1 % each were observed at 22.08 h, in exact correspondence with the occurrence of the large losses in Ring 1 which limited the maximum current to 4.35 A during stacking operation (Fig. 2).

Other small sudden losses occurred later, which are difficult to correlate exactly to events in Ring 1. Between 22.10 and 23.10 h the total loss was 4.5 % corresponding to an average of $7 \cdot 10^{-4}$ min^{-1}, but during this time there were several periods with losses smaller than $3 \cdot 10^{-4}$ min^{-1}.

The beam of 1.589 A was dumped at 23.17 h.

Stacking in Ring 1 with large sextupole fields

During run 42, two working lines had been studied which permitted to have $\frac{\partial Q_{V,H}}{\partial p/p} \geq 3$, without crossing too strong resonances in the stacking region. These lines were intended to avoid instabilities in high-intensity stacks (see running-in report ISR-MA/JPG/rh of 5th April 1971).

A stack at line B, 3.5, 3, was made at the beginning of run 43, before PS breakdown, and survived the whole night, but with continuous losses.

During run 45, line A, 3.5, 3, was set up. The following values of Q were measured to check its position:

at injection	Q_H	= .791	Q_V	= .727
at centreline	Q_H	= .847	Q_V	= .797
at +35 mm	Q_H	= .914	Q_V	= .850

(The values at +35 mm should be used to correct the values at the corresponding point in run 42 diagram, where the measurements had been uncertain).

A stack of 4.35 A could be made, stacking at the bottom, with V_F = 1.6 kV (Fig. 2). Further increase of the current was prevented by the onset of a very fast decay, which continued after stacking was stopped. In 2 minutes the current was down to 2 A, at which level it was still decaying at the rate of 10 % min^{-1}.

An RF scan at 1.6 A level showed considerable loss at the top of the stack and many notches (Fig. 3).

The next stack was stopped at 3 A and had a rather slow initial decay ($3 \cdot 10^{-3}$ min^{-1}) which, however, tended to increase after a few minutes. It was scanned with RF at 2.8 A level.

In order to study the decay under well defined conditions, a third stack was made with the dump at -6 mm. This stack (Fig. 4) reached 3 A in 47 pulses (freq. change 15 Hz/pulse corresponding to $\Delta r \simeq 0.3$ mm). The inflector was immediately withdrawn, with the shutter in central position, then the stack was scraped from inside as far as the centreline, and at last the dump was withdrawn: this whole operation took 3 minutes. In the following 3 minutes the decay rate was 10^{-3} min^{-1}, but afterwards it increased progressively to a maximum of almost 1 % min^{-1}.

For comparison, a 3 A stack was then made at the working line "straightened FATA, 1.5, 1" with closed orbit corrections and vertical bumps, which had been set up during run 44 and had proved satisfactory from the point of view of losses from 4-bunch stacks during luminosity measurements. The handling of scrapers and dumps was exactly as for the previous 3 A stack, and the initial decay after scraping was not so slow ($\sim 2 \cdot 10^{-3}$ min^{-1}), but the following maximum stayed within 0.5 % min^{-1} (Fig. 5).

The conclusions from this part of the run seem to be:

1) Even with large $\frac{dQ}{dp/p}$, the maximum current is not limited by saturation, but by a mechanism which produces a very large loss rate. The large loss rate then persists during the decay at currents where the loss rate would be 10 to 100 times smaller, if the stacking process were stopped at their level.

2) When stacking at moderate currents, the phenomenon of the "initial plateau" appears also in the presence of some (weak) resonances in the stack, but the overall decay situation is more favourable if the stack sits in a "clean" region.

Stacks for colliding beam experiments

During the last hour, stacks for physics experiments were prepared in both rings at the working lines "straightened FATA, 1.5,1" with corrections and bumps for maximum luminosity, as contained in file RS15.

After the sudden and quite unexpected collapse of a 2.9 A stack in Ring 2, which had been most beautifully made, it was decided to limit the stacked current to 2.4 A.

Despite the systematic and careful scraping procedure, which reduced the currents to about 2.2 A, the loss during the first hour was about 12 % (average rate $2 \cdot 10^{-3}$ min^{-1}) but the beams seemed to clean themselves and in subsequent hours the average loss rates diminished and a minimum of $3 \cdot 10^{-4}$ min^{-1} was reached. Such a self-cleaning had not occurred during run 43', where the stacks had been made at working lines which had not been especially selected for colliding beam experiments.

