ISR-TH/KH/1s 4th April, 1972

ISR PERFORMANCE REPORT

Observation of Microwave Signals

Run 151' P, 20 bunches, 22 GeV/c, Ring 2, 24.3.1972
Run 152 P, 20 bunches, 26 GeV/c, Ring 2, 28.3.1972
Run 154 P, 20 bunches, 15 GeV/c, Ring 1, 30.3.1972

Summary

Microwave signals picked up from the stack are harmonics of the revolution frequency. Plotting the amplitude of the signals versus frequency yields a pattern which is very similar to the normal RF scan.

1. Are the observed signals harmonics of the revolution frequency ?

The frequency analyser was fed with a signal picked up by a loop from the beam in Ring 2 and a signal from a comb generator which generated higher harmonics of a frequency f_b obtained from a frequency synthesiser of high stability. The frequency stability was checked with a counter and found to be better than $5 \cdot 10^{-7}$ per minute. The absolute frequency was also read from the counter.

The frequency f_b was chosen such that it corresponded to an orbit close to the stack; the limited number of decades of the frequency synthesiser did not permit the choice of a frequency corresponding to an orbit in the stack. The output of the frequency analyser was sampled many times by the hp correlator used in signal recovery mode in order to improve the signal to noise ratio. Fig. 1 a,b,c shows the "Microwave scan" of a stack together with a single frequency corresponding to an orbit of - 32 mm average radius. The position of the stack in the vacuum chamber can be estimated from the first and last stacking orbit (+ 23 mm, - 6 mm). One can see from the figure that the stack has the correct position relative to the marker for all three frequencies. (In Fig. 1 b,c the stack pertaining to the marker sits on the right, only its low energy tail is visible. The stack in the middle is the "scan" of the next higher harmonic number.)

At 26 GeV/c two different frequencies f_b corresponding to different orbits (- 32 mm, + 32 mm) were used. At 22 GeV/c only one frequency was used corresponding to - 10 mm but 2 stacks with different position in the chamber were available for the measurement.

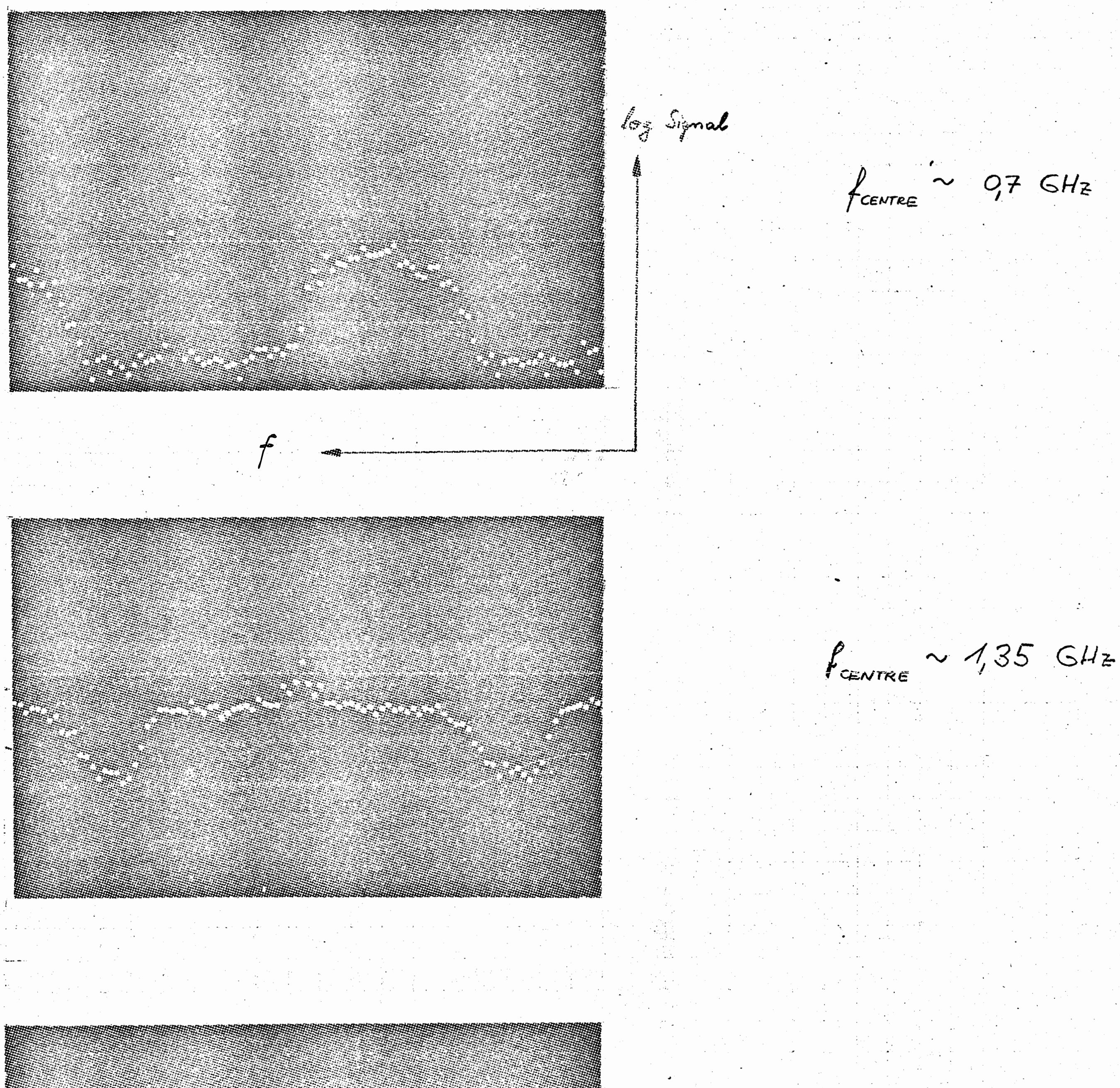
In all the four cases no sign of a frequency shift by a fractional part of the revolution frequency was found. This is an argument in favour of the longitudinal nature of the instability.

