RECIRCULATOR SALO PROJECT IN NSC KIPT

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Abstract

In NSC KIPT the electron recirculator project on energy up to 730 MeV is developing. The accelerator is designed first of all as facility for fundamental basic researches in the field of a nuclear physics. Superconducting accelerating structure TESLA on frequency of 1.3 GHz, which was developed in DESY, is used for electron acceleration. Isochronicity and achromaticity of injection system and magneto-optical system recirculator arcs allow to gain good beam parameters on an exit of the accelerator. The beam lines of the particle extraction to experimental stations are presented. The opportunities of recirculator beams use for applied researches are considered.

INTRODUCTION

Developed in NSC KIPT with Eindhoven Technical University recirculator SALO [1] can be used for the solution of major circle of problems. However the basic requirements to beams have been formulated proceeding from the main task: carrying out of basic researches in the field of a nuclear physics [2]. For reduction the facility cost we have tried to create the design of the accelerator which allowed using the experimental halls of the accelerating complex LU2000. Such decision has restricted the peak electron beam energy to 730 MeV. The general view of complex SALO with possible beam lines for beam extraction on various physical programs is presented in a Fig. 1.

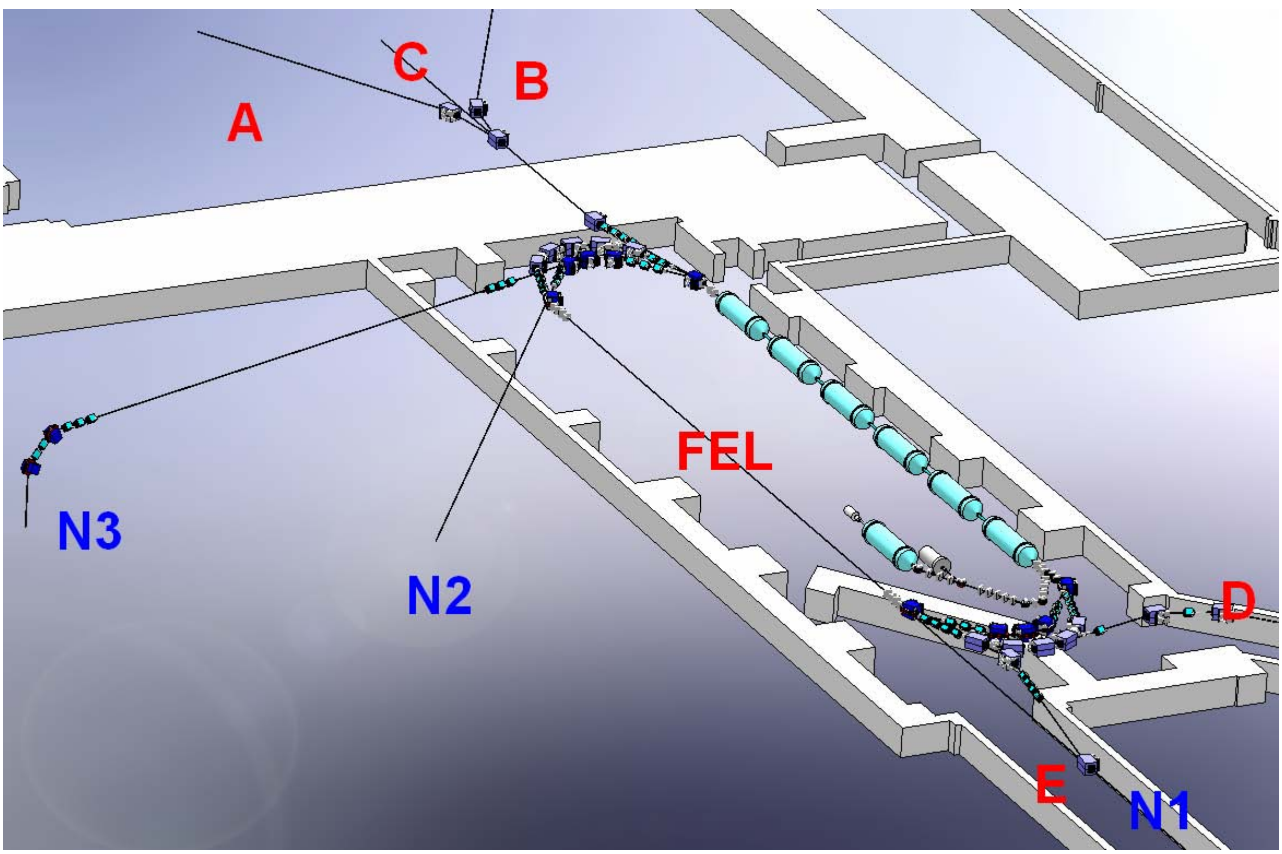

Figure 1: Recirculator SALO lay-out with beam lines. N1-N3: Possible channels of an extraction of particles on sub-critical assembly operation. A, B, C, D, E - channels to the experimental targets for a nuclear physics. FEL - a place of arrangement of the free electron laser undulator.

