E-6

ISR-VA/OG/sm 24th April 1975

ISR PERFORMANCE REPORT

Clearing, Pressure Bump, Beam Behaviour

Run 590, 7.4.75, R1 + R2, 26 GeV/c

Summary

Clearing was switched off in Octant 3 of ring 1. The beam currents were 20 A x 20 A. The effective height grew faster than with clearing on. Decay rate and background increased. e-p activity on the initial stacks was small but increased after switching off the clearing system of octant 3.

A subsequent local neutralisation in ring 2 which was further enhanced by injecting nitrogen up to 1 x 10^{-9} torr caused a high decay rate and background. Violent e-p instabilities could be observed as a consequence of this pressure bump.

Conclusion : external clearing is necessary at 20 A.

1. Clearing experiment

Two old physics stacks, which had been used for collimation studies, were observed for 40 minutes to find h_{eff} and the decay rate. Then the clearing electrodes in octant 3 were set to -6/-3 kV to stop external clearing. The beams were observed for two hours. Clearing was switched on again and an observation period of 20 minutes followed after a beam cleaning.

Fig. 1 shows $h_{eff}(t)$. It grows much faster when clearing is off. Table 1 gives the growth rates including the one measured in run 589 P with the same beam.

Table 1, growth of h_{eff}

$\frac{d\,h_{eff}}{h_{eff}\,dt}$	period	clearing
0.005 h^{-1}	preceding physics run (589 P)	on
0.013 ± 0.008 h^{-1}	first observation period (fit)	on
0.090 h^{-1}	clearing off in octant 8 (R1)	off
-0.008 ± 0.02 h^{-1}	second observation period (fit)	on

Taking into account that only the uncleared beam grew, one finds that this growth is 20 to 40 times larger than the growth with clearing on, which is in agreement with intra-beam scattering.

Fig. 2 shows the decay rate. It increased by a factor of 5 in ring 1 when clearing was off. Fig. 3 gives the background in I2 and I4. The former did not change much. However, the latter increased by a factor of 10. A beam cleaning was tried in ring 1 when clearing was off. Only the background in I2 (R1) decreased. The loss rate was back to the level it had been before within 5 minutes. The e-p activity in beam 1 was initially very low. At the start only 2 lines at low frequency (26 and 15 MHz) could be observed, see figures 4 and 5. These two lines appeared to remain unaffected by the neutralisation in octant 3 of ring 1. As a consequence of switching off the clearing in octant 3 an e-p line appeared at about 95 MHz (see figure 6) which was pulsing with a repetition rate of about 0.8 s. The line persisted after the normal clearing situation was reestablished in octant 3; its rate of pulsing decreased however.

After the second observation period nitrogen was injected in SS 616 at the OBP. The clearing electrodes in the neighbourhood at the OBP were switched off to simulate a local region of high neutralisation as it can be produced by a leak. Since beam 1 was already higher than beam 2 an effect on the beam height was not observable. The decay rate and the background of ring 2 increased by about a factor of 3. Initially only a single line at about 80 MHz could be seen on beam 2; however, the e-p activity increased dramatically during the gas injection. This is shown in figure 9 on a group of lines around 75 MHz. Figure 10 gives a typical example of a single instability recorded in time domain (10 ms/div).

