October 17, 1968
IK/ch

ENERGY PRESELECTION AND RF SYNCHRONIZATION OF THE FAST EJECTED PROTONS BEAM

I. Kamber

The need of a Radiofrequency (RF) synchronization system was mentioned in the technical note PS/FES/TN-21, May 30, 1968 presented to the Serpukhov delegation at the joint ejection meeting in June 1968.

At the same meeting the Serpukhov delegation presented to CERN the report IHEP/SKU-68-26-K on the general synchronization system of the accelerator. This report, however, did not contain details on the problems of the RF synchronization. Only a very preliminary sketch of an automatic RF pulse device, originating from Dr. Komarov*, was received, but not included in above paper.

Generation and Quality of the RF Synchronization Signal

In theory it would be desirable to derive from all RF accelerating cavities by the means of electrostatic or electromagnetic 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 lengths of all cables have to be adjusted very accurately, ± 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 summing 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 synchronization voltage with respect to the geometrical position of the bunches in the orbit. Even when one or more RF cavities do not work correctly, the system is not seriously affected. The constance of the RF-voltage amplitude should be better than ± 1 o/o and the distortions less than 1 o/o. The voltage into the users load of 50Ω should be at least 1 V rms. The time jitter of the RF synchronization voltage zero crossing with respect to the center of one and the same bunch and one and the same geometrical position in the orbit should be better than ± 2 ns.

The position of the bunch should be understood as the position of the gravity center of the proton distribution in the bunch.

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 choice of a few cavities will also guarantee a perfectly working RF synchronization voltage generation.

The shaping, zero crossing detection and the variable phase shift of the RF-synchronization voltage should always be done in the users' area. That prevents difficulties with sharp pulse transmission over long distances.

Another reason for the local treatment of the RF-voltage is the possible individual phase shift correction for various applications. For instance a possible automatic phase correction of the kicker magnet firing circuits (see fig. 1) is a function of signals derived from the beam diagnostics. This phase shift correction is independent of and superimposed on the dB/dt signal derived from the main ring magnets. The value dB/dt may be converted into a setting voltage for the phase shift correction by the means of a coil in the 121st magnet unit or by a time to voltage conversion of the B pulse sequence.

The phase shift correction can be done by a variable discriminater level. In place of the normal setting potentiometer a variable DC voltage sets the discrimination level (see Fig. 2).

Due to the importance of the question the present paper repeats the main points of the note PS/FES/TN-21 and supplies some additional, more detailed data, adopting partially Dr. Komarov's proposal.

*) Dr. Komarov, private communication