STATUS OF KEKB

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1. INTRODUCTION

KEKB [1] is an electron-positron B-factory two-ring collider. The energy of the electron ring (called HER) and that of the positron ring (called LER) is 8GeV and 3.5 GeV, respectively. Two rings were constructed in the tunnel for the TRISTAN experiment [2], the preceding experiment. The construction was completed in the end of November 1998, and the beam commissioning was started in December. Since then, KEKB has been successfully accumulating B-meson events improving its performance dramatically to achieve the luminosity design value $10^{34}/cm^2 \cdot sec$.

2. STATUS OF THE KEKB OPERATION

The KEKB operation has been going quite well. The accumulation of luminosity at KEKB is shown by the blue curve in Fig. 1. The integrated luminosity has exceeded 100/fb on 26 October 2002. The maximum peak luminosity achieved is $8.3 \times 10^{33}/ cm^2 \cdot sec$, about 10 times larger than that at CESR. The best record for the luminosity accumulation in a day is 434/pb·day. The operation

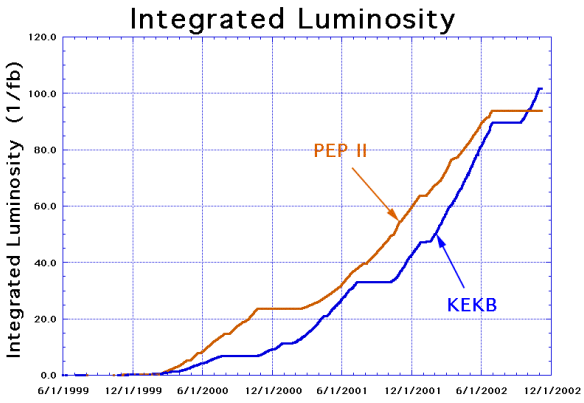

Fig. 1 Accumulation of the luminosity. The blue curve shows the accumulation at KEKB, and the red curve that at PEP II.

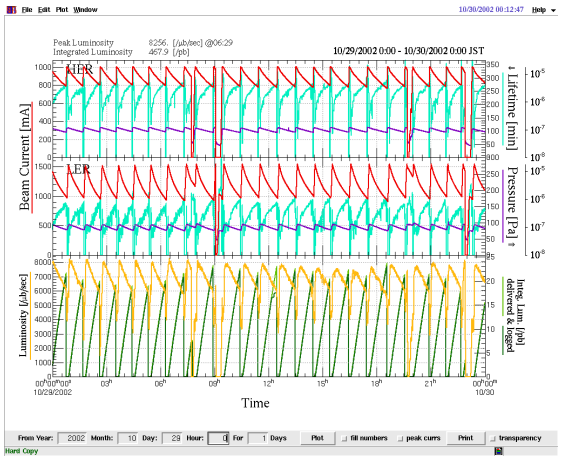

Fig. 2 One-day status for the beam operation on 29 October 2002, when the new record was obtained for one-day accumulation of the luminosity.

status for the day, when the best record on one-day accumulation of the luminosity was achieved, is shown in Fig.2. The top and middle plots in the figure show the status for HER and LER, respectively. The red curve shows the beam current, and the green one the beam life. Maximum beam current achieved is 1,610mA for LER and 1,006mA for HER. The bottom plot in Fig.2 shows the status for the luminosity accumulation. The orange curve shows the luminosity value and the green one the integration of the luminosity for each running period.

3. DRIFT OF THE KEKB TUNNEL LEVEL

Before the construction of the KEKB ring, the center height of the TRISTAN quadrupole magnets was marked on the tunnel wall. The level of these beam level markers was surveyed. Fig.3 shows the results of the survey carried out during the period from February to June 1996 (blue curve) and in August 1997 (red curve). The level was lower in the south arc than that in the north arc by about 14mm in 1996. This is the accumulation of the drift of the tunnel level during the 9-year operation of the TRISTAN ring. The difference of the tunnel level between the north and south arc increased by about 4mm in a year from 1996 to 1997.