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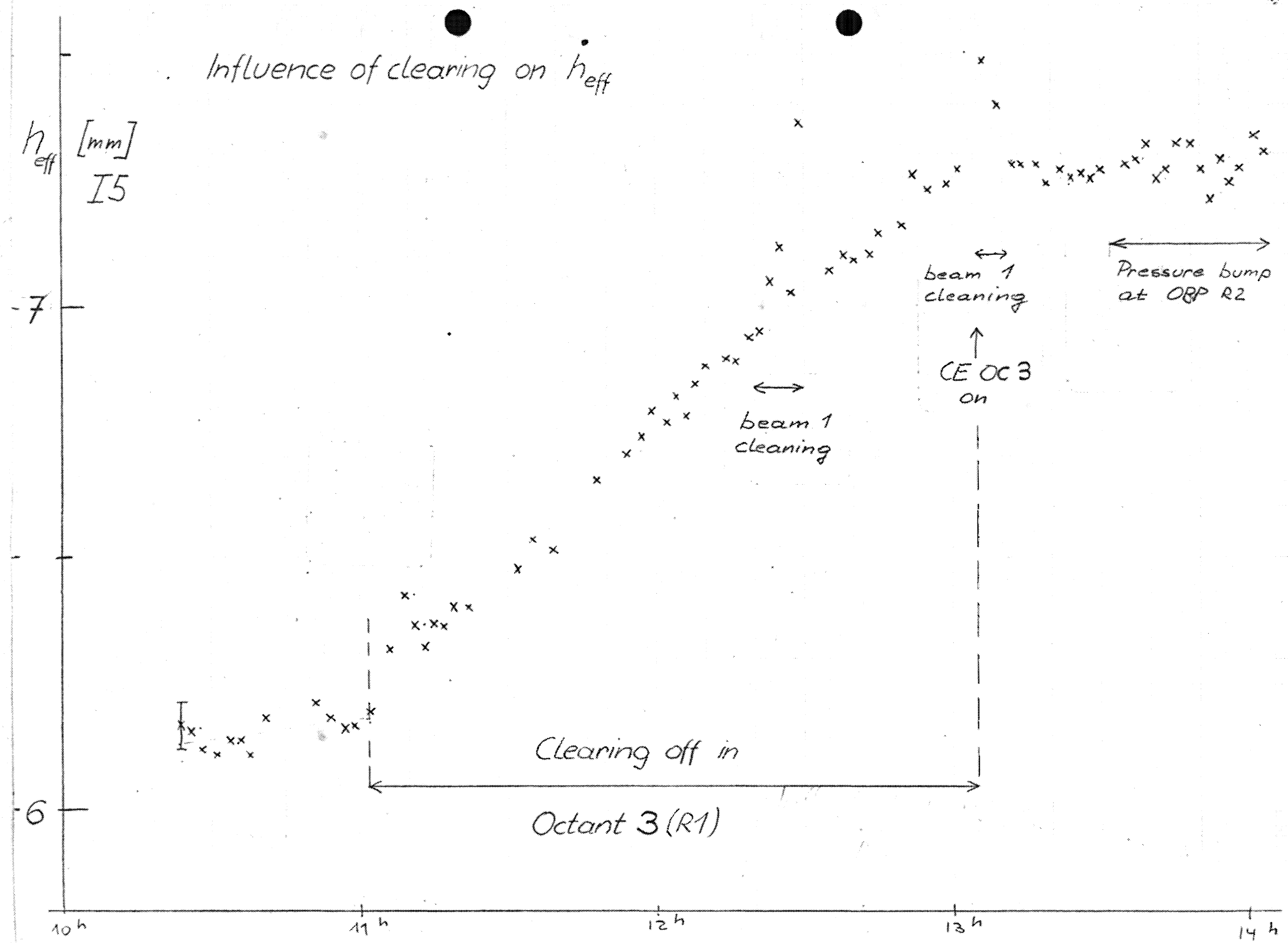
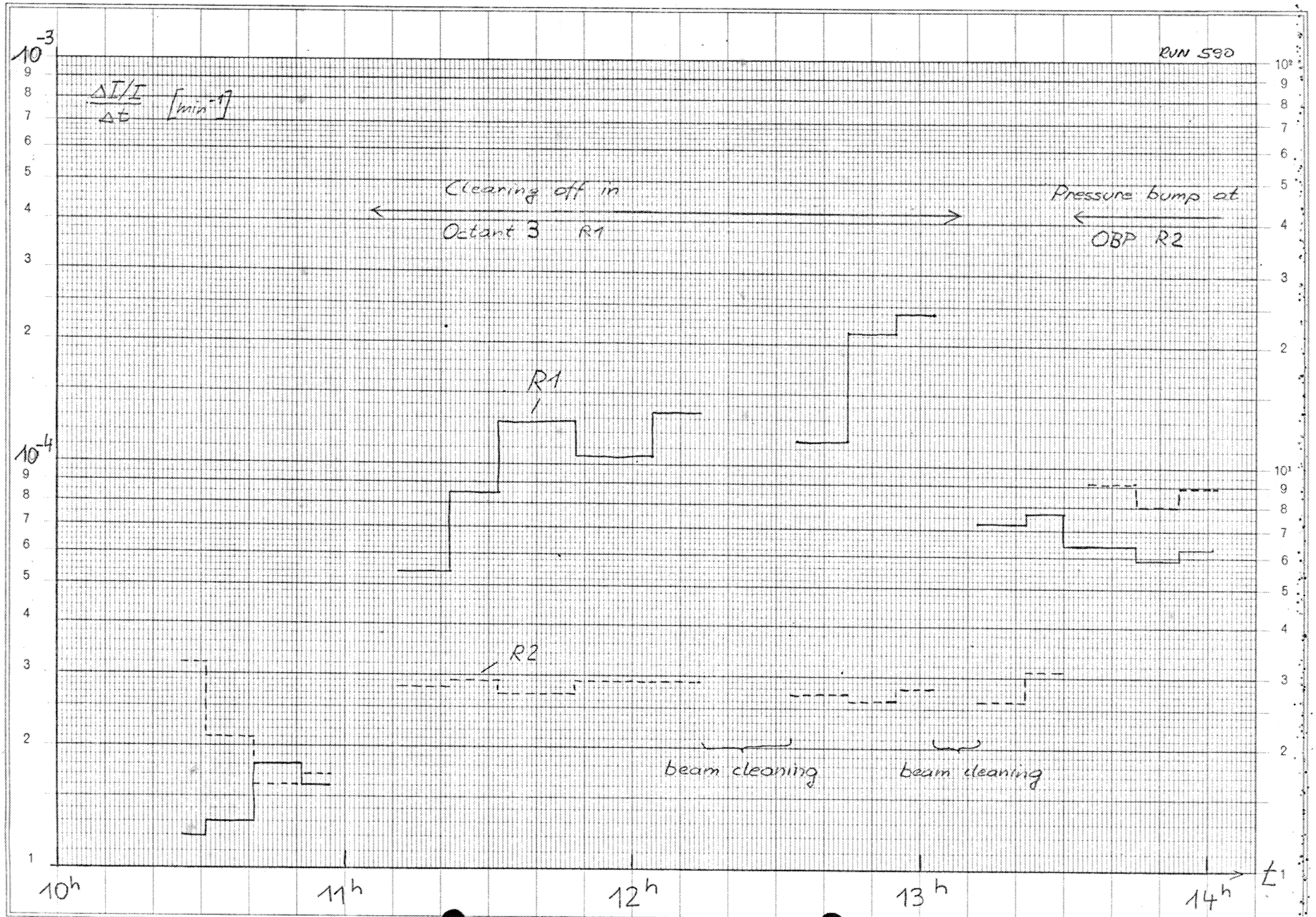


