THE COMMISSION OF HEFEI LIGHT SOURCE AFTER RECONSTRUCTION

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Abstract: :Hefei light source was updated. Both the kicker system and RF system were reconstructed completely, and commissioned well. Two methods were used to suppresse transverse coupling instability. After the effect of SCW is compensated, beam life was increased. The global closed orbit is realized firstly in Hefei electron storage ring.

INTRODUCTION

HLS is a dedicated synchrotron radiation light source. It consists of a 200 MeV linac, a beam transport line, and an 800 MeV electron storage ring. The phase II project of HLS have many improvements for every sub-systems including injection system, RF system, control system etc. The commission of all the sub-systems is important work.

THE INJECTION SYSTEM UPDATED

The old three-kicker injection bump system of the HLS ring, lattice-dependent, was composed of three air-core coils in vacuum chamber, which meet the requirements of the current operation mode(namely, GPLS) well. To improve the debugging of the high brightness operation mode (namely, HBLS) of HLS and the stability of the long-term operation, Phase II Project of NSRL will adopt a new compact injection system.

The new four-kicker injection bump system of the HLS ring, lattice-independent, was composed of four coils of ferrite dominated core out of ceramic chambers, shown in Fig1, and mounted in one long straight section which length is three meters. After the new injection system was mounted, it is found that the magnetic field of four–kicker magnet through the same pulse current is different each other, the main reason is what the timing of the pulse magnet fields produced by kickers is not same, shown in Fig.2, so the four-kickers can not form completely local bump, and produce large global orbit distortion, and lead to beam loss. At last we found that the films of ceramic chambers were plated unevenly. So the new ceramic chambers were plated evenly. In the same time, to reduce the beam loss supplement direct current bump was added, and above 200mA beam intensity can be stored. workstations are mainly used to control the ring main magnet power supplies and other key subsystems.

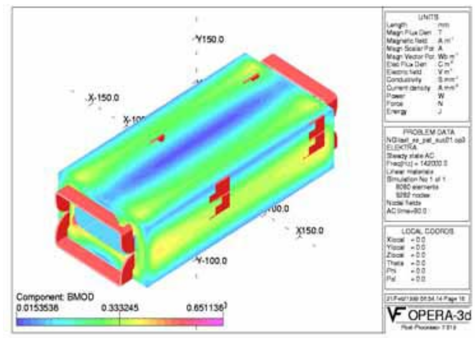

Figure 1: The model of new kicker magnet.

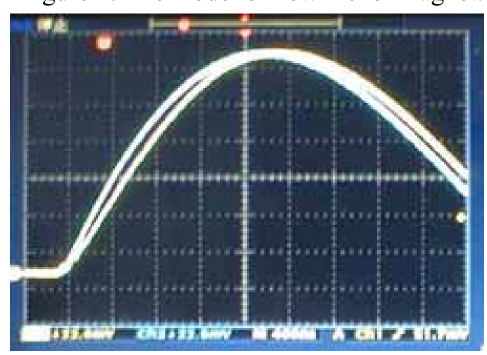

Figure 2: The delay of two kickers magnet field.

THE NEW RF SYSTEM

The old rf system have no low level controls, which was working in the situation of large detune angle, and the cavity voltage always change while beam is injected. The big reflected power often destroyed the rf power supply. Due to large reflected power, the rf power supply can not output enough power for high beam intensity, so the old rf system limited the operation beam intensity. The new rf system have low level control circle circuit, shown in Fig3, which are the frequency automatic adjustment system and amplitude automatic adjustment system. Because the energy of injection electron beam is 200MeV, synchrotron radiation loss is much small and radiation damping is weak, and storing beam is not much stability, so to get amplitude controlling circuit do not disturb the injection beam, the gain of amplitude circuit was adjusted to the small value on purpose. In the same time, the beam load is large, and Robinson instability [1] happen easily, so the small detune angle is preset, and

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after ramping end, the small detune angle will be set to close tune situation. Now the new rf system can work well.

Figure 3. The low level setup of RF system.

Figure 4: The octu-pole magnet mounted in ring.

THE SUPPRESSION OF TRANSVERSE COUPLE BUNCH INSTABILITY

In the process of injection, transverse beam instability limited the beam intensity. So two methods were used to suppress the instability. Two octupoles were inserted in storage ring for producing Landau damping to damping instability, shown in Fig.4. The tune spread is calculated under following formulae[2]:

$$\Delta \nu = \frac{3}{8}\left\langle \beta^2 \frac{k_3}{6} \right\rangle \left(\frac{a^2}{\beta_0} \right) \qquad 1$$

where β is Beta function, a is oscillation amplitude, $k_3 = \frac{1}{B\rho}\frac{\partial^3 B_y}{\partial x^3}$ is the intensity of octupole magnet. After octupole magnet inserted, the injection beam intensity can be up to 300mA.

And over compensated chromaticity[3] was adjusted to suppress transverse couple instability, shown in Fig 5. The two methods is in effect for suppress the beam instability.

