THE BEAM TRANSPORT SYSTEM IN THE SRS-1200

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In NSC KIPT the synchrotron radiation source SRS-1200 for the Ukrainian national synchrotron center (Kiev) is developed. An injector for a storage ring is the electron linear accelerator with energy 180 MeV. For compactness of a complex LUE-180 dispose under a storage ring. The transport system provides transport of electron beam from linear accelerator without losses and injection him in the storage ring. The calculations of the performances of transport systems with five-lens and three-lens variants of translation line, and also with use 42 and 45-th of degree rectangular and sector bending magnets were carried out. As a result of the comparative analysis the five-lens symmetric variant of translation line with 42-th degree sector bending magnets was chosen. In the report the basic results of calculations, parameters and performances of transport system of electron beam are submitted.

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THE BEAM TRANSPORT CHANNEL

In NSC KIPT the synchrotron radiation source SRS-1200 for the Ukrainian national synchrotron center (Kiev) is developed [1,2]. An injector for a storage ring is the electron linear accelerator with energy 180 MeV. Its principal parameters are listed in Table 1.

Table 1. *Principal parameters for the electron linear accelerator LUE-180*

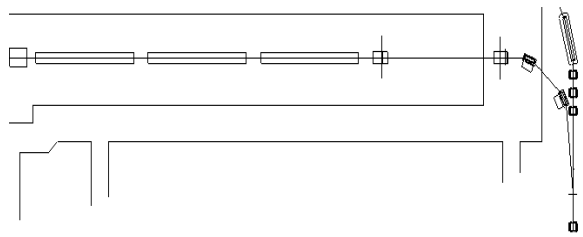
Parameter	Value
Electron energy, MeV	180
Pulsed current, A	0.1
Pulse rate, Hz	1, 3, 6, 12, 25
Beam current pulse length, ns	30…300
Beam emittance at exit point, mm·mrad	0.2
Energy spread, %	0.3
Bunch length, ps	5
Operating frequency, GHz	2.797
Number of accelerating sections	3
Length of accelerating section, m	3.2
Total accelerator length, m	10.7

The choice of electron linac disposition and functional scheme is depended on conditions of facility compactness and possibility form precision phase volume of the beam. The beam as electrons bunch from a RF-gun, which is an injector, arrives in the magnetic compressor. Magnetic compressor separates the central part of the bunch, shapes it further along the longitudinal axis and directs immediately in accelerating sections, where the electron beam are accelerated to an energy 180 MeV.

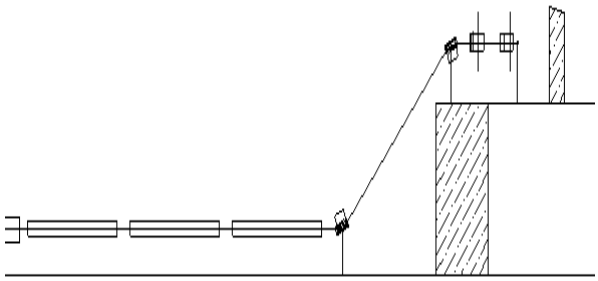
The main requirements to the line of beam transport from the linear accelerator LUE-180 to the storage ring SRS-1200 are as follows:

- beam transfer from the LUE-180 exit point to the septum – magnet without losses;
- agreement of beam emittance at the LUE-180 exit point with the acceptance of the SRS-1200 ting structure;
- the electron beam size at the entrance of the septum – magnet should not exceed ±2 mm in both coordinates;
- separation of the beam with an energy spread $\Delta E/E \le 0.3$ % from the bunch formed by the LUE-180, should the need arise.

The beam transport line represents vertical parallel transfer line with achromatic turn of charged particles beam in a horizontal plane on 90 degrees. The general scheme of a disposition of the linear accelerator and elements of charged particles beam transport system represented on Fig. 1.