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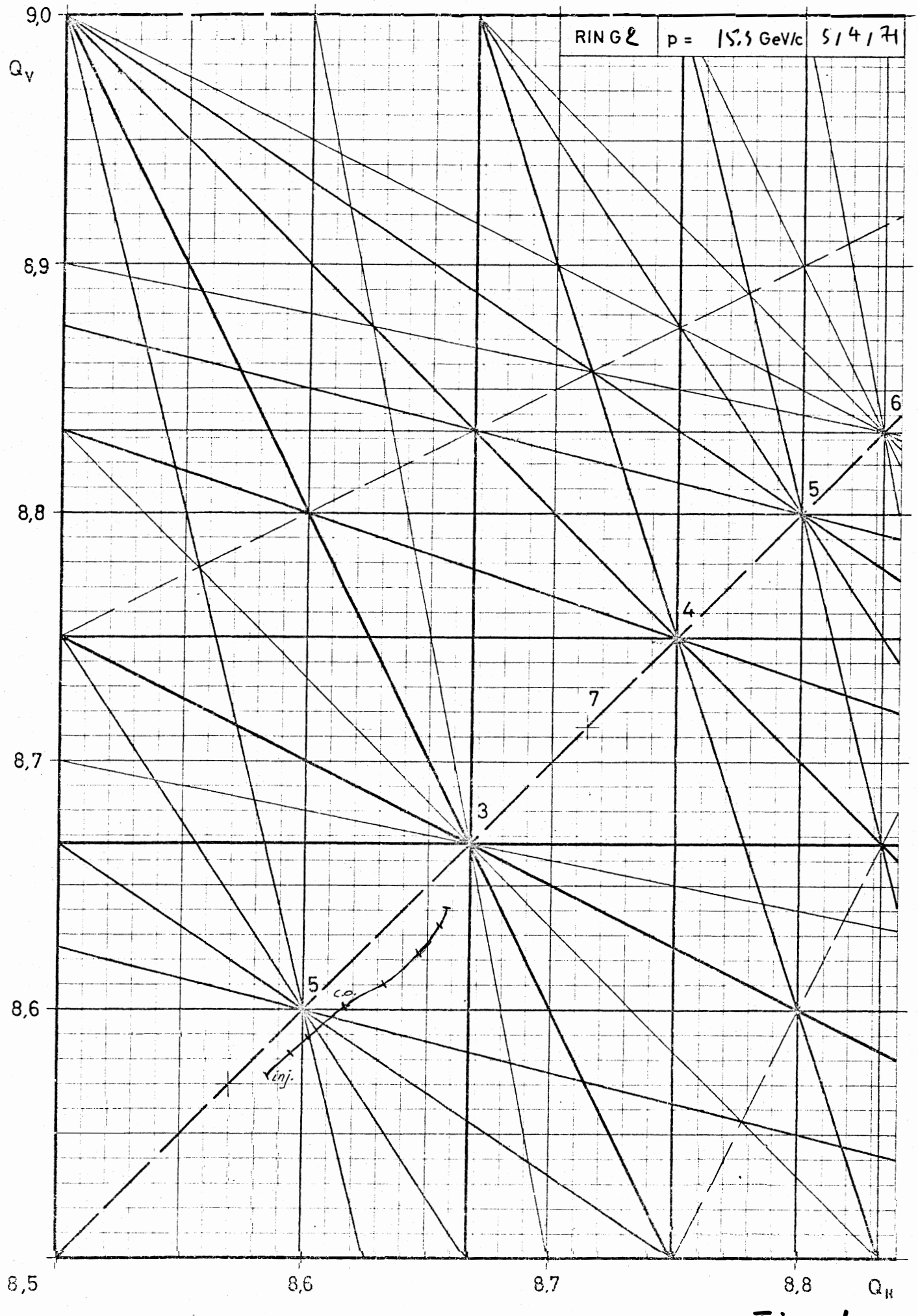


