ADJUSTMENT OF THE LINAC AND TRANSPORT LINE OF NSRL

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1. INTRODUCTION

The Synchrotron Radiation Facility of NSRL (National Synchrotron Radiation Laboratory) is mainly composed of an 800Mev electron storage ring and a 200Mev Linac. The 200 Mev is not only an injector of the 800Mev storage ring, but an electron accelerator used for nuclear physics research and applications in other fields as well (Fig.1).

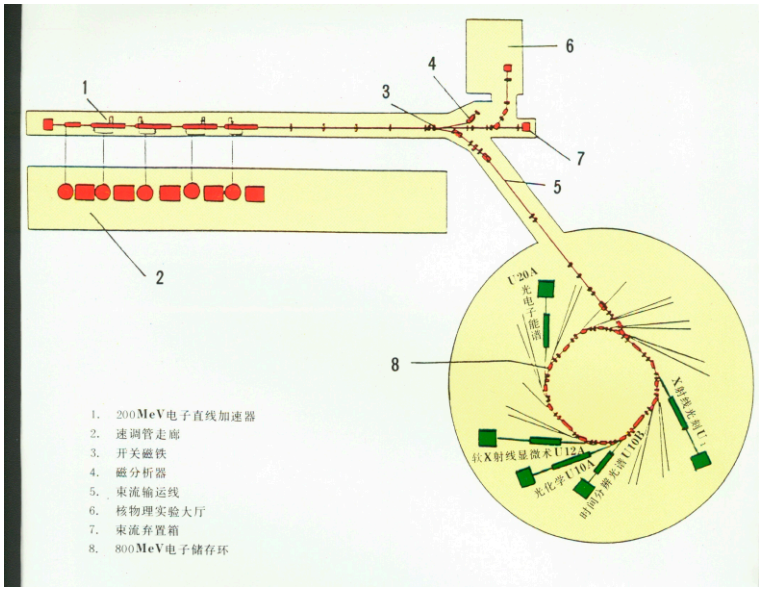


Fig.1 Layout of the linac, transport line and storage ring of NSRL

The Linac tunnel, which is about 80m in length, was constructed semi-underground. In order to protect the safe of the environment, the layer of the mixture of soil and stone covers the tunnel, which is about 4 meters in thickness (fig.2). Because the building was completed at the end of 1986, there were not much time for it to be stable before the Linac was installed. The tunnel ground has sunk a lot in the following years. The Linac's initial operation was successful on November 9, 1987. Since then the Linac and the followed Transport Line orbit plane has not been adjusted though it functioned normally by using steering coils. But the uneven sinking of the tunnel had made its operation more and more difficult. So, in the spring of 2000, the group of alignment of NSRL took a large scale of adjustment of the Linac and the Transport Line.

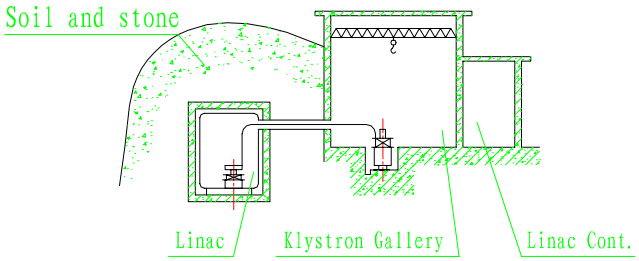
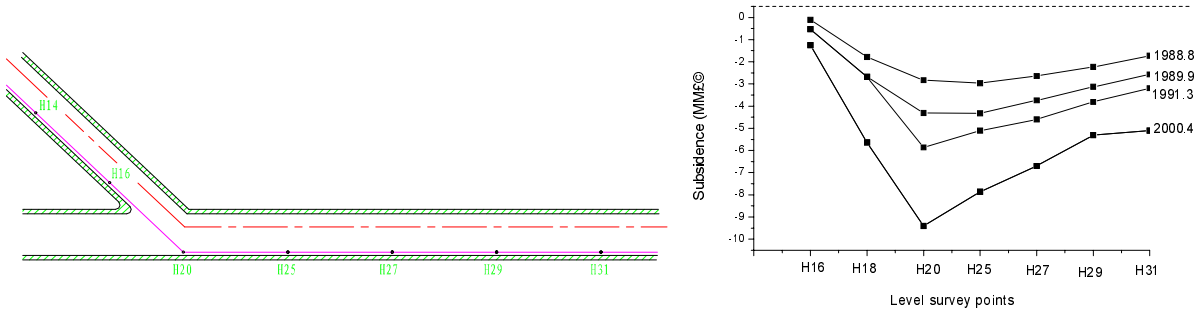


Fig.2 Cross section of the tunnel

2. ADJUSTMENT OF THE ORBIT

The tunnel subsidence VS time is shown in Fig.3, in which the part from the points H16 to H20 shows the subsidence of the Transport Line tunnel. We can see that there were uneven sinking along the tunnel during the past years. At the pre-injection end the subsidence was relatively small, but at the end of the straight part of the tunnel, the subsidence got the largest. By April of 2000, the largest subsidence was about 9.5 millimeters.