View from above



Side view

Fig. 1. *The general scheme of a disposition of the linear accelerator and elements of charged particles beam transport system*

Four bending magnets determine the beam trajectory, each with a beam bending angle of 42°. Two of the magnets provide the beam translation in the vertical plane, and the other two magnet together with the septum magnet of the beam injection system perform the achromatic bending through 90°. As result, the median plane of the SRS-1200 storage ring is located about 3.7 m higher than the accelerator axis.

The translation is accomplished through the use of a traditional symmetric five-lens scheme that imposes less rigid requirements of the stability of electromagnetic equipment power supply. The collimator-monochromator located close to the beam dispersion maximum ensures the required beam energy spread as the beam is injected to the storage ring. Fig. 2 shows dispersion function in the transport line computed with the TRASPORT code [3].

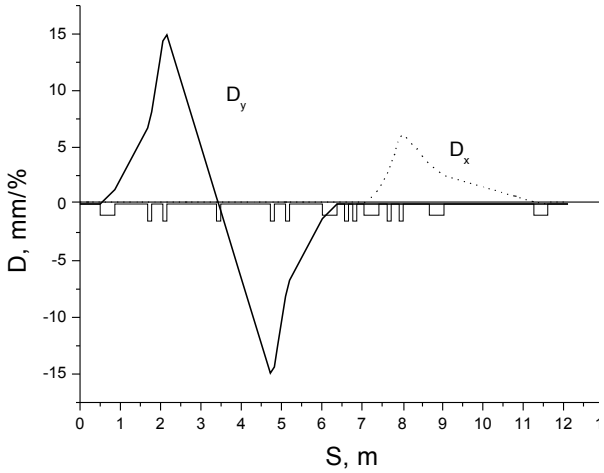


Fig. 2. *Dispersion function in the transport line computed with the TRASPORT code*

Fig. 3 shows the envelopes of particles in the transport line computed with the TRANSPORT code [3].

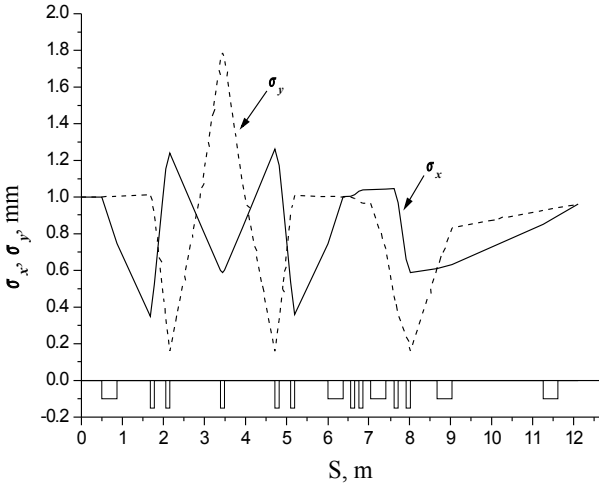


Fig. 3. *Envelopes of particles in the transport line computed with the TRANSPORT code*

Note that the transverse dimension of the beam in the transport line with the particle energy spread $\Delta E/E \leq 0.3$ % does not exceed ± 0.5 cm (for an assigned vacuum chamber aperture value of ∅4 cm). The main parameters of transport dipole magnets are listed in Table 2.

The beam in the transport line is focused by means of 9 quadrupole lenses, whose principal parameters are given in Table 3. Its trajectory in the transport line is corrected with four two-coordinate dipole correcting magnets. In addition, the dipole correcting magnets incorporate a 2 % correction winding. The total length of the transport lines is about 12 meters.

Table 2. *The main parameters for transport dipole magnets*

Parameter	Value
Magnet induction in the gap, T	1.2
Gap size, mm	40
Effective angular size in the magnetic field, degree	42
Rated energizing current, A	600
Axial pole length, mm	366.8
Number of turns in the winding	48
Weight, kg	3000

Table 3. *The main parameters for transport quadrupole lenses*

Parameter	Value
Magnetic field gradient, T/m	16
Aperture diameter, mm	35
Pole-face length, mm	100
Rated energizing current, A	600
Quadrupole lens weight, kg	30

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