straightened FATA 1.5, 1

Fig. 1

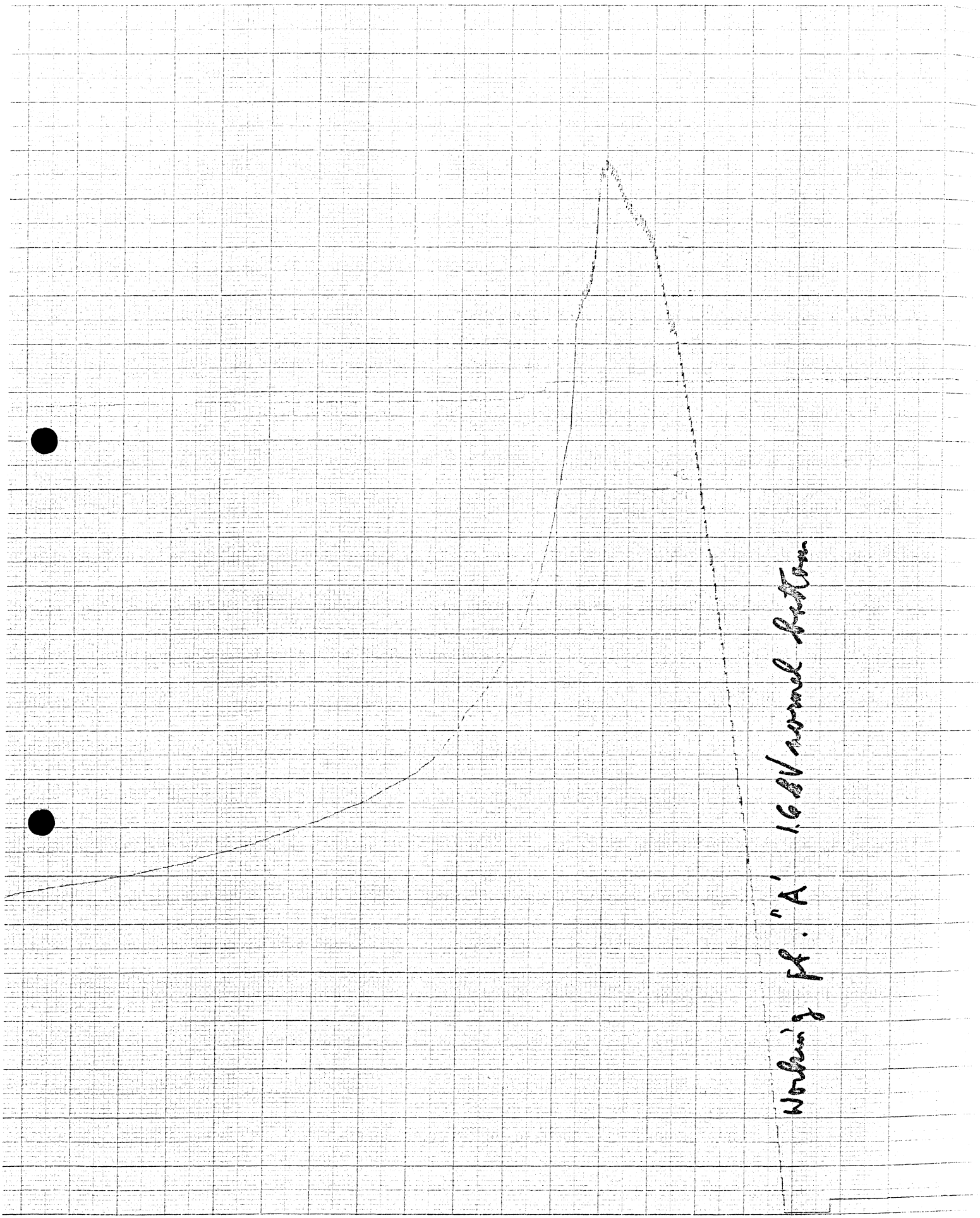


Fig. 2

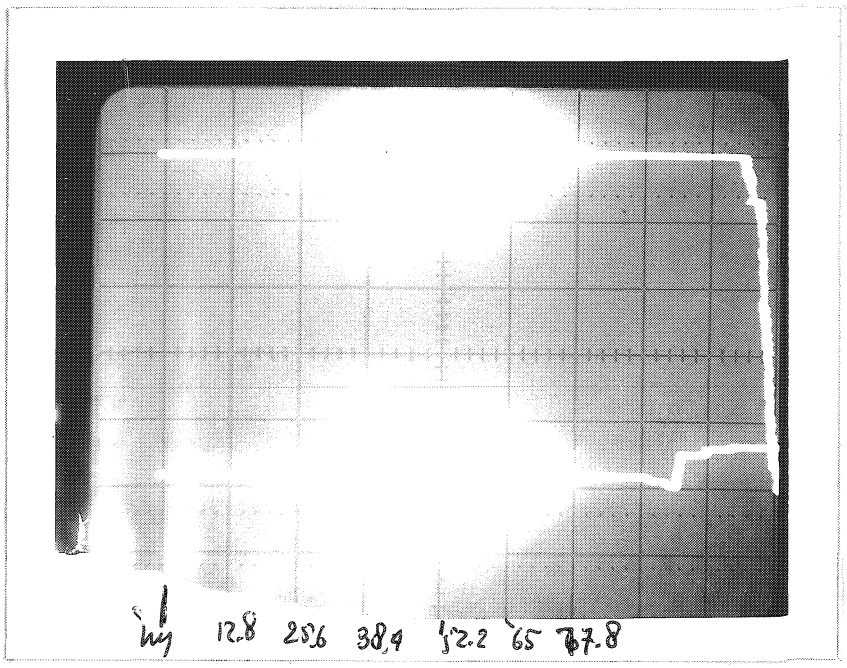