(a) Level survey points along the tunnel (b) Subsidence of some points

Fig.3 Tunnel subsidence VS time

Using the Spoton system, which will be introduced later, we can measure the relative displacement of the reference line of the Linac and Transport Line electron beam orbit. The displacement includes the vertical and horizontal directions (see Fig.4 and Fig.5). Because the adjustment of horizontal displacement is very easy, we should pay more attention on the adjustment of vertical displacement. The relative displacement plus the tunnel subsidence is the absolute displacement of the reference line of the orbit.

How to adjust every part of the Linac and Transport Line to make the orbit comfort to or get closer to the ideal line? Before that adjustment, the steering coils to rectify the electron beam orbit. But the operation became more and more difficult. And it is very difficult to adjust all the parts just on the ideal line and it is not necessary to do so. We have to find an orbit line, which has an even changing law and can be easily corrected by using steering coils. If we

want to adjust all the displaced parts to the ideal line, the joins of the accelerator units, the vacuum seal joins of the waveguide etc. may be disrupted. So we choose a point where has a steering coil as the starting point, which is the point of No.20 (Fig.6), and the following points would be adjusted to the same high as it. The deviation of the adjusted orbit from the ideal orbit is about 2.5mm.When the machine is operating, the deviation can be adjusted by using the steering coil. All these just are the first step of our adjustment. In the coming years, we shall adjust other points which were not be adjusted that time, and shall make the actual orbit comfort to the ideal orbit step by step.

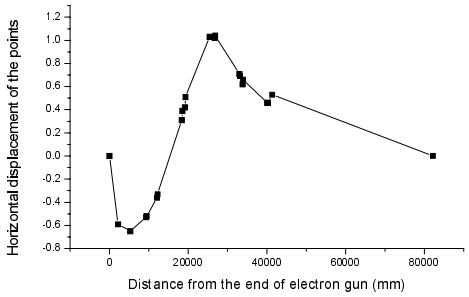


Fig.4 Horizontal displacement of the points.

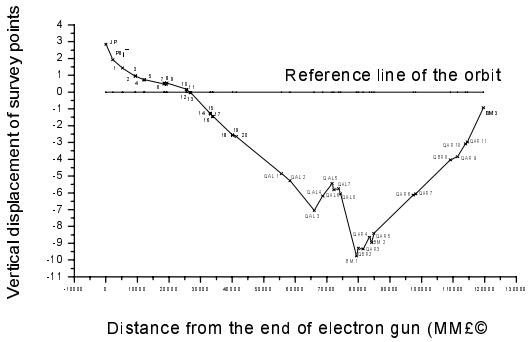


Fig.5 Absolute vertical displacement of the points

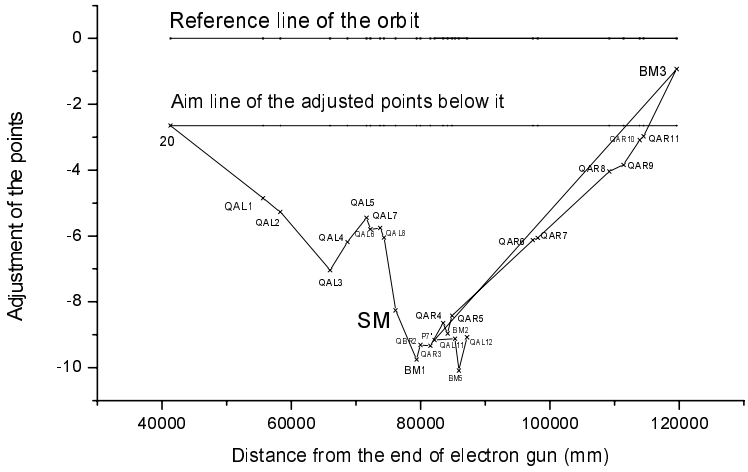


Fig.6 Adjusted points and the displacement

3. INSTRUMENTATION

Besides using these conventional instruments, for example the Wild N3 precision level, T2 theodolite, etc., we also used the Spoton Optical Beam Position and Power Measurement System (Fig.7), which is produced by the Duma Optronics Ltd, Israel. This system uses large area silicon Position Sensitive Detectors (PSDs) to detect and record the position of an

incident light beam. It is computer-card-level devices that plug directly into a personal computer. Each instrument consists of a detector head with attached cable, a standard half-size computer card, and control software. Its position measurement range is 8mm diameter circle maximum, the position resolution is ±1μm, and the position accuracy is ±50μm over 8mm diameter calibrated area. We use this system, a He-Ne laser light source and a series of Fresnel lenses (Fig.8) to establish an alignment system. Using this system we measured the relative displacement of the points on the reference line of the beam orbit.

Fig.7 SpotOn System

Fig.8 Fresnel lenses

4.CONCLUSION

We completed the adjustment by the end of July. During the later commission of the machine, the Linac was operated normally, and the electron beam from it passed through the transport line more easily and steadily.

5.REFERENCE

[1] Yuanji Pei, Defa Wang, Douhui He, *200 Mev LINAC-INJECTION FOR HESYRL RING*, Proceedings of the International Conference on Synchrotron Radiation Applications,1999,Hefei,China.

[2] Chao Zhang, Sakou Matsui, *First Alignment Result of the Storage Ring Magnet Units*, Annual Report,Spring-8,117-118.