Influence of clearing on h_{eff}
h_{eff} [mm]
I5
-7
-6
10 h
11 h
12 h
13 h
14 h
beam 1 cleaning
beam 1 cleaning
CE Oc 3 on
Pressure bump at OBP R2
Clearing off in
Octant 3 (R1)

Fig. 1



Logar. Teilung / Division } 1-100, Einheit / Unité } 83,33 mm

Fig. 2

Ed. Aerni-Leuch, Bern Nr. 527

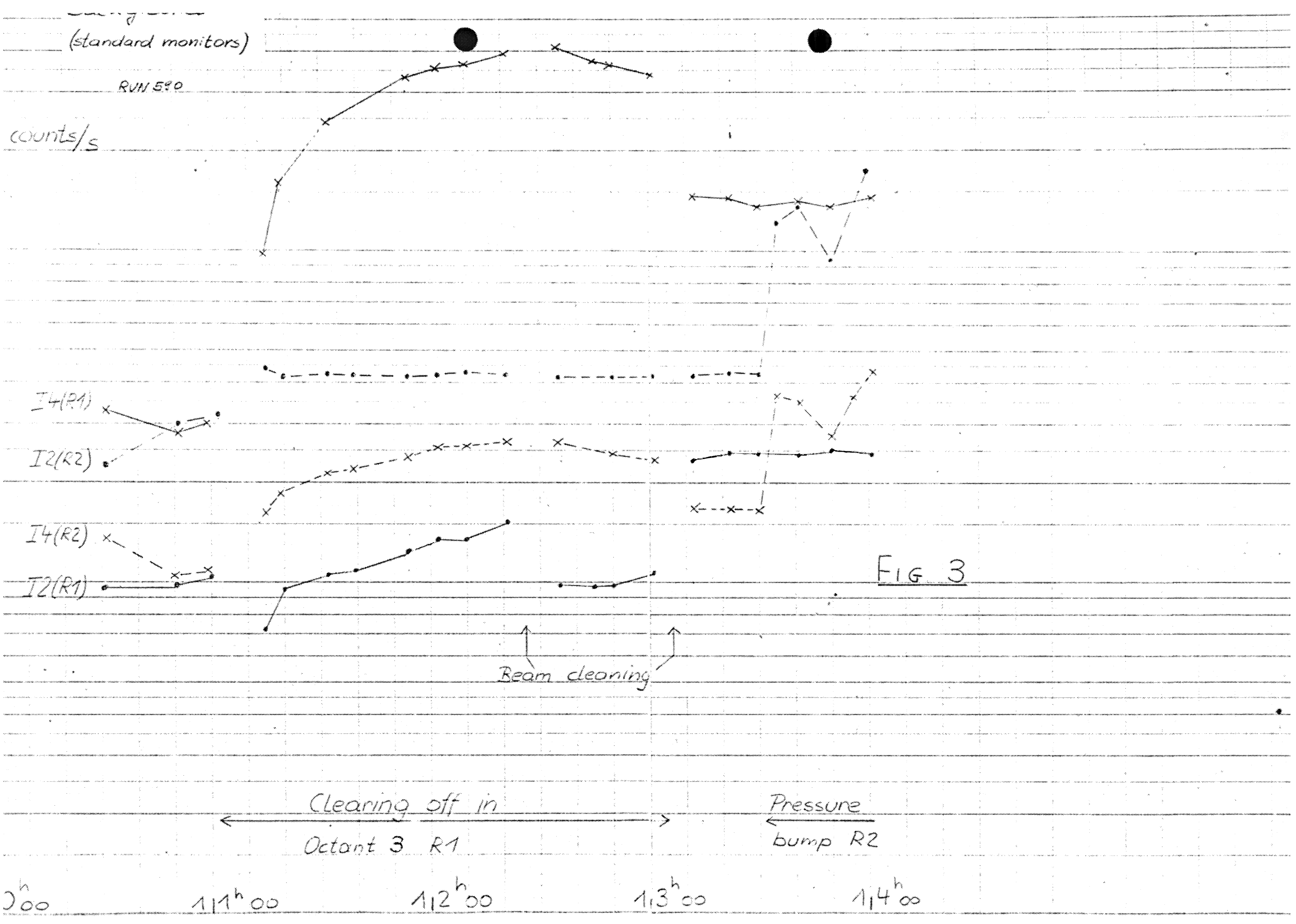

(standard monitors)
RUN 5°0
counts/s
I4(R1)
I2(R2)
I4(R2)
I2(R1)
Beam cleaning
Clearing off in
Octant 3 R1
Pressure
bump R2
11h00
12h00
13h00
14h00

