CHANGE OF THE PLAN OF BEAM INJECTION IN RECIRCULATOR *SALO*

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Abstract

In work are offered and investigated variants of the scheme of the beam injection in recurculator which allow to make smooth adjustment of the beam energy on all beam lines from minimal - 59.5 MeV up to maximal 730 MeV. Parameters of the beam for the specified ranges of injection energy for injection beam line and on input in accelerating section recirculator are designed. Parameters of magnetic elements of injection beam line are resulted.

INTRODUCTION AND STATEMENT OF PROBLEM

The feature of magnetooptical structures of recirculation SALO is overlapping by the same magnets functions both bending for the first revolution, and bending and spreder-recombiner magnets for the second revolution of recirculation. At constant energy of the beam injection in the accelerating structure [1] this feature imposes the certain restrictions on the range of the energy adjustment of extracted beam as for preservation in the specified magnets the orbit similarity at various the beam energy values it is necessary to fulfill the condition $(2\Delta E+E_{inj}) / (\Delta E+E_{inj}) = K$ (1,962) where E_{inj} is energy of injections, ΔE is a gain of energy at single-shot passing of accelerating structure. This is possible only at change the beam injection energy.

PROPOSED SCHEME OF INJECTION

For providing adjustment in required limits the energy of extracted beam two circuits of injection with injecting beam energy changing (see Fig. 1-2) were analyzed.

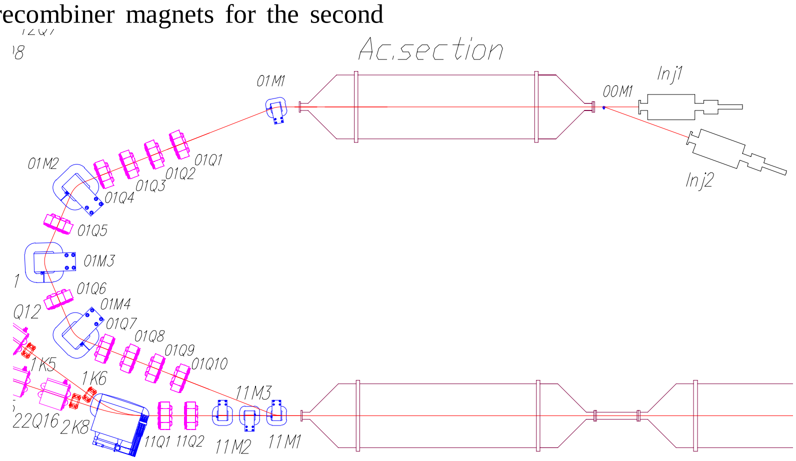

Figure 1. Scheme of injection for energy range 9,5-28 MeV. inj 1, inj 2 are the sources of polarized and unpolarized electrons respectively, 00M1 is bending magnet for energy 100 KeV, Ac.section – accelerating section, 01M1 – 01M4 and 11M1 are bending magnets, 01Q1 – 01Q10 are the quadrupole magnets.

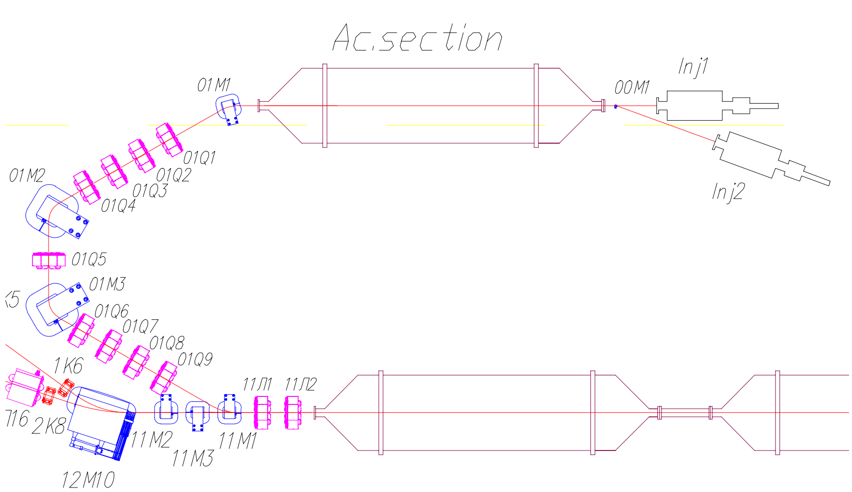

Figure 2. Scheme of injection for energy range 6,66-20 MeV. The labels are the same as on Fig, 1.

Calculations were fulfilled for a source of non-polarized electrons with E_{inj}=9.5 MeV, ε = 2.8$*10^{-7}$ m$*$rad., $\Delta E/E$=1.5$*10^{-3}$ [2] and for source polarized electrons with energy 100 KeV, with ε = 1.2$*10^{-6}$ m$*$rad.. and $\Delta E/E$=1.5$*10^{-3}$ [3].

The main parameters of magnetic elements of injection system are submitted in Table 1.

