PSR-2000. An Injecting System

Peter Gladkikh, Ivan Karnaukhov, Stanislav Kononenko,
Alexander Shcherbakov,
Michael Strelkov, Andrey Zelinsky

Kharkov Institute of Physics and Technology, 310108, Kharkov, Ukraine

Abstract

The channel structure for electron beam injection from 2 GeV linac to PSR-2000 with the energy spectum compression system and the electron spin control system is presented. The beam injection into the storage ring by bump-method in all the operating regimes is considered.

1. BEAM INJECTION SYSTEM

The pulse stretcher ring PSR-2000 [1] is intended for using under several modes of operation such as:

- injection and slow extraction of an unpolarized electron beam at Q_x=16/3 and Q_z=11/2 resonances;
- injection and slow extraction of a polarized electron beam at Q_x=16/3 and Q_z=11/2 resonances;
- generation of synchrotron radiation (SR) with the betatron oscillation frequencies Q_x=8.26 and Q_z=7.16.

Each of these modes of operation specifies particular operation of the injecting system, which includes the channel for beam transport from the linac to the exit of the injection magnetic septum and three kickers initiating a local perturbation of the reference orbit on the radial plane during injection.

The lattice of the transport channel and the envelopes of the injected beam are shown in Fig.1.

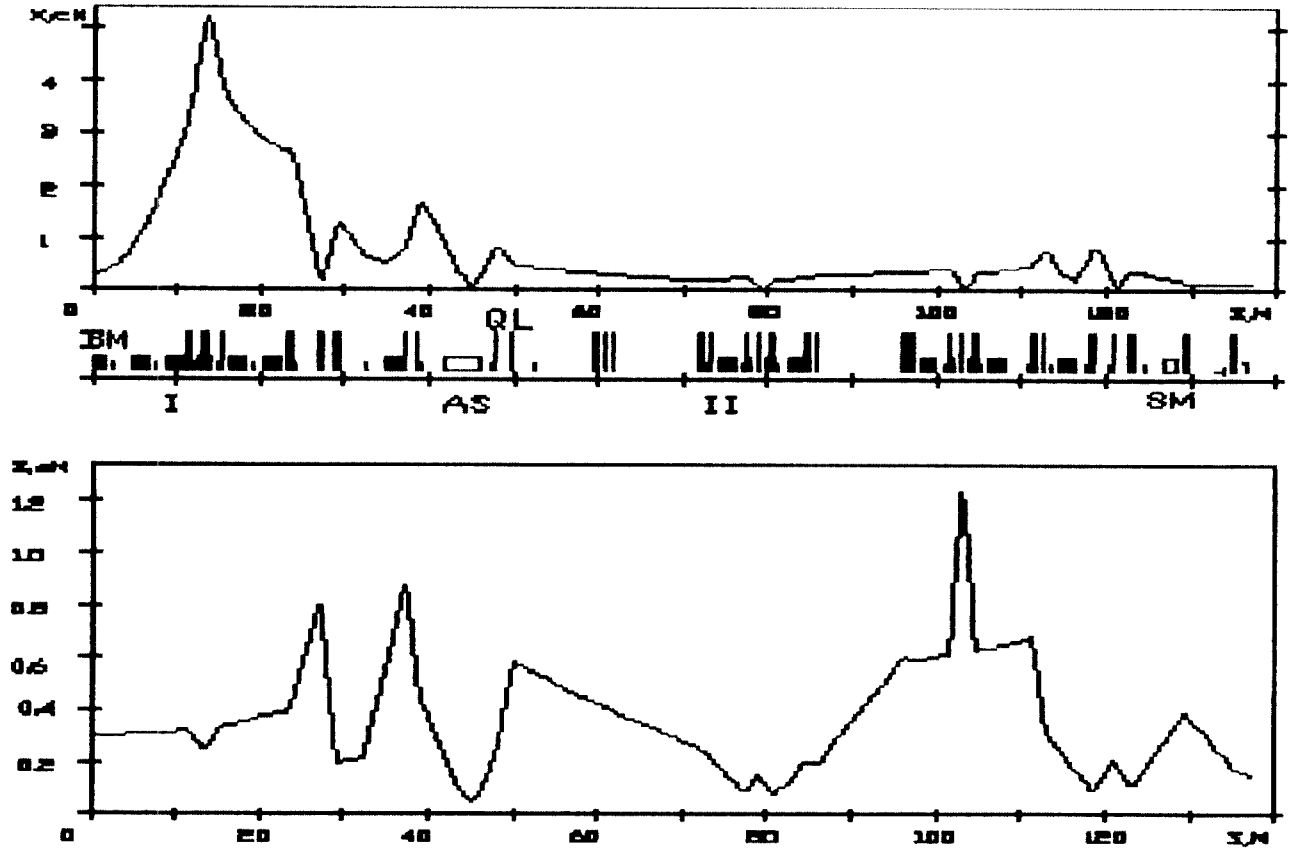

Fig.1 Envelopes of injected beam

In the initial section of the channel (I-AS) there are located the magnetic debuncher and the compressor unit. On using the 60 MeV accelerating section, the phase advance of 45 deg in the debuncher per 1% of the energy spread makes it possible to reduce the latter from 1% at the linac output down to 0.1% after the compressor [2].

