THE PARAMETERS EXTRACTED BEAMS IN RECIRCULATOR SALO

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Abstract

Optimization of recirculator SALO magnetic structure has allowed to refine essentially beam parameters in points of a leading-out of particles. Beam parameters on an inlet and an exit of the basic channels of an extraction of particles from recirculator are given in article. Calculations are spent taking into account nonlinear field components of dipole and quadrupole magnets of the accelerator.

INTRODUCTION

The recirculator SALO project envisages an extraction of electrons in several experimental halls [1]. As it has been shown in paper [2], nonlinear field component of dipole and quadrupole magnets can exert on recirculator beam parameters appreciable influence. Channels of beam transportation contain enough large number of dipoles and quadrupoles. Therefore beam characteristics can change on these channels under the influence of the same causes. By means of program code MAD X [3] lateral dimensions of beam in extraction points from recirculator and on an exit of beam transportation channels have been counted. Magnitudes sextupole component field of dipole magnets of the injection channel and the first ring of recirculation were are taken from papers [4, 5]. They have been measured in these publications on prototypes of magnets which will be used in recirculator SALO. Dipole magnets of the second recirculation ring and output channels were not produced yet. Because these magnets window type it is natural to assume that the sextupole component of the field of the magnets will not exceed the values measured for the first ring magnets [4]. Octupole component of the value of the quadrupole lenses was calculated based on data from the literature [2].

These data were used for the numerical simulation of the particle dynamics in the recirculator. Sextupole component is taken into account in the description of the dipole. Octupole field component simulated thin lens on the entrance and exit of the quadrupole. The figures present the results of modeling the movement of 3000 electrons through the recirculator magnetic structure.

BEAM PARAMETERS

Location of the main beam channels on the recirculator shown in Fig. 1.

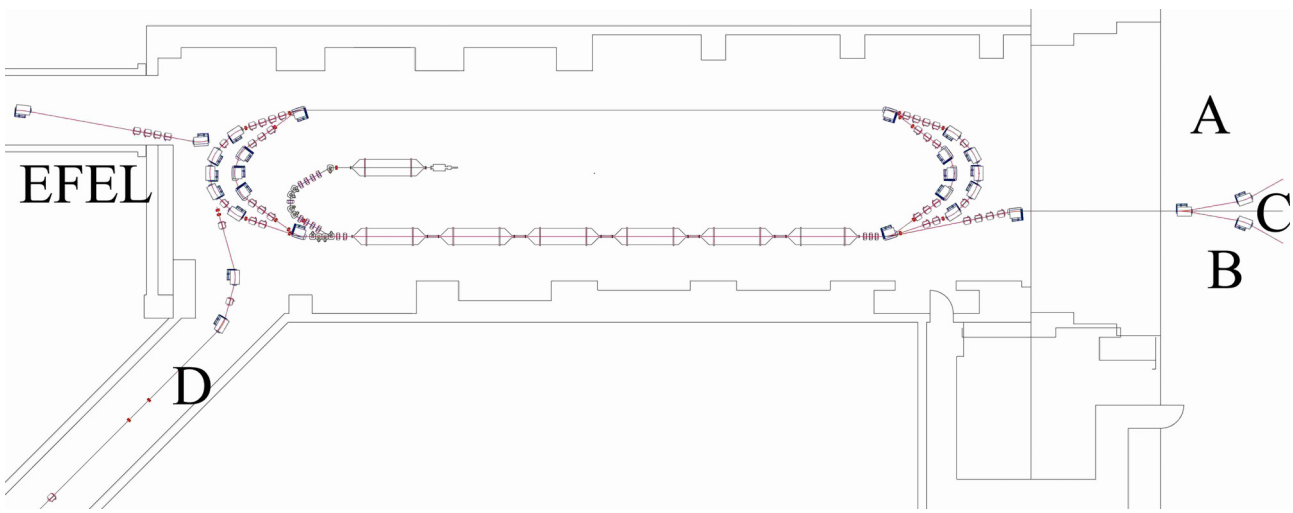

Figure 1: Beam output channels on SALO recirculator.

In channels A, B and C the beam with energy from 60 to 750 MeV [1, 6] can be extracted. For beam formation on channels A and B four quadrupole and two dipole magnets are used (one dipole magnet on the channel C). The electrons with energy to 270 MeV can be received in these halls with use of injection magnetic system and the magnets which are a part of channel magnetic system [3]. To produce a beam with energy of up to 490 MeV it is necessary to use magnetic system of the first ring of recirculation. For obtaining the maximum energy also magnetic system of the second ring of recirculation is used. Thus the bunch will pass accelerating structure three times. The cross-section of a bunch on an entrance to the transportation canal at the maximum energy of 730 MeV is presented on fig. 2. On fig. 3 distribution of particles on an exit from the channel B at distance of 26 m from input point for the same energy is presented.