Table 1.The main parameters of magnetic elements of injection system

The energy change range 9,5-28 MeV		
The bending magnet type	Length, m	H-field strength, T
01M1, 11M1	0.1124	0.31
01M2, 01M3, 01M4	0.2	0.3713
Quadrupole magnets	Length, m	The maximal gradient T/m
01Q1 – 01Q10	0.1	8.23
The energy change range 6,66-20 MeV		
The energy change range	Length, m	H-field strength, T
01M1, 11M1	0.1124	0.31
01M2, 01M3	0.2	0.354
Quadrupole magnets	Length, m	The maximal gradient T/m
01Q1 – 01Q9	0.1	3.1

The calculation of beam parameters was carried out with the help of MADX code which takes into account transverse defocusing of the beam in accelerating section. Use of this code has allowed to take into account the longitudinal phasing of particles also. Modeling was carried out for an initial normal distribution with number of electrons 10^3.

On Fig. 3, 4, 5, 6 are shown the beam enveloping for the chosen energy ranges. They are optimum for considered circuits of injection.

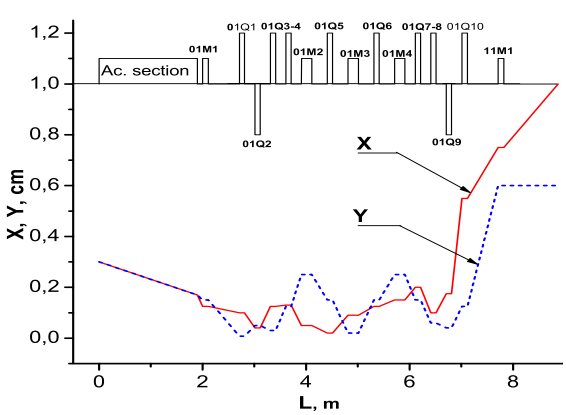

Figure 3. The beam envelope for injection energy 28 MeV.

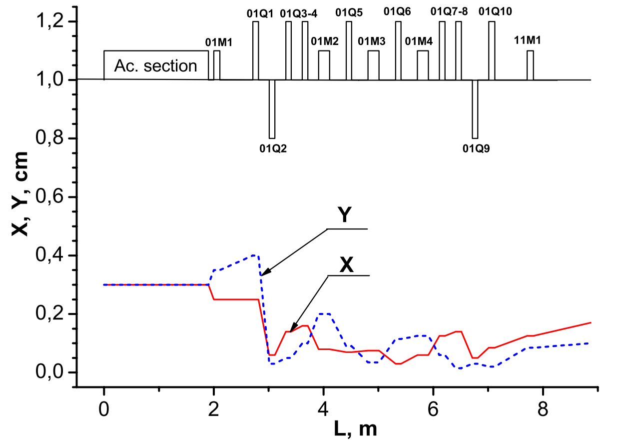

Figure 4. The beam envelope for injection energy 9,5 MeV.

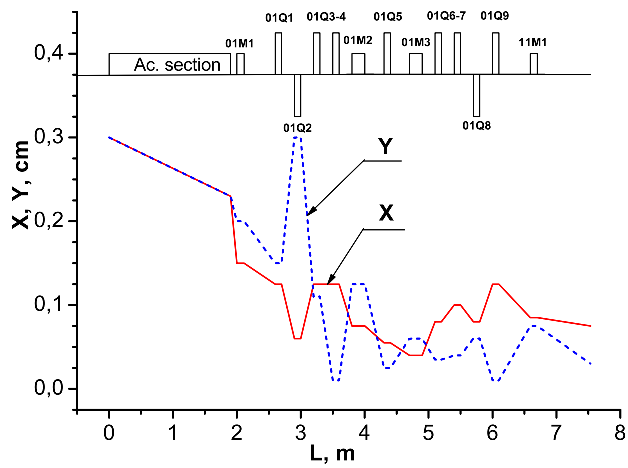

Figure 5. The beam envelope for injection energy 20 MeV.

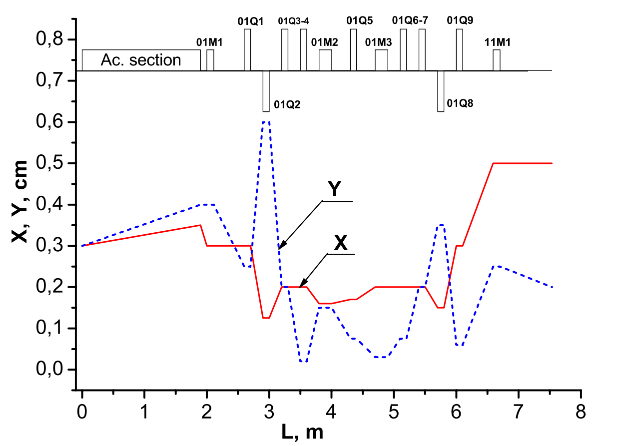

Figure 6. The beam envelope for injection energy 6,66 MeV.