Section II of the injection channel comprises a wide-range spin rotator which transforms the longitudinally-polarized electron beam from the linac to the transversely-polarized beam at the rotator output. The spin rotator consists of six magnets with a total bending angle of 45 deg, two magnets with a total bending angle of 22.5 deg, and two solenoids. For the solenoids fields B_sL_s<15T·m this structure ensures the polarized beam transfer from the linac to the PSR in the energy range between 0.6 and 2.9 GeV [3].

The radial and vertical β-functions in the long straight-line injection and extractin sections are shown in Fig.2.

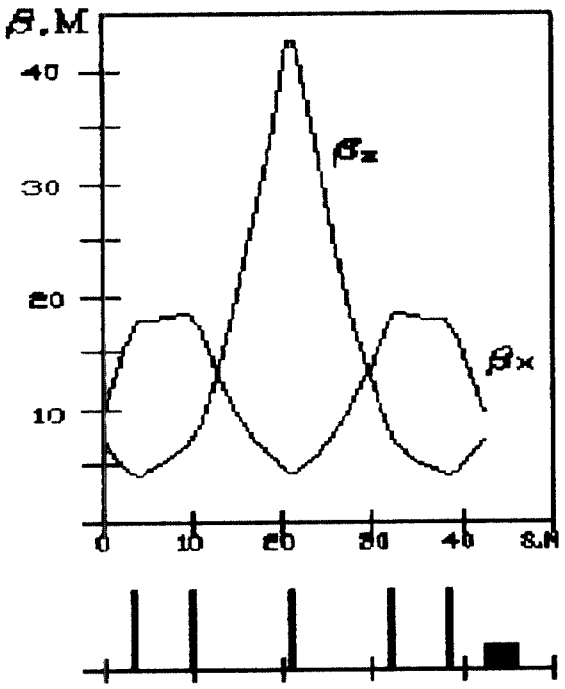

Fig.2 β-functions

The injection and extraction are carried out in the sections with the constant β_x, the β_x value being the highest at the superperiod in these sections. This makes possible to inject end extract the beam at optimum angles, that are close to zero, and to provide the highest amplitude of particle oscillations in the process of extraction on the azimuth of the extracting devise.

Figure 3 depicts the trajectories of the injected and circulating beams in the straight injection section under different PSR operation conditions.

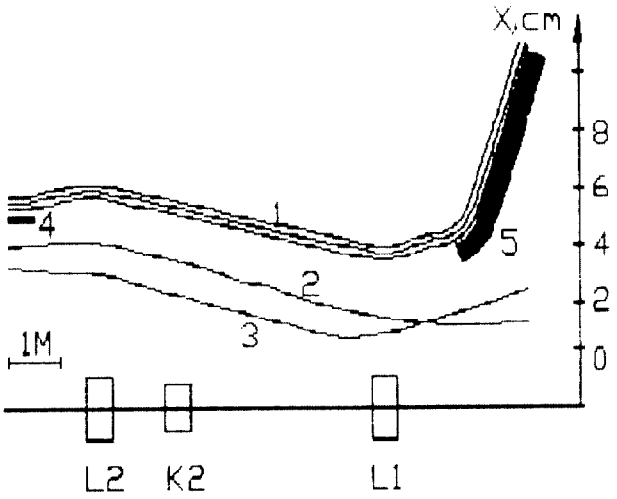

Fig.3 Beam envelopes in the injection section

In the parametric resonance extraction mode of operation, the section of a "thin" injection septum seems most critical from the viewpoint of possible losses of the injected and circulating beams. Here, the separatrix orientation is such that with the pitch Δx=10 mm the extracted particle trajectories appear to be at a distance of 6 mm from the "thin" septum. During the extraction at the third-order resonance, for the pitch Δx=15 mm the extracted particles pass at a distance of 7 mm from the "thick" injection septum. To avoid possible significant losses of the injected and circulating beams, it is necessary to ensure a precise correction of the reference orbit in the srtraight sections of beam injection and extraction.

The bump value is estimated to be 45 mm for all modes of PSR operation. To attain this distortion of the reference orbit for an injection energy of 3 GeV, it would be necessary to install kickers with B_kL_k>0.03 T·m. For this purpose we intend to use ferrite kickers which would be mounted on ceramic plates inserted in a vacuum chamber of the storage ring. At times-off τ_{off}<500 ns these kickers would provide the two-turn injection for the modes of extraction at the third-order resonance and operatin as a SR source, and the one-turn injection for the other operation conditins.

2. REFERENCES

[1] S.Efimov et.al. "Pulse Stretcher Ring PSR-2000. The current status" These proceedings (1992)

[2] P.I.Gladkikh et.al. "Parallel transfer of the 2 GeV ELA. A system of beam energy compression." Vopr. At. Nauki i Tekhn., ser. Yaderno-fizicheskie issledovaniya. Is. 3/11/ 1990, pp. 56-59 (in Russian)

[3] A.Zelinsky , I.Karnaukhov, A.Shcherbakov "Polarized Electron Beam in the Pulse Stretcher Ring PSR-2000" These proceedings (1992)