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In the paper by E.A.Perevedentsev and A.N.Skrinsky /1/ the proton beams of big accelerators are suggested to be used for exciting the linear accelerating structure.

The present paper is devoted to further extension of this idea. Our development allows the excitation of the larger accelerating fields if the amount of particles is the same, as well as there is a hope to have the manimum large accelerating fields and, furthemore, to have no rigid tolerances on the geometrical sizes of the structure typical for linear accelerators.

If a single dense ultrarelativistic proton bunch is injected into the non-excited resonance structure of the linear accelerator-type, then the protons will be acted by radiation deceleration, the electrons inside the proton bunch being accelerated by the same field.

The time pattern of the lines of force of the electric field of a single charged bunch traveling past the diaphragm in the waveguide is shown in Fig.1 /2/. Analysis of radiation fields shows that the radiated energy is higher, the smaller is the aperture of the diaphragm and the shorther are the distances between the diaphragms. In terms of Fourier harmonics this means that the higher harmonics with a wavelength of order of typical size of the structure are radiated. With taking into account the fact that higher harmonics are also cut by the longitudinal size of a charge the selection of the structure sizes is monitored by a charge size. Thus, in the case of a sufficient large amount of the particles in the proton beam and also of the necessary sizes of the structure it is possible to obtain large radiation fields, and consequently, large accelerating fields for the electrons. It should be noted that the summary radiated energy may be significantly higher (depending upon a charge size , by a factor of 10 and higher) compared to that radiated into the fundamental harmonic. This means that the single bunch of protons creates the accelerating fields for electrons which are much higher compared to the sequence of the bunches having the same total number of particles (10-30%).

The distribution of field inside the bunch mainly depends on the distribution of charge. As an example, the field dependence along the bunch averaged over the structure period is given in Fig.2. Shown is also the charge distribution along the bunch. As seen in Fig.2, in principle, the corresponding arrangement of the electrons in the proton bunch allows the attainment of a sufficient monochromaticity. In this case the number of accelerated electrons constitutes a considerable share relatively to the number of protons.

When the values of electric fields on the surfaces of the diaphragms are large, the electron autoemission will be significant so that the pattern of electric fields becomes another. This circumstances limits the applicability for our calculations but, as we hope, not for the acceleration method proposed.

To prevent the fail of the electrodes upon vacuum breakdown by the energy radiated by a proton beam (this breakdown appears after traveling of the proton beam), this energy must radiate into the environment and also be absorbed already in a big volume (Fig.3).

This method makes it possible to attain the maximum short time for existence of the fields on the surface of the diaphragms.

The acceleration rate of about 3000 MeV/m is attainable for the proton bunch of about $3 \cdot 10^{13}$ particles and of about 0.5 cm in size (Batavia).

The authors are indebted to A.N.Skrinsky for useful discussions and a series of valuable remarks.

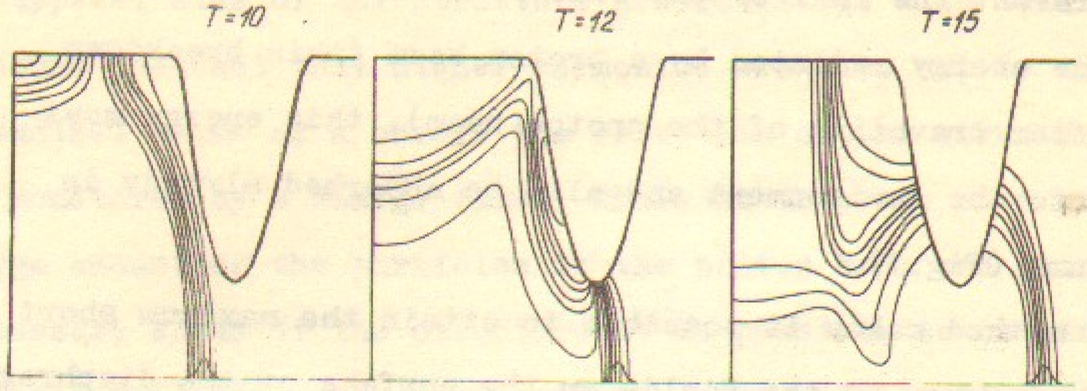

Fig.1 The time pattern of the lines of force of the electric field of a charge traveling past a diaphragm.