On Fig. 7 and 8 are shown the phase portraits of the beam for boundary values of injecting beam energy on input of the accelerating structure of recirculator.

The energy spread at accelerating section is equal 8.7$*10^{-4}$ (28 MeV), 1.0$*10^{-3}$ (20 MeV), 1.5-1.0$*10^{-3}$ (9.5 MeV), 2.5$*10^{-3}$ (6.66 MeV) respectively.

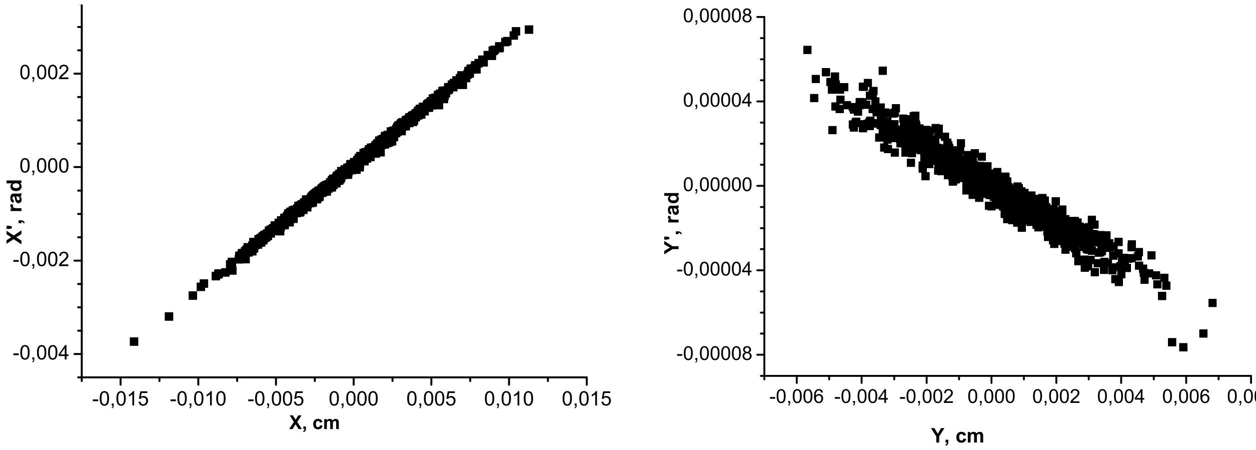

Figure 7. Phase portraits of the beam on planes X, X′ and Y, Y′ for injection energy 28 MeV at input of accelerating section of recurculator.

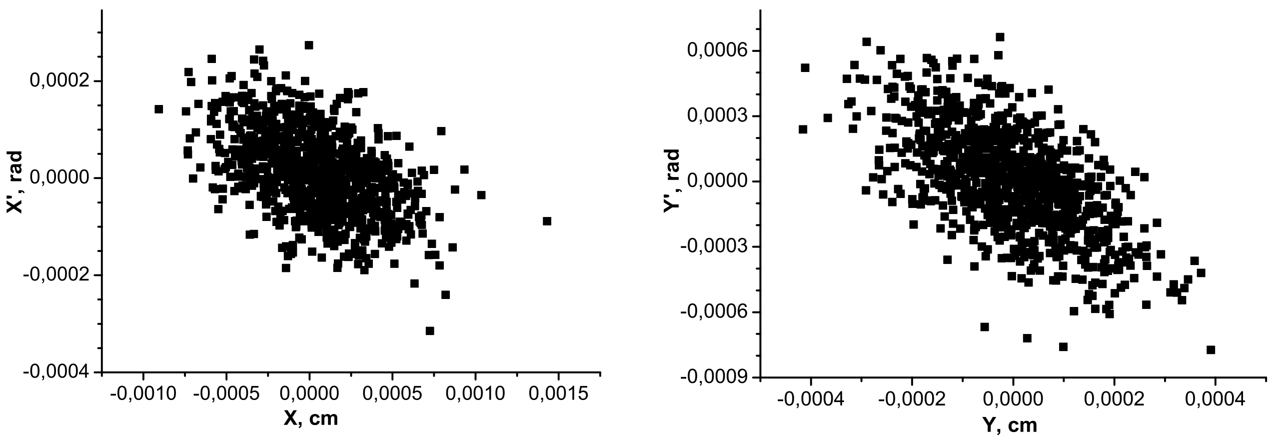

Figure 8. Phase portraits of the beam on planes X, X′ and Y, Y′ for injection energy 20 MeV at input of accelerating section of recurculator.

CONCLUSION

On the basis of obtained results of numerical modeling of the particle dynamics in the offered injection beam lines it is possible to make following conclusions:

- the both of examined variants of injection allow to provide the beam energy regulation on an exit of designing beam lines in required limits;

- from the obtained data it is clear, that the variant with E=6.66-20 MeV is preferable as on parameters of the beam on an exit of an injection beam line, and on parameters and an amount of magnetic devices.

REFERENCES

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