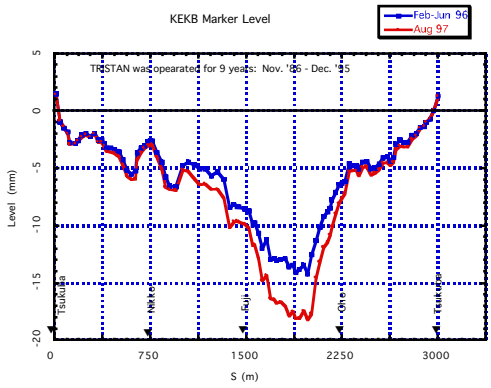

Fig.3 Survey results for the level of beam level markers. The blue and red curves show the results of survey during the period February to June 1996 and that in August 1997, respectively.

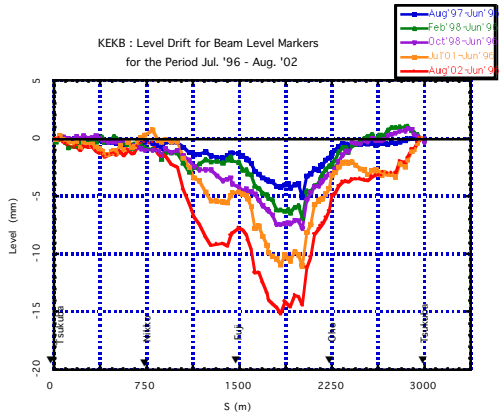

Fig.4 Drift of the level of beam level markers in recent 6 years. Each curve shows the deviation from the level surveyed in spring 1996.

At the time of the KEKB construction, magnets were set level correcting this tunnel level variation. KEKB beam operation was started in December 1998. Four years have passed since then. Fig. 4 shows the drift of the level of the beam level markers from the level surveyed in spring 1996. It is seen that the south arc is sinking at average speed of about 2.5mm/year. But the speed is not constant. Fig. 5 shows the speed of the level variation for each survey interval. The speed is normalized to the variation in a year. Only the variation during the period from February 1998 to October 2001, shown by the orange curve, is quite small. The speed of the level variation in other periods is about 4mm/year. The period from February 1998 to October 2001 is the beam operation time, and the tunnel temperature had been kept constant all through the year. Before this period, the construction of two rings was going on. In this summer, shown by the red curve, the air conditioner system was stopped for two months to do maintenance and the tunnel temperature rose by about 6°C. It seems that the variation of the tunnel level is small if the tunnel temperature is kept constant.

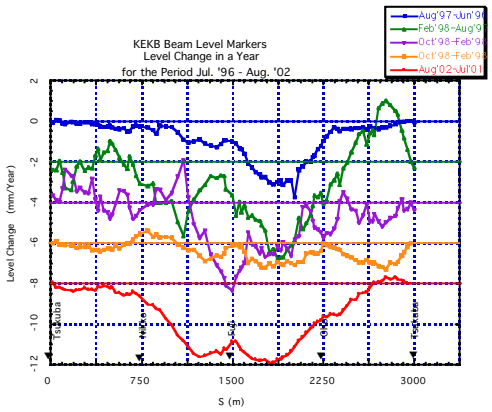

Fig.5 Drift speed of the level for beam level markers in each survey interval. The unit of the speed is mm/year.

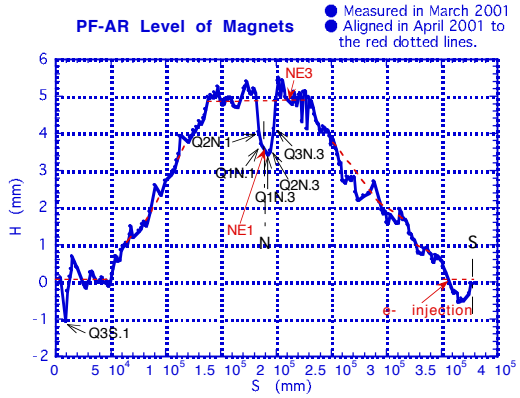

Fig.7 Results of survey for the level of PF-AR magnets in March 2001. The magnets were re-aligned to the red dotted lines in the plot after this survey.

