CURRENT STATUS OF THE DESIGN OF THE KHARKOV PULSE STRETCHER RING PSR-2000

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Abstract

Struktural and engineering designs of the PSR-2000 are completed on the whole. Stands for investigations magnetic, vacuum, RF elements as well as some experimental units are constructed. In the design, the first stage of realization is determined. It will allow us to obtain a continuous electron beam with energy of 1.5 GeV and average current of 5μA, and to start nuclear investigations in the existing experimental hall. Engineering and technological problems are discussed in this report.

I. INTRODUCTION

The currently central problem of the accelerator physics and engineering is the production of continuous electron beams of energies ranging from a few MeV to several GeV. Such beams are required for investigating the subnuclear degrees of freedom in the nucleus. The design work for the pulse stretcher ring PSR-2000 at the output of the operating at Kharkov 2GeV electron linac [1] was started several yeas ago. The basic design parameters of the setup have been given in [2,3]; the operation of the PSR-2000 in mode of low radiation emittance as a source of synchrotron radiation has been considered in [4]. By the present time the engineering aspect of the design is completed.

II. GENERAL DESCRIPTION AND DESIGN PARAMETERS

The magnet lattice of the PSR-2000 consists of four superperiods ensuring the achromaticity of straight sections. Each superperiod comprises 8 dipole and 12 quadrupole magnets. To compensate the chromaticity, each arc section has 4 sextupole lenses, and each straight section comprises one sextupole lens to adjust the ampiitude and the phase of the 16th harmonic of the sextupole field during a slow extraction at the third-order resonance. The detuning of betatron oscillations and adjustment of the angle of extraction are corrected by means of pulsed quadrupole and sextupole lenses. The achromatic and chromatic regimes of slow extraction were optimized by the use of the DeCA package [5]. The beam injection to the ring is carried out with septum magnets bringing the beam on the reference orbit perturbated by three pulsed bump magnets. The reference orbit in the two planes was corrected with 30 dipole correctors.

The RF system is based on 4 sections, each consisting of Ω-shape cell. The operating frequency is 699.3MHz, the power of each of four klystrons is 100 kW, the accelerating voltage is 3 MV. The beam parameters are monitored by pickup stations, RF and magnetoinduction transducers, against synchrotron radiation, etc. The basic structural material of the vacuum chamber is an aluminum alloy. The chamber is elliptical in the cross section, the semiaxes being 70 and 19 mm. In the dipole magnets of the storage ring the chamber with an antichamber is used. The PSR-2000 design incorporates the arrangement of an internal jet target with an appropriate detecting equipment, the systems of photon tagging and monochromatic gamma-photon beam production through Compton interaction of laser light with the electron beam. The main parameters of the PSR-2000 are presented in Table 1.

Table 1

Parameter	Stretching mode	Low rad. emittance mode
Beam energy, GeV	0.5...3.0	0.75...2.5
Stored current, mA (multibunch mode)	140	400
Average current, μA	30	-
Emittance, mrad -horizontal -vertical	 10^{-7} 10^{-8}	 (2...15) 10^{-8} (2...15) 10^{-9}
Duty factor	0.9	-
Energy spread, %	0.1	-
Momentum compaction factor	0.048	0.021
Orbit length, m	214.78	214.78

The report on the state of the setup design has been presented at the European Particle Accelerator Conference EPAC-92 [6], but for the last year the project has undergone substantial changes due to the following circumstances. The realization of the project in its full scale would recuire, apart from the construction of the PSR-2000, the updating of the linear accelerator now in service and the construction of new experimental halls. In this connections, two stages are allowed for the implementation of the project. The first stage provides for a continuous beam of energy up to 1.5 GeV and a current up to 5 μA. This can be reliable attained by using the linear accelerator-injector and the existing facilities in the operating experimental halls. The setup is mounted in a skeleton-type structure, which also comprises two halls for conducting synchrotron radiation experiments. The design of the structure is such that it allows its subsequent development as needed. Besides, we have adopted in the project the concept of a demontable biological shield. This allows us to start the commissioning of the facility at a shield thickness of 1m, with its further build-up as the beam intensive grows. In the sections where the beam losses exceed the average value, the local shield is built. The general arrangement of the PSR-2000 units at the 1st stage is shown in Figure 1.