RECIRCULATOR STRUCTURE

In recirculator SALO structure includes [3] (see Fig. 2):

1. The electron injector of on the basis of high-frequency gun with superconducting accelerating structure on frequency of 1.3 GHz. As the injector prototype the one which was developed during several years at centre ELBE in Rossendorf (Germany [4] is chosen. The peak electron energy at an exit of injector equals 9.5 MeV.

2. The source of polarized electrons. As prototype we chose injector developed for SEBAF accelerator [1]. For injection in recirculator energy of electrons will be incremented at the expense of use of additional accelerating section.

3. The system of beam formation and transportation in recirculator. The injection scheme allows promptly transferring from operation with one injector before operation with another [3] is chosen.

4. For injection the magnet, which is a part of a chicane from three magnets is used. Three dipole magnets which are located in front of accelerating section, cause a feeble arcuation of a trajectory for the basic beam and allow yielding injection of a beam passing magnets of arches.

5. The accelerating system on the basis of superconducting structure TESLA. For embodying of the design we assume to use the accelerating module developed by firm ACCEL [5]. Such module contains two sections TESLA. The sizes of target hall allow to use six modules for particle acceleration. Planed acceleration rate is equal 20 MeV/m in a cw mode.

6. Two rings of electron recycling, which allow a beam triple passage through accelerating structure.

Optimization of all chosen magneto optical system with the purpose of diminution of energy straggling of a beam [4] has been lead.

Minimization of energy spread has been attained for the isochronicity and achromaticity of all sections of transportation of a beam, since a section of injection and two sections of a beam recycling.

For the electron peak energy 730 MeV the beam emittance on a recirculator exit will be equal 0.004 $\pi\cdot$ mm·mrad and energy spread - $2\cdot 10^{-5}$.

Recirculator magnetic devices and their parameters are featured in article [6]. Into a composition of magneto-optical system of the first ring enter dipole magnets and quadrupole lenses of EUTERPE storage ring transmitted NSC KIPT by Eindhoven Technical University [1].

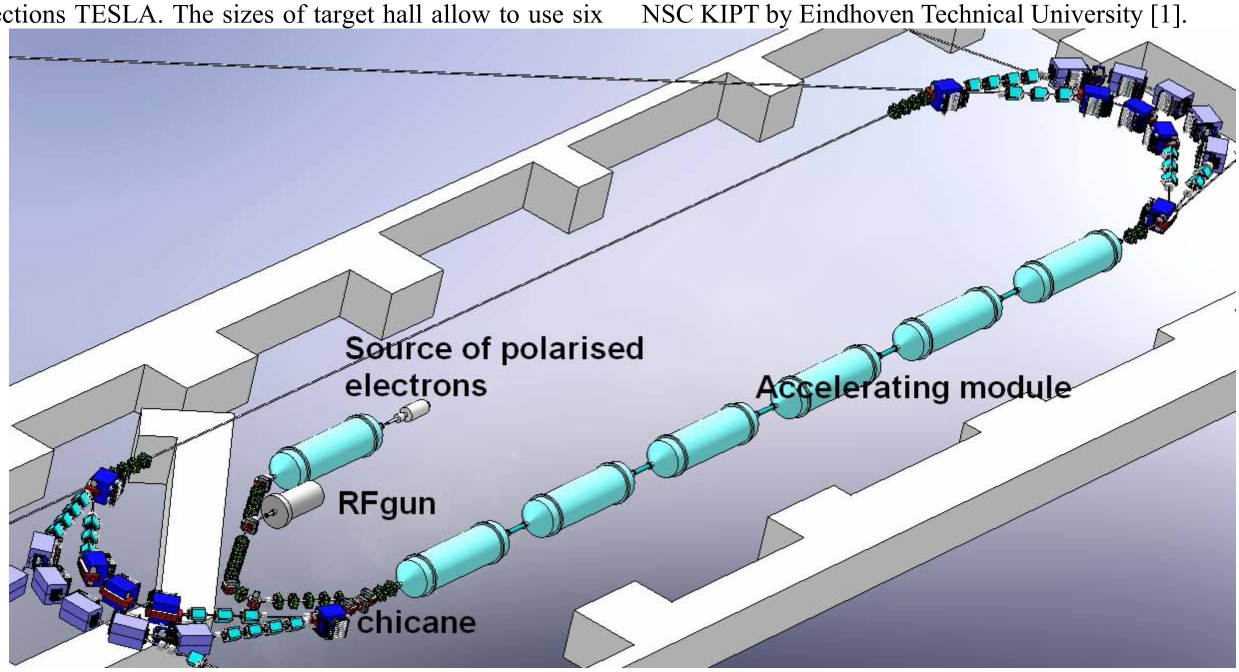

Figure 2: Recirculator SALO on the peak energy 730 MeV.

THE ELECTRON BEAM LINES FROM SALO RECIRCULATOR TO PHYSICAL INSTALLATION

The basic recirculator operating modes, which allow to output beams for experiments on a nuclear physics are featured in [6], and structure of the beam lines in [7].