FIG. 3

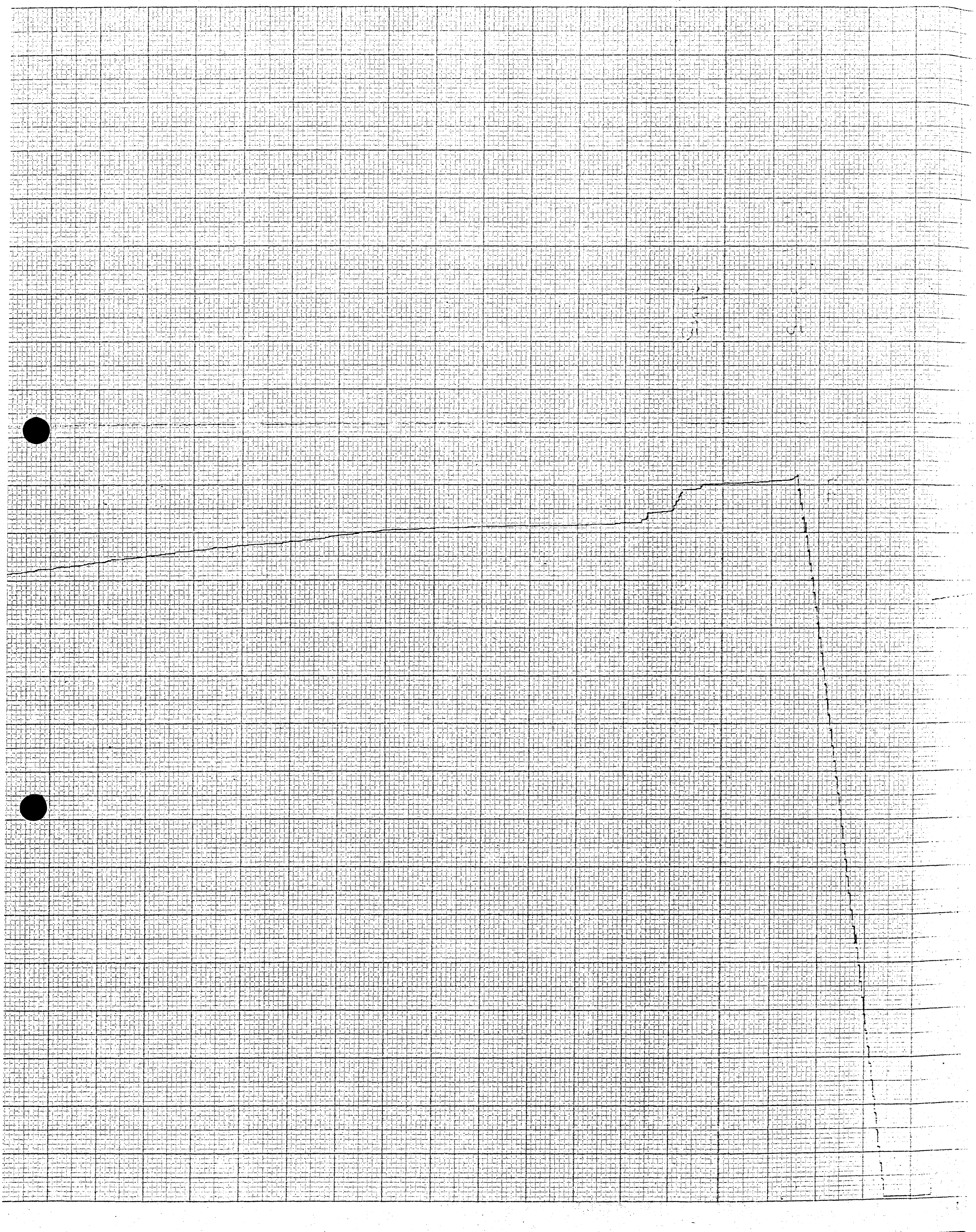
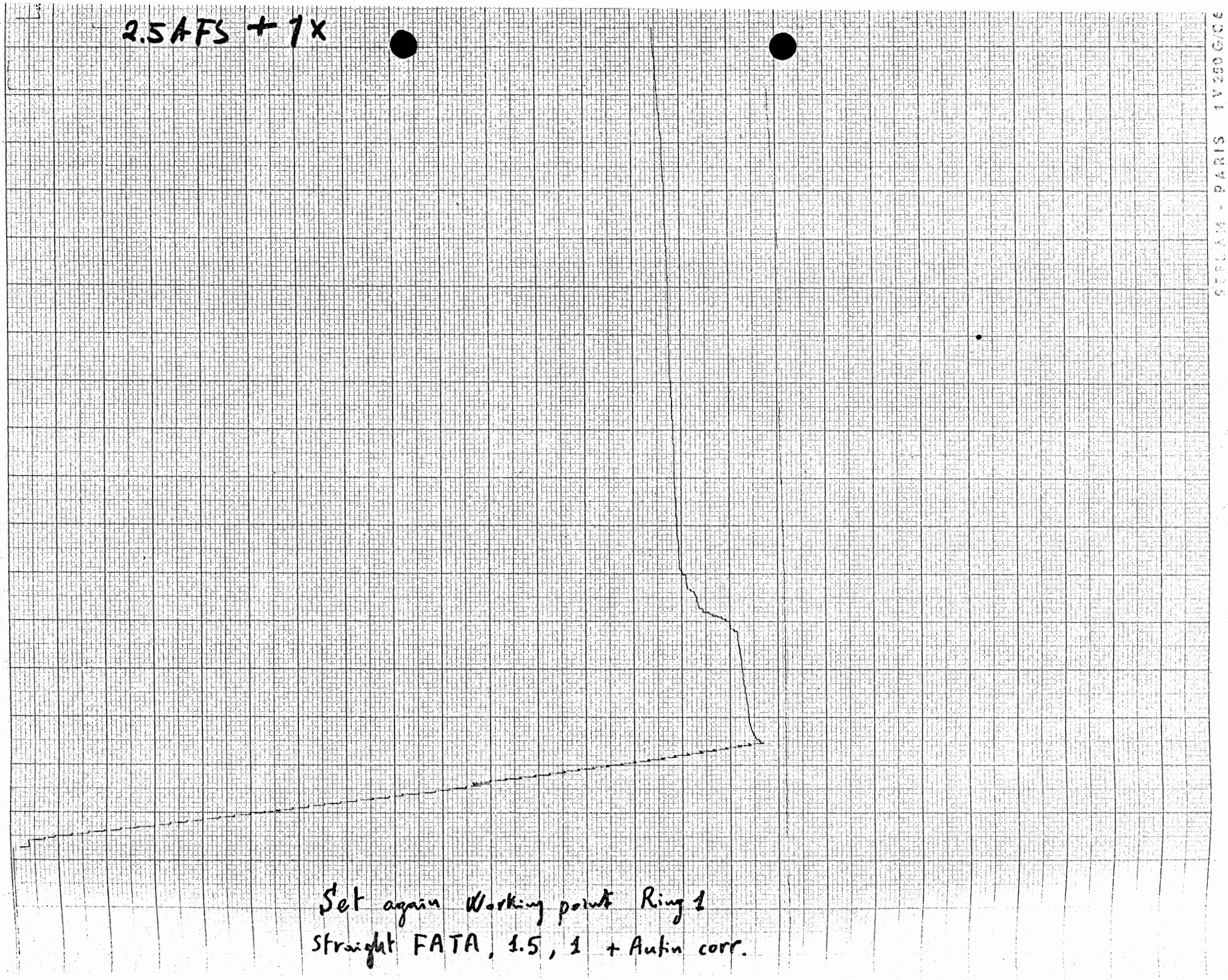


Fig. 4

2.5 AFS + 1 X



Set again Working point Ring 1
Straight FATA, 1.5, 1 + Autin corr.

Fig. 5