4. MOVEMENT OF THE PF-AR TUNNEL

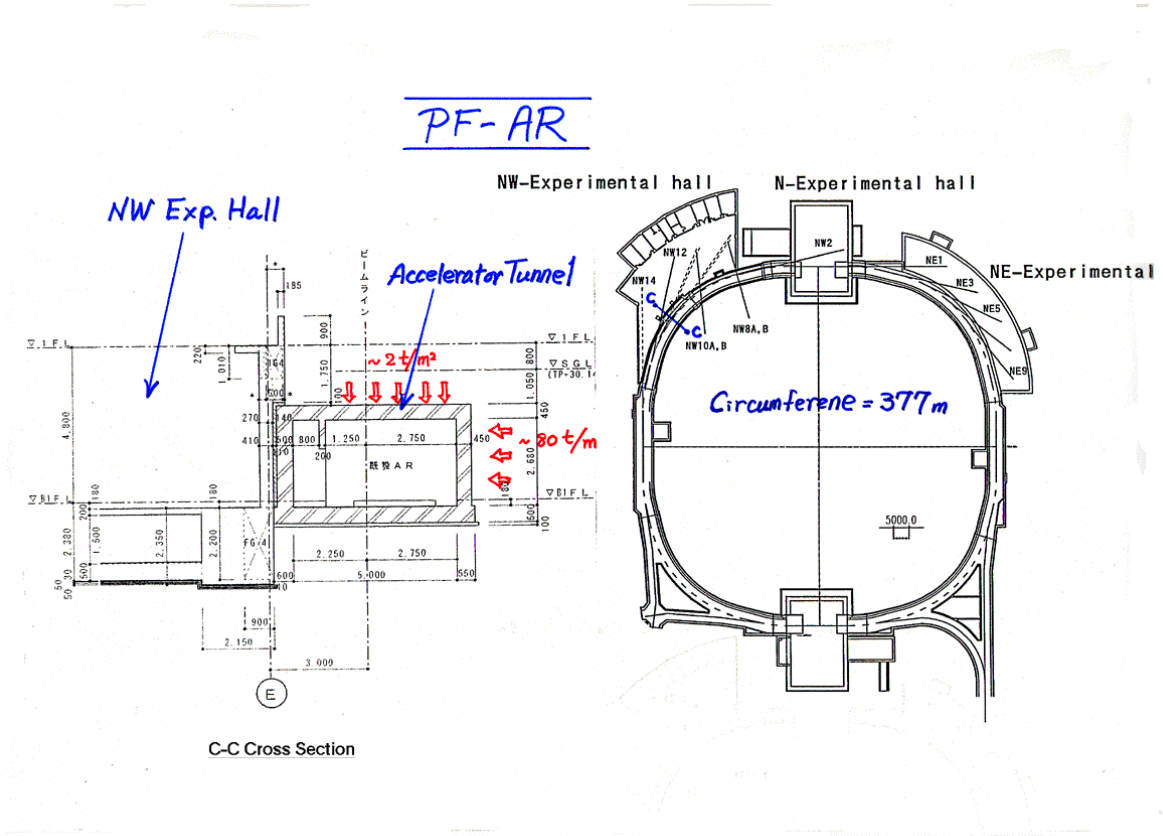

Fig.6 Layout for the PF-AR ring (right drawing) and the cross section for the Northwest arc section (left drawing)

PF-AR [3] was an electron and positron accumulation ring for the TRISTAN main ring. It is now dedicated to the synchrotron radiation experiment because the electron and positron beams are injected directly from the linac to the KEKB main ring. The circumference of the PF-AR ring is 377m. The movement of this tunnel both in vertical and horizontal direction was observed during the construction of a new NW (North-West) experimental hall. Fig. 6 shows the plan view for the PF-AR ring and the cross section for the northwest area. The structure of the NW experimental hall

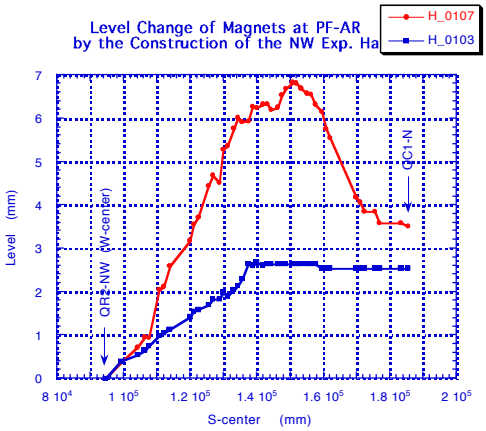

Fig.8 Results of survey for the level of magnets in the northwest arc before the construction (blue curve) and during the construction period (red curve).