2. Comparison between the "Microwave scan" and the RF scan

If the microwave scan is due to many small buckets moving swiftly through the whole stack, the two scans should agree. They seem to agree both in shape and in width as shown in Fig. 2 for 26 GeV/c. At 15 GeV/c the low energy flank agrees but the high energy flank is somewhat different as shown in Fig. 3. The width of the two scans agrees within about 5 %.

The harmonics of the stacking and scanning RF can be seen in the microwave region. They appear as a single line moving on top of the stack which is made visible by the microwave instability. Their amplitude is higher than the microwave instability.

P. Bramham K. Hübner W. Schnell



50 KHz / Div
5 KHz / bin
3 KHz Bandwidth

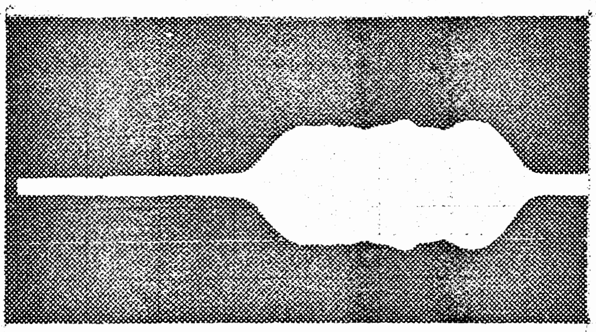
I_2 = 5,2 A

2000 Samples

Fig. 1

The "Microwave scan" of one end the same stack at different frequencies. The single line corresponds to a frequency pertaining to ~32 mm average radius.

Comparison between RF-scan and Microwave-scan

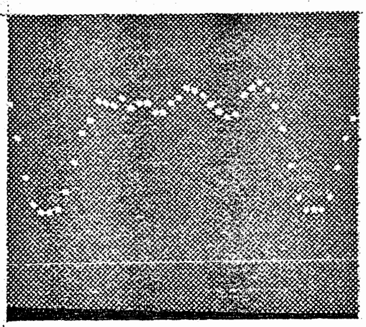


Normal RF-scan

$f_c \cong 9{,}5$ MHz

560 Hz/Div ⟵

Fig. 2



"Microwave scan"

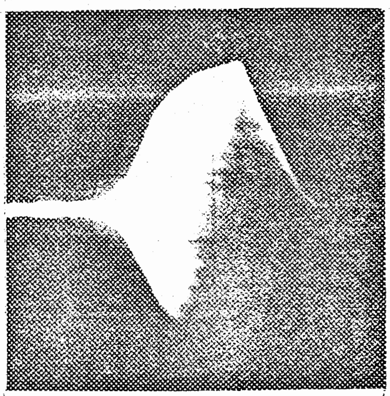
$f_c \cong 1{,}35$ GHz

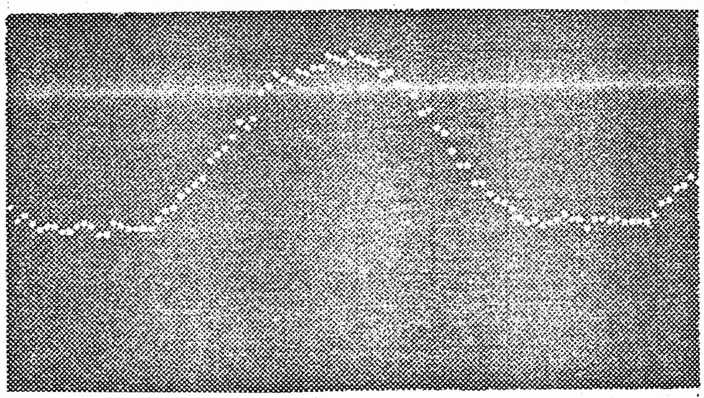
4096 samples
10 KHz / Bin
Microwave p.u. loop ; R2

26 GeV/c

100 KHz/Div ⟵

Comparison between RF-scan and Microwave-scan





560 Hz/Div ⟵

50 KHz / Div ⟵

Normal RF-scan
$f_c \cong 9{,}5$ MHz

Microwave scan" 8192 samples
$f_c \cong 1{,}35$ GHz

R1, Wide band p.u., 15 GeV/c

Fig. 3