FAST BUNCH BY BUNCH EJECTION OF 3 TeV PROTON BEAM FROM UNK STORAGE RING

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Construction of two high energy accelerator facilities—the UNK proton ring and the VLEPP electron-positron linear collider—in the same scientific centre (IHEP) opens the unique possibility for their co-operation in such experiments as, for instance, *p-e* colliding beams or acceleration in VLEPP linacs of pions generated by the extracted from UNK proton beam, and so on. To perform such experiments the time structure of the extracted proton beam should be matched with the VLEPP time structure. That could be achieved if the beam ejection is carried out one by one of stored in UNK bunches with 100 Hz repetition rate corresponding to that of VLEPP operation. With 200 MHz design frequency of the RF-system of the UNK storage ring there will be about $1.3 \cdot 10^4$ stored bunches of 1.5 ns duration separated by 3.5 ns. The presented solution of the problem of one by one extraction of the proton bunches is based on the following approach.

1. With account of the smallness of the transverse emittance of accelerated proton beam the kickers could have a very small aperture and be placed outside the working aperture of the accelerator.

2. Accelerator straight section optics is to be oriented to the goal of bunch by bunch exraction.

3. To direct the beam into kickers aperture and to the wall of the Lamberstone type magnet a local distortion of equilibrium orbit should be made.

4. Kickers system is composed of many short counter travelling wave units separately fed by a couple of opposite polarity nanosecond pulses.

5. A special generator based on high current electron beam commutator is used as a source for such pulses.

As initial data for estimating, the following values are taken:

Bunches repetition time	5 ns
Spacing between bunches	3.5 ns
Bunch duration	1.5 ns
Accelerator acceptance (X and Z)	6.9 mm·mrad
Beam emittance (at the energy of 3 TeV)	0.0123 mm·mrad
Beta-function	100 m
Beam size (FWHM)	1.11 mm
Kickers ensemble length	10 m
Kicker length	30 cm
Kicker aperture	6 mm
Kicker travelling wave field	150 kV/cm

With the present scheme of VLEPP location the system for bunch by bunch extraction is convenient to be placed in the 4th UNK straight section, that provides a good accordance with the existing schemes of fast and slow beam extraction. Energy dispersion in the extraction straight section should be zero.

Independent supply a short kickers by mutually delayed pulses provides without the disturbance of the neighbouring bunches. Admissible length of kicker which, together with risetime and falltime durations of pulse, defines those of a kick. It is dependent on the spacing between neighbouring bunches and on the instability of generator synchronization.

The schematic of a nanosecond pulses generator is shown in Fig. 1. The generator consists of a high current electron pulse accelerator, a sweep unit, a set of targets and a set of transmission lines. The pulse accelerator produces the 1 kA electron beam of 0.3 mcs flat-top duration and 100 Hz repetition rate. After passing the sweep unit and the drift space the beam reaches the targets, which are placed on the ring, and the trace of the beam intersects every target connected to the 50 Ohm transmission line input. So, in every line the travelling wave negative pulse of 50 kV amplitude and 100 Hz repetition rate is formed, as shown in Fig. 2. The beam diameter on the target is to be smaller than the target dimension. In such condition the

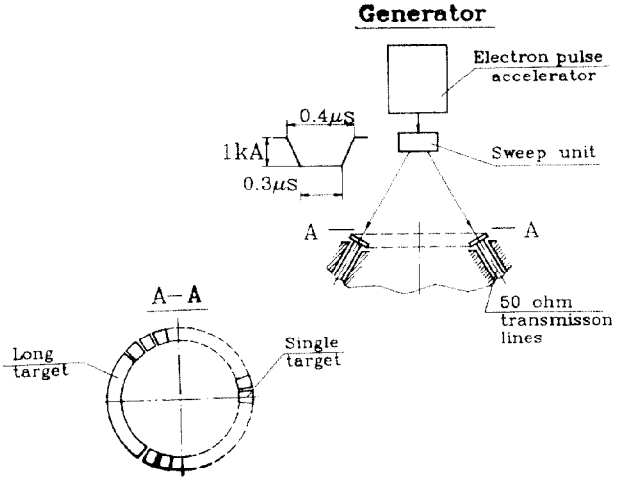

Fig. 1. Schematic of pairs nanosecond pulses burst generator.

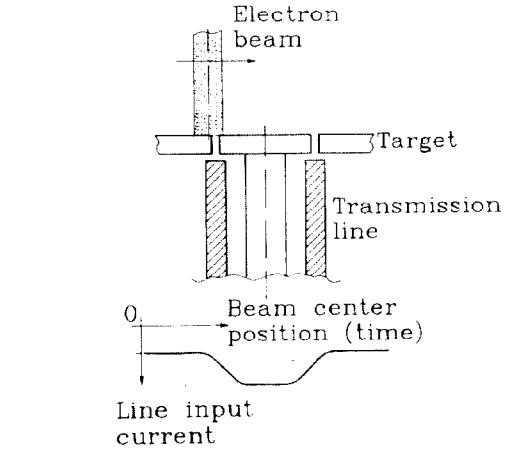

Fig. 2. Forming of line input pulse

pulse duration is equal to the time required for the electron beam to cross the target. The pulse risetime and falltime are equal to the time which needs to intersect the target border by the beam.

The kicker system is schematically shown in Fig. 3. Every 30 cm length kicker is manufactured as a symmetrical stripline and deflects the proton bunch in radial direction. The symmetrical stripline is to be pulsed by a couple of the opposite polarity synchronized pulses, that is why in every second transmission line gap the pulse invertor is placed to produced the positive pulses. The transmission line length is chosen in such a way as to provide the kick of one bunch only in each ejection cycle by means of all kickers in series. The sweeping frequency and phase are to be synchronized with those of the storage ring RF accelerating system. It is possible, in principle, to use a linear sweep instead of a circular one, but the accurate synchronization is also necessary.

The electron beam energy is determined by the complex of considerations concerning the problems of the electron beam forming, focussing, sweeping and transporting. This task is under consideration and not yet settled in detail for the time being. The expected beam energy is about 2 MeV.

This is not a detailed project but only a principal proposal. However, as for the problems of high current electron pulse accelerator, the nanosecond engineering and the other aspects this proposal is based on the achieved parameters (or closed to them) in the INP and IHEP. This enables us to expect the feasibility of this proposal.

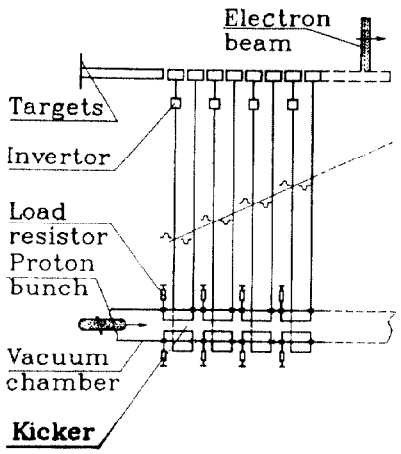

Fig. 3. Schematic of kickers system.

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