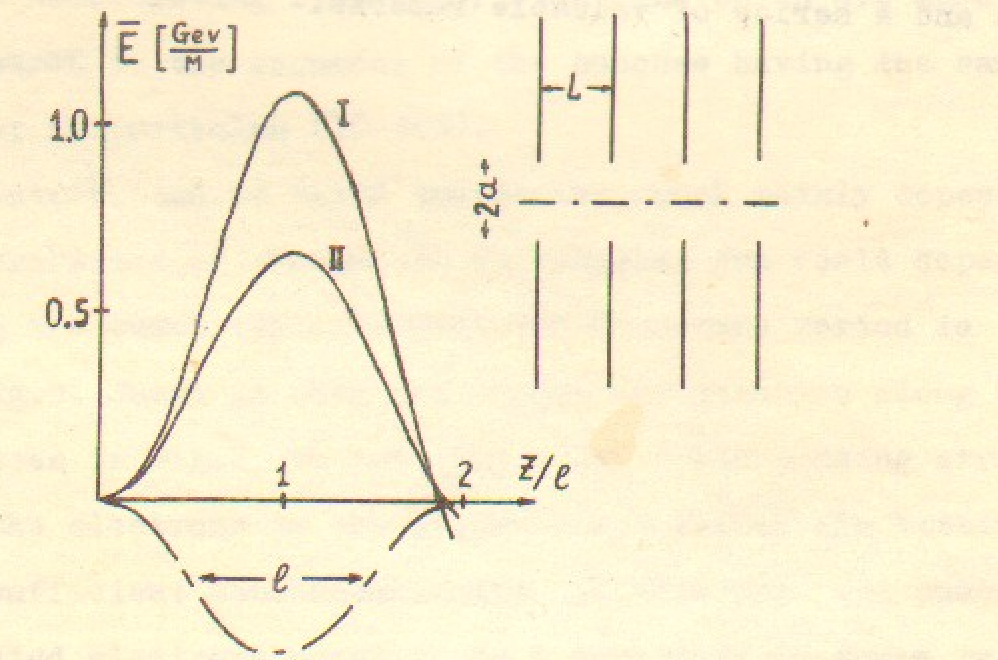

Fig.2 The field dependence along the bunch averaged over the structure period and the charge distribution along the bunch;

$N = 10^{13}$, $\ell = 0.5$ cm, $\frac{a}{\ell} = 0.5$

(I) $L/\ell = 1$

(II) $L/\ell = 2.5$

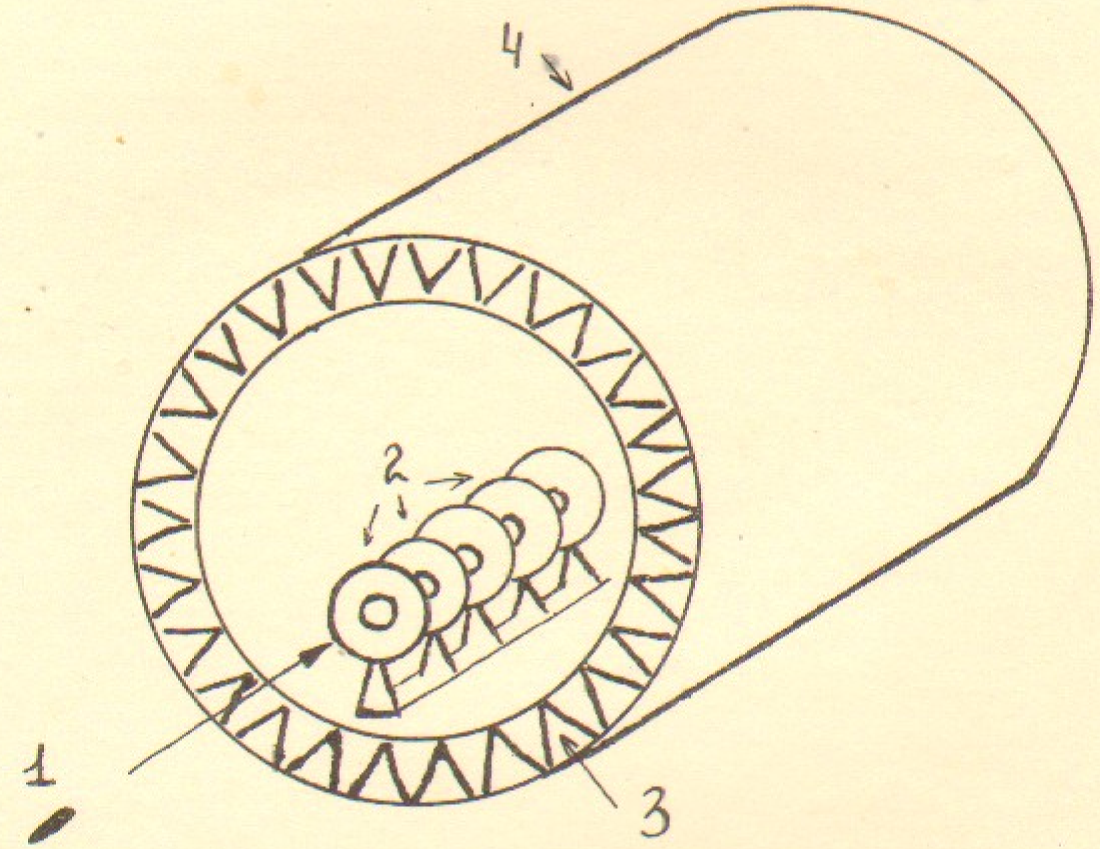

Fig.3 The accelerator layout
1 - proton beam
2 - diaphragms
3 - absorber
4 - vacuum chamber

R e f e r e n c e s

1. E.A.Perevedentsev, A.N.Skrinsky, Proc. of the 6-th All-Union Conf. on Charged Particle Accelerators, Dubna, 1979, vol. II, p.272.
2. V.E.Balakin et al., Proc. of the 6-th All-Union Conf. on Charged Particle Accelerators. Dubna, 1979, vol.I, p.143.

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