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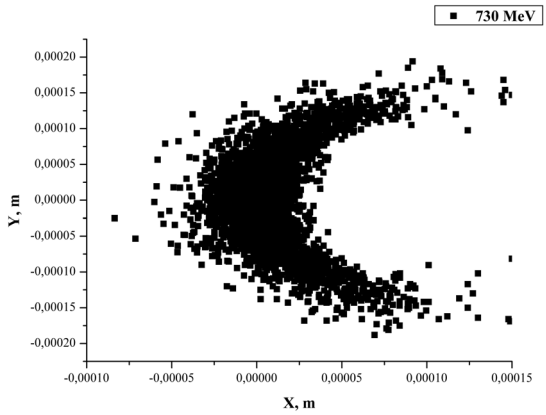

Figure 2: Beam cross-section on an input in the B channel.

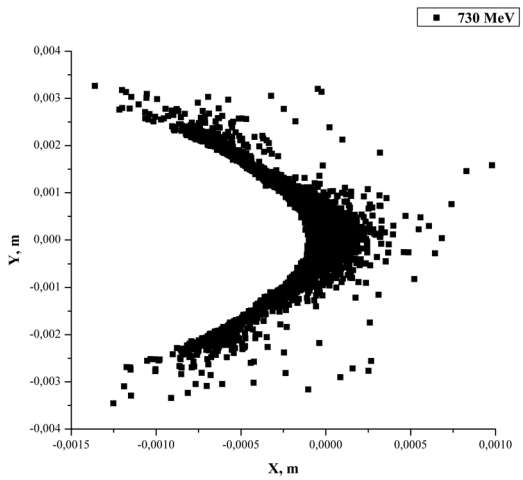

Figure 3: Beam cross-section on exit the B channel.

Distributions of particles in phase space x, x' and y, y' for the same point are presented on fig. 4 and fig. 5.

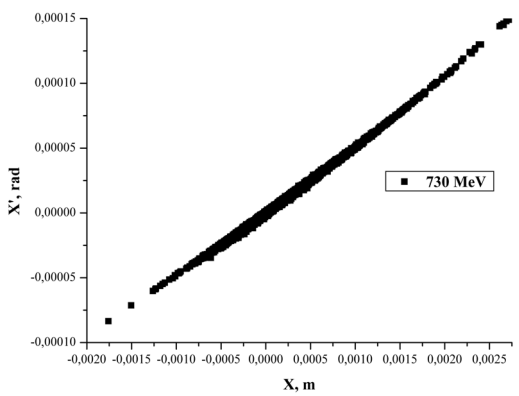

Figure 4: Distribution of particles in phase space x, x' on a channel B output.

Channels A, B and C are intended for experiments with beams of polarized and unpolarized electrons. On the channel C free electron laser installation is possible.

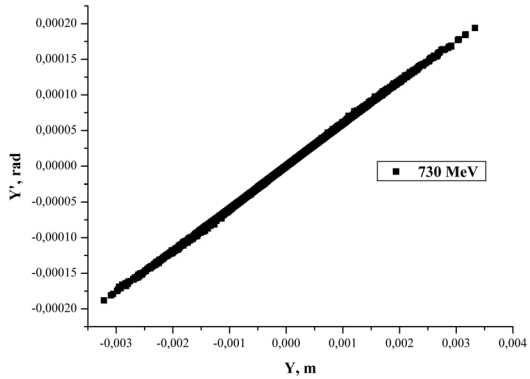

Figure 5: Distribution of particles in phase space y, y' on a channel B output.

In the EFEL channel the electrons with energy to 240 MeV can be extracted with use of the first five magnets of the first ring of recirculation. The beam with the maximum energy to 490 MeV is extracted to the canal in case of the switched-off magnets of the second arch of the second ring of recirculation. The beam on this channel can be created by eight quadrupoles and two dipole magnets. Cross distribution of particles on an input in the channel and on an output from it at distance of 66 m is presented on fig. 6 and fig. 7. The EFEL channel is supposed to be used for operations with beams of electrons and photons.

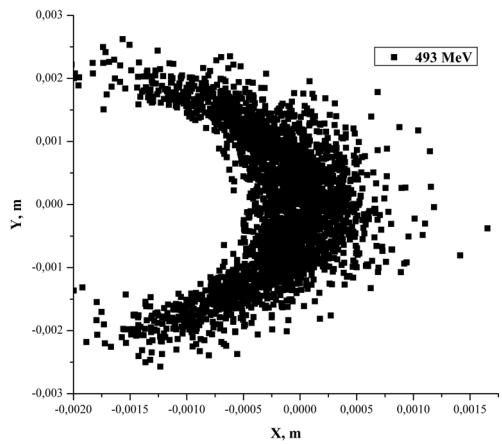

Figure 6: Beam cross-section on an input in the FEEL channel.