FIG 3

Ring 1 - lines

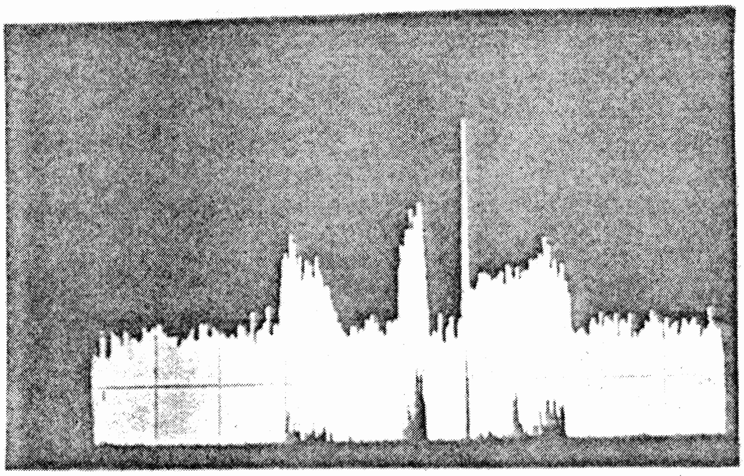


Figure 4

line at 26.07968 MHz
I = 19.88 A
20 kHz/div, 0.3 kHz BW

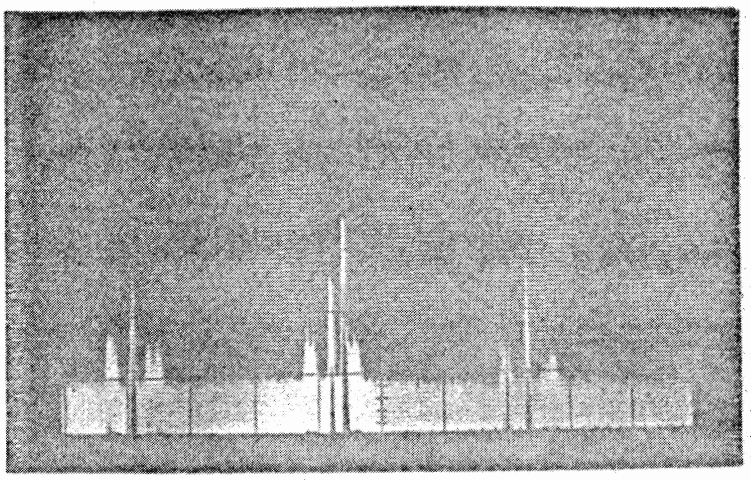


Figure 5

line at 15.27863 MHz
I = 19.99 A
100 kHz/div, 3 kHz BW

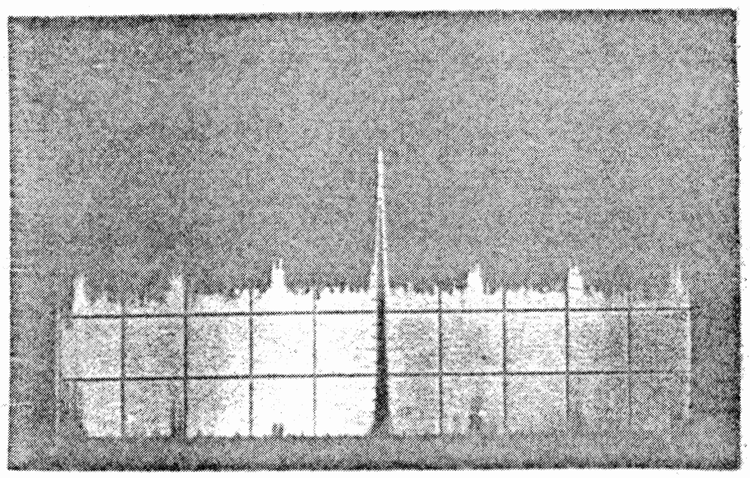


Figure 6

line at about 95 MHz which appeared after neutralising octant 3, but remains when clearing is switched on again.

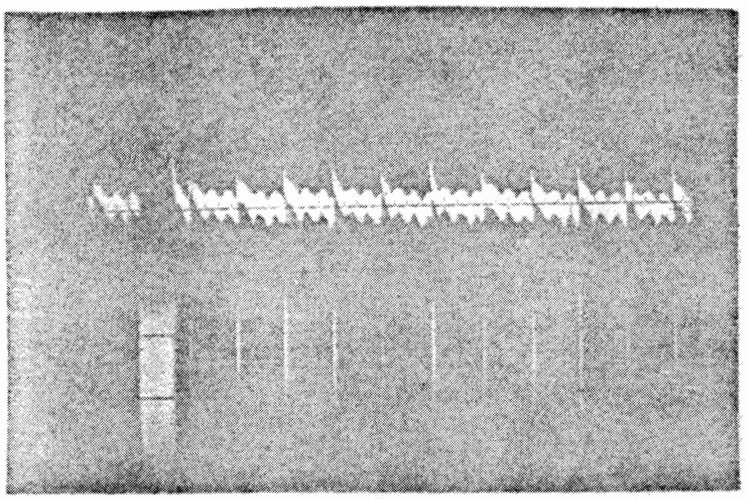


Figure 7

same line at 95 MHz pulsing with rep. rate of about 0.8 sec. Rate of pulsing becomes less frequent when clearing of octant 3 is switched on again.

