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STATUS OF INJECTION COMPLEX VEPP-5: MACHINE COMMISSIONING AND FIRST EXPERIENCE OF POSITRON STORAGE

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Abstract

The VEPP-5 Injection Complex will supply BINP RAS colliders with electron and positron beams. Primary launch have been performed: electron and positron beams were obtained, injection to damping ring have been done, as well as storage of electrons and positrons. At present time test extractions of electron beam with energy of 360 MeV into beam lines to users are being performed. Main users require a reliable and troubleproof source of particles, thus reliability and stability of operation are the paramount task.

INTRODUCTION

VEPP-5 Injection Complex consists of 270 MeV driving electron linac, 510 MeV positron linac and dumping ring. Both linear accelerators are based on four accelerating modules, each one feeds by one SLAC klystron (5045). Two first modules have three accelerating structures and second two — four structures. Both linacs can operate at 50 Hz repetition rate. (See Figure 1) Dumping ring stores and cools down both electron and positron beams. (See Figure 2) It is equipped by 50 Hz injection system. Designed parameters of VEPP-5 Injection Complex are presented in Table 1. At the parameters listed above VEPP-5 Injection Complex will be able to cover all needs of BINP e+ e- colliders (VEPP-4M and VEPP-2000) for nearest future. Only with new injection complex these colliders can reach their maximum luminosity.

Table 1: Parameters of Injection Complex

Beam Energy (MeV)	510
Max. number of electrons in the bunch	$2\cdot10^{10}$
Max. number of positrons in the bunch	$2\cdot10^{10}$
Energy spread in the bunch (%)	0.07
Longitudinal bunch sigma (mm)	4
Vertical emittance (mm• mrad)	0.005
Horizontal emittance (mm• mrad)	0.023
Dumping times vert./horis. (ms)	17/11

Figure 1: Linear accelerators.

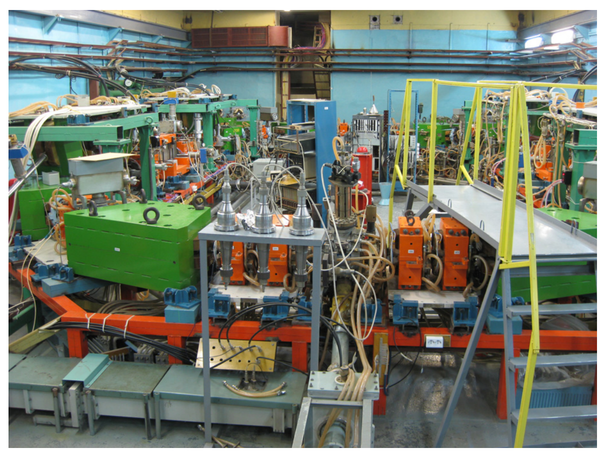

Figure 2: Damping ring.

Figure 3: Transfer line K500 to VEPP-2000.

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COMMISSIONING PLANS

The VEPP-5 Injection Complex should be running in the near future. Damping ring of the Complex stores the electron beams of 350 MeV today. Store rate is 3•109 electrons per pulse and maximum store current is 160 mA, which exceeds design parameters in many times. Beam transfer line K500 is completely assembled and ready for beam accepting. The Damping ring optics were tuned to improve the Complex stability. Also new beam diagnostics were installed to ease beam injection in the Damping ring. The diagnostics methods and equipment are described below.

Fiber Beam Loss Monitor

This monitor can find place of particles losses. It is very useful for accelerator tuning especially for first beam pass. Test of the Monitor was done on beam transport lines between linacs and dumping ring. Along vacuum chamber three optical fiber peace's were laid. Photo electronic multipliers were connected with end of the fibers (See Figure 4). Then signal was transferred to oscilloscope. Figure 5 show an example of the monitor running.

Flashes of intensity emerge in locations of high beam losses. Spatial calibrating of the facility has being proceeded via artificial dropping of the beam against the vacuum chamber in known place. Due to short duration of the flash of Cherenkov light the monitor is sufficiently fast, which allows measuring energy losses in a dumping ring for each turn and continuously controlling and minimizing beam losses during the injection.

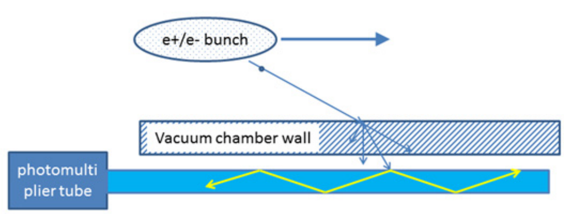

Figure 4: Scheme of beam loss monitor.

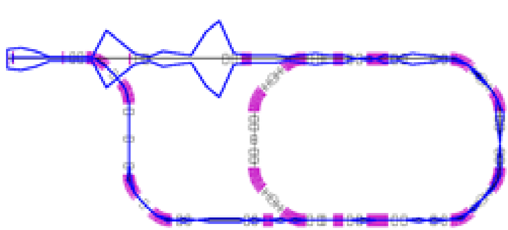

Figure 5: Beam loss signal.

Lattice Correction

One of the most crucial issues arising during launching the dumping ring is a presence of optical parameters inaccuracies in a real structure. Thus, detection and removal of such inaccuracies are tasks of highest priority in achieving the stable functioning of the complex.