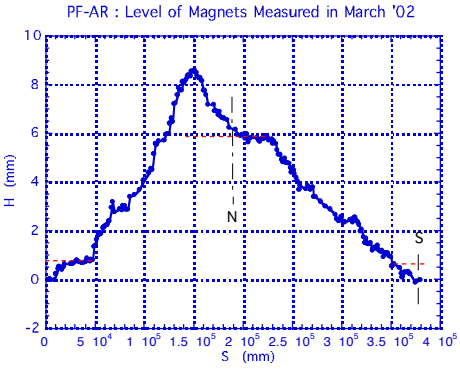

Fig.9 Level of magnets in the northwest arc after completion of the construction of the NW experimental hall. Survey was carried out in the end of December 2001.

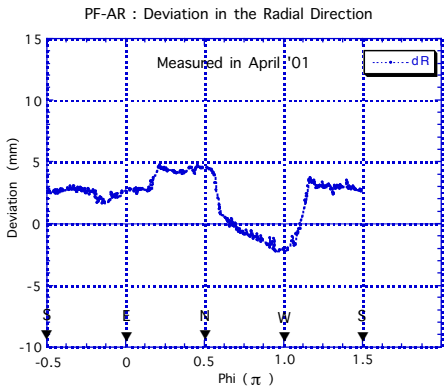

Fig.10 Deviation of the radial position for magnets from the designed lattice before the construction of the NW experimental hall. Survey was carried out in March 2001.

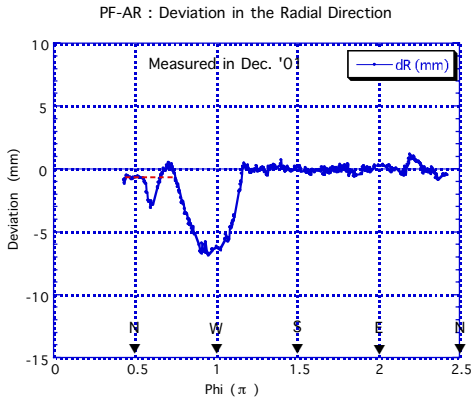

Fig.11 Deviation of the radial position for magnets from the designed lattice after completion of the NW experimental hall construction. Survey was carried out in the end of December 2001.

is shown in left and that for the accelerator tunnel in right in the cross section. Construction of the NW experimental hall was started in May 2001, and completed in December. Before this construction, position for the magnets was surveyed and the local deviation was corrected in March and April 2001. The movement of the tunnel in vertical direction is shown in Fig. 7-9 and that in horizontal direction in Fig. 10-11, respectively.

Fig. 7 shows results of survey for the level of magnets, which were realigned to the red dotted line in the plot after this survey. Fig.8 shows the level of magnets in the northwest arc. The level before the construction is shown by the blue curve, and that at the construction time by the red curve, when the soil in the NW experimental hall area was removed. It can be seen that the northwest arc tunnel popped up by about 4mm when the soil was removed in the NW experimental hall area. Fig. 9 shows the level for magnets surveyed in the end of December 2001 after the construction. Deviation of About 3mm was left.

Fig. 10 shows results of the survey for the position of magnets in the horizontal plane before the construction. Fig.11 shows the level of magnets in the northwest arc surveyed in the end of December after the construction. It can be seen that the center of the northwest arc moved towards outside of the ring by about 6mm. The local deviation was corrected after the survey according to the red dotted line in the plot.

5. SUMMARY

KEKB operation has been going quite well. It is updating the world record on luminosity.

The south arc of the KEKB tunnel is sinking at the speed of about 4 mm/year. But the speed looks small if the tunnel temperature is kept constant.

It was observed that the northwest arc of the PF-AR tunnel had moved by some millimeters both vertically and horizontally because of the construction of a new NW experimental hall.

6. REFERENCES

[1] High Energy Accelerator Research Organization, *KEKB B-factory Design Report*, KEK Report 95-7, August 1995.

[2] TRISTAN project group, *TRISTAN Design Report*, KEK Report 86-14, March 1987.

[3] Institute of Materials Structure Science, High Energy Accelerator Research Organization, *Design Report on Advanced Ring for Pulse X-rays (PF-AR)*, KEK Report 97-2, May 1997.