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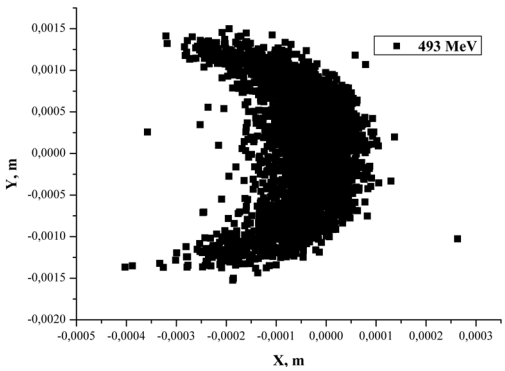

Figure 7: Beam cross-section on an exit the FEEL channel.

The electrons with the maximum energy of 490 MeV can be sent to the channel D if to switch on three magnets of the second arch (see fig. 1). The beam cross-section on an input to this canal is provided on fig. 8.

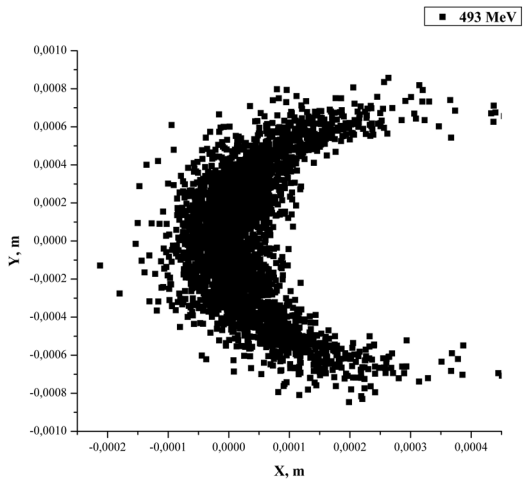

Figure 8: Beam cross-section on an input in the D channel.

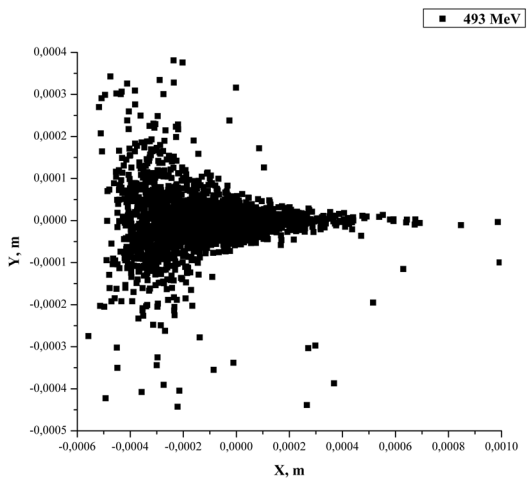

Figure 9: Beam cross-section on exit the D channel.

For beam framing on this channel two dipole magnets and five quadrupole lenses are used. On fig. 9 distribution of particles in a beam at distance of 76,8 m from entry point is presented. The channel D is supposed to be used for operations with beams of electrons and photons.

The carried-out calculations showed that non-linear components of a field of dipoles and quadrupoles influence distribution of density of electrons on an exit of channels. However the beam sizes thus change slightly.

CONCLUSION

Results of these researches give the chance to simulate interaction of electron beams with targets in the experimental halls.

REFERENCES

[1] I.S. Guk, A.N. Dovbnya, S.G. Kononenko, F.A. Peev, A.S. Tarasenko and J.I.M. Botman , “Recirculator SALO project in NSC KIPT ” EPAC’08, Genoa, Italy, June 2008, WEPP082 , p. 2710 (2008); http://www.JACoW.org.

[2] I.S. Guk, S.G. Kononenko, A.S. Tarasenko, Problems of atomic science and technology, Series: Nuclear Physics Investigations, № 3 (79) (2012) 137.

[3] MAD - Methodical Accelerator Design; http://mad.home.cern.ch/mad.

[4] X. Boling, J. I. M. Botman, A. T. A. M. Derksen, H. L. Hagedoorn, A. H. Kemper, C. J. Timmermans, “Magnetic Performance of the EUTERPE Ring Dipole” EPAC1994, London, June 1994, p. 2232 (1994); http://www.JACoW.org.

[5] I. S. Guk, A. N. Dovbnya, S. G. Kononenko, V. N. Lyashchenko, A. Yu. Mytsykov, B. P. Romas’ko, A. S. Tarasenko, and V. A. Shcherbinin. Physics of Particles and Nuclei Letters, Vol. 9, No. 4–5 (2012) 410.

[6] A.N. Dovbnya, V.B. Ganenko, I.S. Guk, S.G. Kononenko, A.S. Tarasenko, The Journal of Kharkov National Univesity, No. 784, Physical series “Nuclei, Particles, Fields”. Issue 4/36/. (2007) 74.

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