First betatron tunes were set to the project values. After that software "sixdsimulation" developed for VEPP-2000 [1], was applied to correct linear lattice and closed orbit. It took 4 iterations to correct linear lattice by fitting the model to the experimental data composed of closed orbit responses to the all dipole correctors, dispersion, and betatron tunes. After last iteration the fitted model didn't show significant variation from the ideal configuration. Closed orbit correction was done with respect to the quadrupole magnetic centers (See Figures 8-9). To do so closed orbit responses to the gradient variations of the individual quadrupoles.

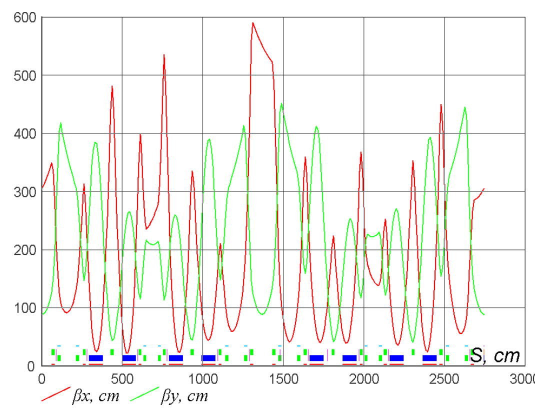

Figure 6: Beta functions after linear lattice fit to best describe experimental data.

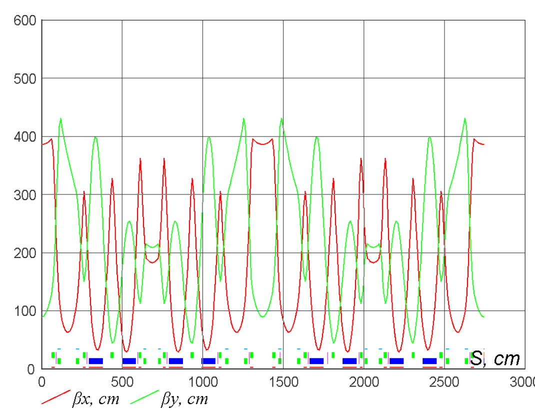

Figure 7: Project beta functions.

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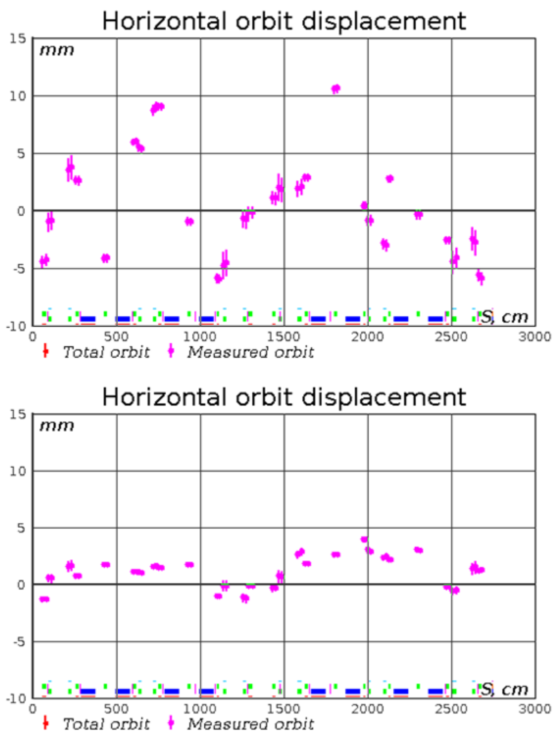

Figure 8: Orbit correction. Top – before correction, bottom – after.

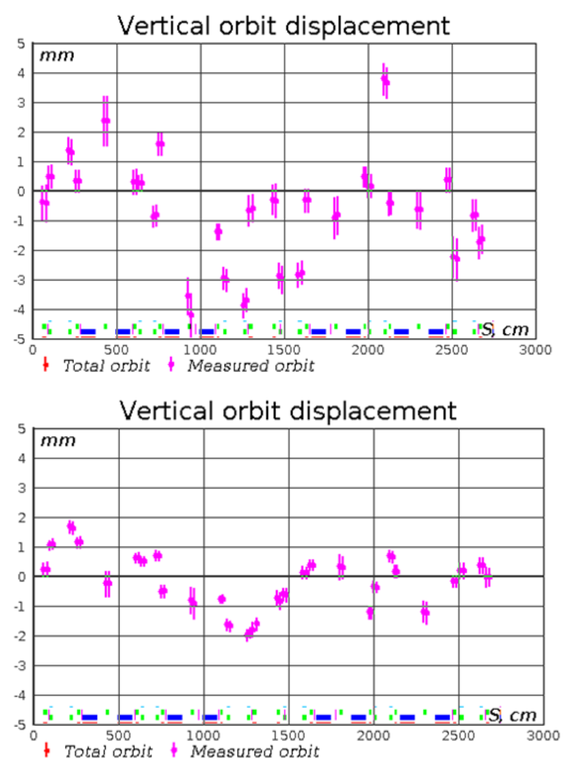

Figure 9: Orbit correction. Top – before correction, bottom – after.

REFERENCES

[1] A. Romanov et al., Round Beam Lattice Correction using Response Matrix at VEPP-2000, Conf. Proc. IPAC-2010, THPE014 (2010).