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ENERGY PRESELECTION AND MF SYNCHRONIZATION OF THE FAST EJECTED PROTONS BEAM

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The energy of the ejected protons beam could be fixed by a preset pulse derived from the crystal clock pulse train. A more accurate energy determination of the ejected protons beam may be obtained by using a preset pulse from the B-pulse train. Both operation modes are possible during the rise and fall time of the magnetic field in the accelerator magnets. If ejection takes place on the machine flat top, a combination of both pulse train preset pulses is required. The crystal clock preset pulse determines the rough timing and the B-train preset pulse synchronizes the ejection to the correct proton energy.

For the ejection system the information on the momentary geometrical position of the bunches in the vacuum chamber is essential. The rise of the magnetic field in the kicker magnet should start right after the last unkicked bunch has left the kicker magnet. The following, to be kicked bunch, should not enter into the kicker magnet before the kicker magnet field has reached its flat top value. It is obvious that the kicker magnet rise time must be shorter than the time spacement of 2 neighbouring bunches, for instance, at the kicker magnet entrance. The voltages across the radio frequency accelerating cavity gaps is the only physical dimension of the machine which is linked to the bunch position in the orbit. Therefo the radio frequency (RF) signal for the ejection synchronization should be derived directly from the RF accelerating cavity electrodes or the plate circuit of the final power amplifier.

Correction and Quality of the RF Timing Signal

In theory it would be desirable to derive from all RF accelerating cavities by the means of pick ups an RF signal which is really seen by the protons. This signal should be lead by cables to a common summing point. The length of all cables have to be adjusted very accurately, $\pm$ 1 ns, so as to add all signals with the same phase. From the summing point the RF sine-wave synchronization voltage is distributed. If more than one user of the summin point voltage is existing, then the different users should be separated by buffer amplifiers. This system is insensitive against phase shift errors in the transmission from the master generator to the final power amplifier. Maintenance of amplifier setting values or modifications are not influencing the precision of the RF timing voltage with respect to the geometrical position of the bunches in the orbit. Even when one or more RF accelerator do not work correctly, the system is not seriously affected. The voltage into the users load of 50 Ω should be at least 1 V rms. The time jitter of the RF timing voltage zero crossing with respect to one and the same bunch and one and the same geometrical positior in the orbit should be better than $\pm$ 2 ns.

In practice, for the Serpukhov PS with about 50 RF accelerator units, it will not be possible to take from each RF accelerator unit a sample. A reasonable device will also guarantee a perfectly working RF synchronization voltage generation.

It must be considered whether the shaping and zero crossing detection of the RF synchronization voltage should always be done in the users area and with the users electronic equipment or rather near the summing point and then distributed in form of peaked pulses. Questions of noise, quality of the zero crossing detection and the difficulty to transmit fast pulses through long cables should be compared.

The use and need of the MF synchronization voltage

After zero crossing detection of the RF synchronization voltage the shaped RF pulse train synchronizes the fast ejection system. The same pulse train supplies an amplifier manifold. The manifold supplies the RF pre and post preselection counters [1]. These counters are delivering the preselection pulses synchronization to the geometrical bunch position in the orbit for the beam observation system. These RF preselection counters, the so-called RF timing units, are also essential for the physicists.

The inconvenience of a beam monitor device for the RF synchronization voltage generation.

Since the RF pulse train must supply the RF timing counters, the train should be continuous. This is impossible if the RF pulse train is generated by electrostatic or electromagnetic beam pick-ups. Either pulses are missir due to the ejected bunches or due to a bad inflection.

1) H. van Breugel, H. Dijkhuizen, I. Kamber, B. Kuiper, S. Milner "Operation Straight Flush" . A programme of supplementary fast ejection facilities. NPA/int.67-11 (19.6.67).