THE GLOBAL CLOSED ORBIT

In Hefei storage ring, the global closed orbit was corrected automatically, and local bump correction was realized also. The SVD method was used for correcting closed orbit. The correction system of beam orbit in HLS is composed of 24 Bergoz BPM model,digital process by VXI system, compute & process by industry PC finally, realize digital sharing by network interface(using UDP agreement), EPICS providing the CA serve, 16 horizontal corrector and 16 vertical corrector.

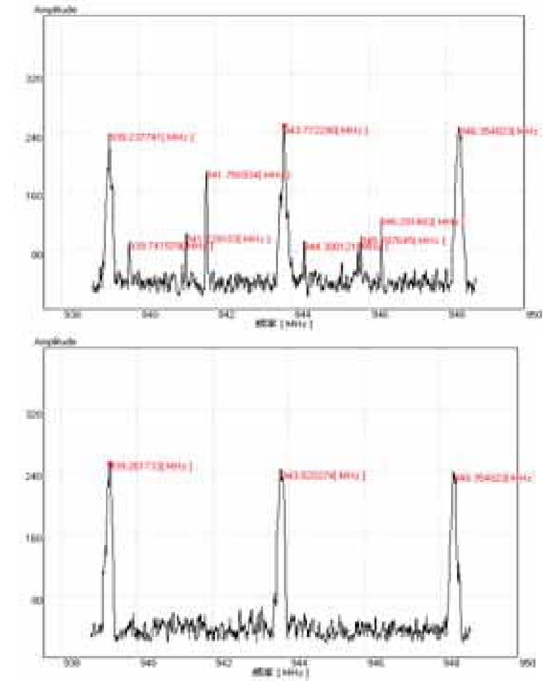

Figure 5: (up) The frequency spectrums of beam under oscillation, (down)The frequency spectrum of beam after the over compensated chromaticity is adjusted.

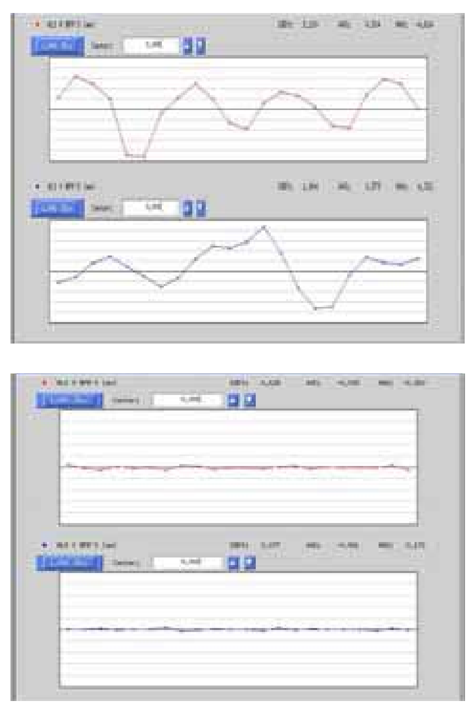

Figure 6: The electron beam orbit before and after the closed orbit correction.

THE LATTICE COMPENSATION OF SCW

Superconductor wiggler which peak magnetic field is 6 Tesla is mounted in ring, and it bring the variation of beta function and tune shift. By adjusting the intensity of local quadrupole magnet, tune shift was compensated, shown in Figure 7, but the beam lifetime decreased from 8 hours to about 3 hours, and seriously influenced the operation of Hefei light source. Again, by adjusting the K of global quadrupole magnet, both the beta functions and tune shift was compensated to situation ago, shown in Figure 8. The beam lifetime was improved, shown in Figure 9.

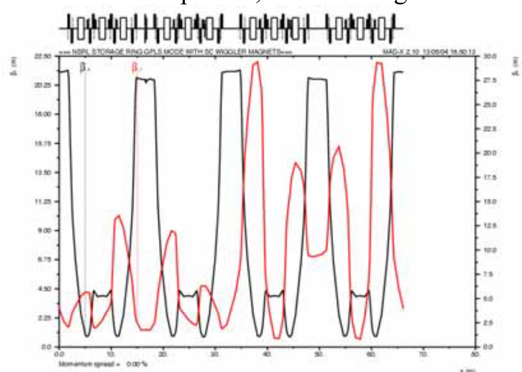

Figure 7: The beta function after local compensation.

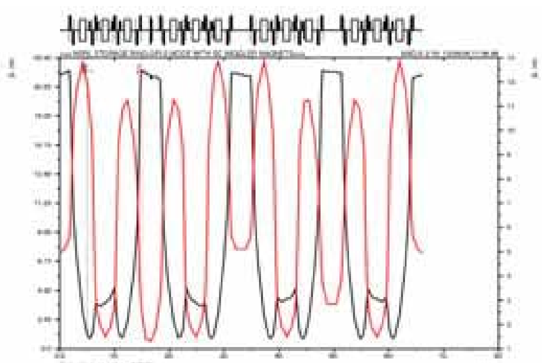

Figure 8: The beta function after global compensation.

Figure 9:The beam lifetime after global compensation.

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