III. CURRENT STATUS OF THE PSR-2000

The development of the 1st stage of the PSR-2000 construction is completed. All equipment necessary for commissioning the setup is devised. Test beds are created to investigate magnetic systems, vacuum and RF systems as well as diagnostics tools. Pilot samples of the 699.3 MHz RF klystron with a meanpower of 100 kW as well as the vacuum chamber of beam transport lines and straight sections of the ring are made. Machine-tool attachment are made to fabricate the dipole-magnet vacuum chamber. The scale models of beam diagnostics components are made.

IV. CONCLUSION

The design work in extent necessary for realizing the scope of the 1st stage is completed. Now the pilot components are being fabricated, though at not such a good pace as desired, this being due to many economical difficulties. The realization of the project will depend on how successfully the problems of financing the setup construction and fabrications of the equipment will be solved.

V. REFERENCES

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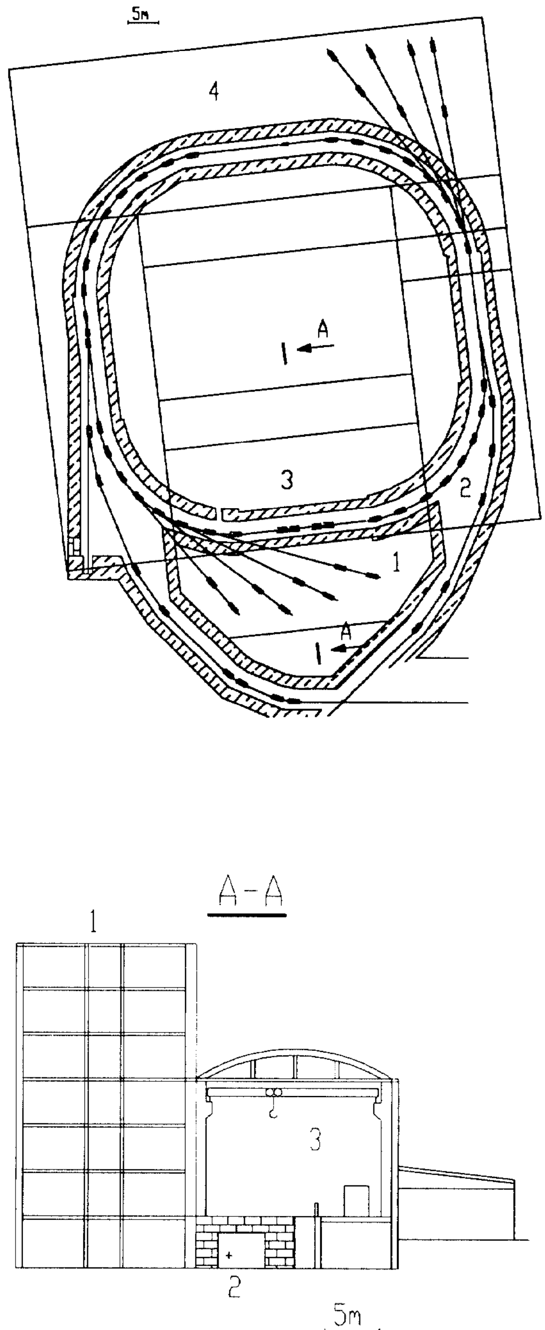

Figure 1. Layout of the PSR-2000. 1 - laboratory with underground synchrotron radiation hall; 2 - PSR-2000 ring; 3 - main hall; 4 - synchrotron radiation hall.