ISR-RF/MdeJ/ps

3rd November 1972

CM-P00072647

ISR PERFORMANCE REPORT

Run 245, 25.10.1972 (13.00-17.00 h.), 26 GeV/c, 20 bunches

Phase displacement acceleration

Purpose

To accelerate a stacked beam by means of phase displacement acceleration to higher momenta and to measure the blow-up of the stack due to the passage of empty buckets.

Results

From a stack of 2.7A made at 26.5 GeV/c, 1.36A was accelerated to 31.4 GeV/c using the working line developed for rebunching. A total of 169 passages of empty buckets through the stack were required to cover this shift in momentum. The stack of 1.36A was at least 60% wider in momentum than the original 2.7A stack (see fig. 1 and fig. 2). A more detailed analysis of the blow-up will be published later.

The loss-rate at 31.4 GeV/c was 3 ppm measured over 15 minutes and the background 2.6 10^3 counts/sec, without any radial scraping being done. A precise $h_{eff.}$ measurement could not be done, but the vertical density distribution was measured and found to be approximately 30% narrower than the density distribution of a non-accelerated stack made on the same working line.

All data obtained seem to indicate that stacks made with phase displacement acceleration could be used for physics, whereby a certain amount of radial scraping and steering will be required to minimize the background.

Method used

For this experiment the RF system was modified such that buckets moving towards injection orbit could be generated. The bucket area determines the momentum shift that can be obtained, and since the bucket area increases with decreasing value of Γ a low value of Γ was selected, which is also assumed to be profitable to minimise the blow-up. As large as possible a voltage was used, thus minimizing the number of passages required. A lower limit of Γ is set by the speed required (the lower Γ, the lower $\dot{p}$) which depends on the rate

of change of the magnetic field and on the inherent noise in the RF system. A further limit is given by the condition that the momentum bite covered by the empty bucket sweep has to be considerably larger than the momentum bite occupied by the stack, in order not to cause additional blow-up of the stack due to switching transients. The optimum choice of parameters, given the 1.5% change in momentum per 20 sec (fixed by the digital to analogue converter controlling the main power supply) was found to be 18 kV and $\Gamma = 0.1$. With these parameters it is just possible to cope with the momentum increase dictated by the main field in the available time. During the process the stack has to be kept in the neighbourhood of the centre of the vacuum chamber in order to avoid the crossing of resonances. The momentum bite traversed by the empty buckets was in this experiment typically twice the width in momentum of the initial stack at the beginning of the process and only 1.2 times the stack width at the end of the process, which results in additional blow-up.

During the experiment the beam position was measured with the Vosicki device, which was more and more difficult as the beam blow-up increased.

During the whole process the starting point of the empty bucket sweep had to be adjusted, such that the stack is centred at the sweep at all momenta, which created a difficulty with the cavity tuning system.

Conclusions

Further experiments will be required to optimize this method of acceleration for which a slower change in magnetic field must be made possible and for which eventually a new working line having a larger resonance-free region should be developed.

M.J. de Jonge.
K.N. Henrichsen.

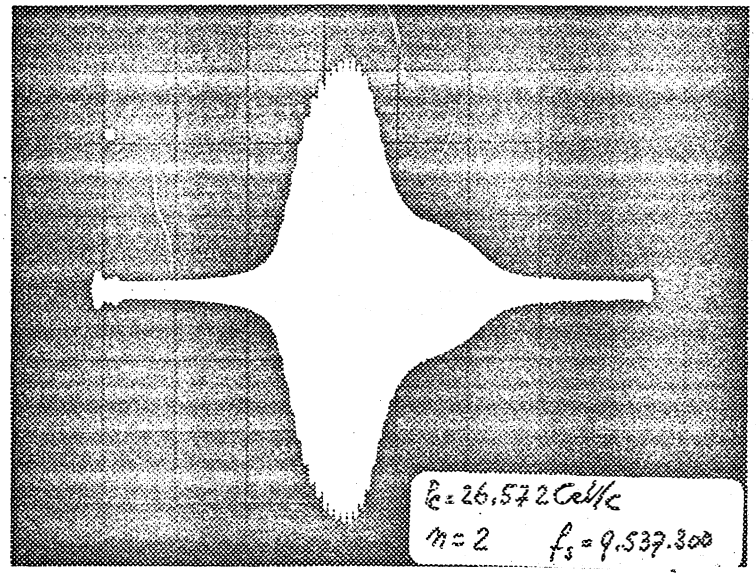

Fig. 1

Initial stack 2.7A.

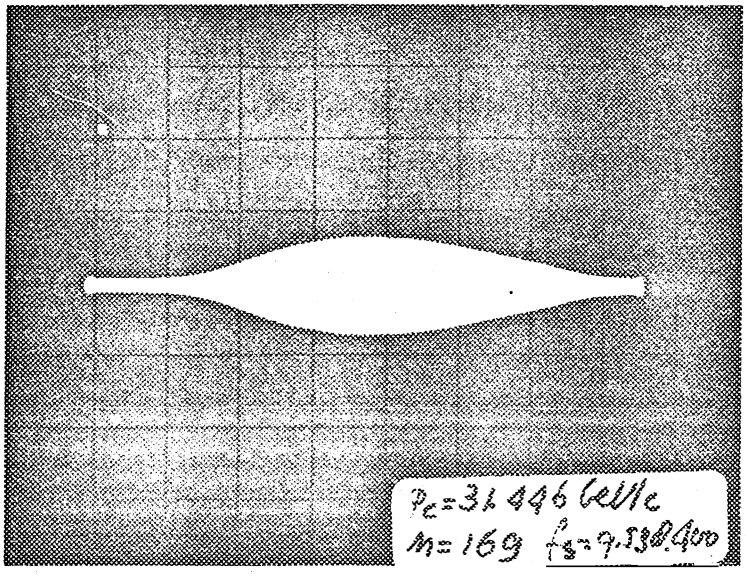

Fig. 2

Stack after phase displacement acceleration to 31.4 GeV/c, 1.36A.