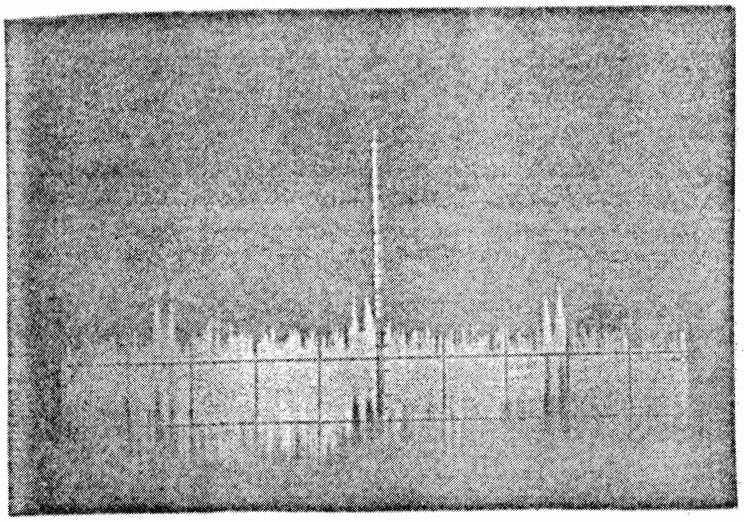


Figure 8

line at about 80 MHz
I = 20.7 A

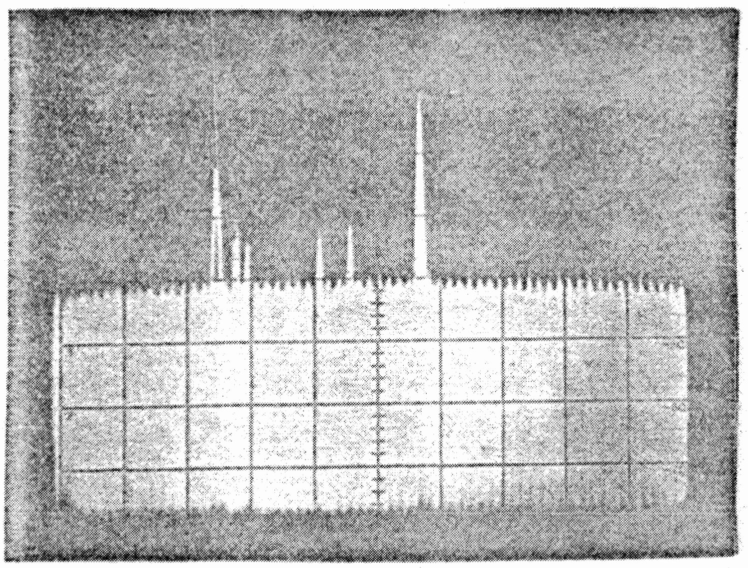


Figure 9

family of lines appearing during nitrogen injection in 616.
Centre frequency 75 MHz, 2 MHz/div.

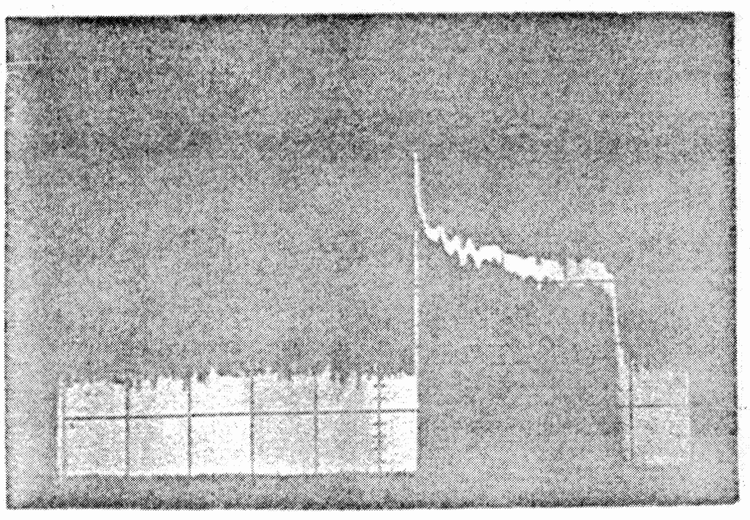


Figure 10

time behaviour of e-p instability during nitrogen injection in 616,
time scale 10 ms/div.