For operation on the physical program [2] the developing of five beam lines A, B, C, D and E (see Fig. 1, 3, 4) are provided. The maximum energy of electrons on lines A, B, C is equal 730 MeV, and on lines D and E - 490 MeV. The lines magneto-optical structure is chosen from conditions of satisfaction of experiment requirements fulfilment [7]. For all beam lines they are almost identical close: the cross sizes of a beam on the targets - ± 0.02 cm; divergence - ± 0.05 mrad.

Proceeding from these requirements the structure of beam focusing on beam lines got out. On Figs. 3 and 4 general views of magneto-optical structures of the channels, providing given parameters on targets are presented.

The accelerator design provides an opportunity of its operation as driver of subcritical reactor [8]. For this purpose making special line which possible directions are shown in Fig. 1 and are designated N1-N3. At designing this line the main attention should be given to minimization of beam losses which mean power will be close to 130 kW.

The free electron laser (FEL) can be disposed in the free rectilinear recirculator gap, and radiation can be output in a direction of channel E. The second place for arrangement of the laser - the channel C.

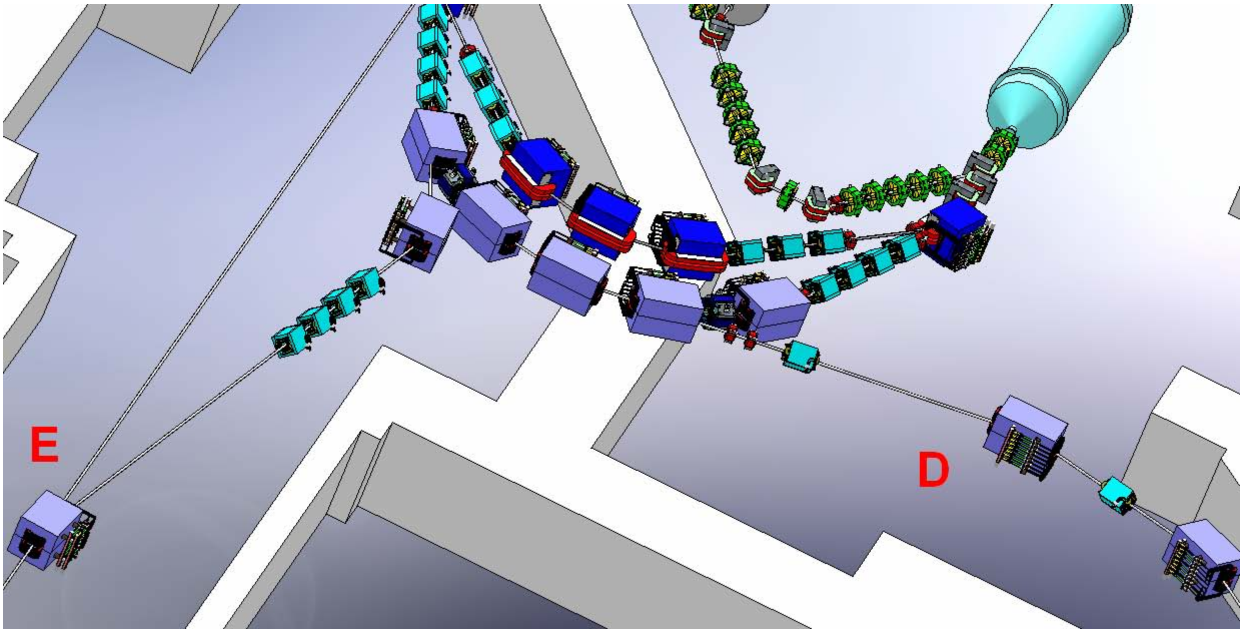

Figure 3: E, D beam lines.

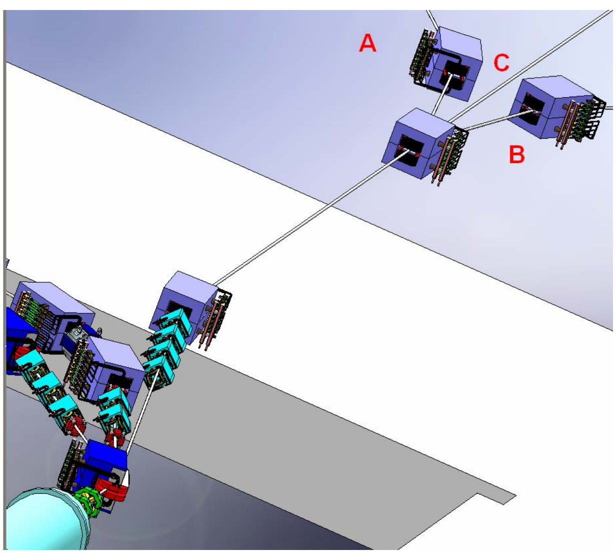

Figure 4: A, B, C beam lines.

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