Status of Alignment for the Linac

Akihiko MIZUNO and SPring-8 Linac Group

SPring-8/JASRI

1. Introduction

In the SPring-8 linac, alignment errors were once measured in 1995, just after all magnets were installed [1]. But no other measurements were performed since then. To confirm accuracy of the alignments, we measured this in August, 1998, and compared to the initial alignment data.

In order to keep on record, measured data of the alignment error are summarized here.

2. Measurement Method

Of course beam line of the linac is in vacuum, so we can not measure along a beam line axis. In the linac, alignment target are able to be mounted on each quadrupole magnet and other major devices which level is 420 mm above the beam line. Line that connects the each target forms measuring axis parallel to the beam line. We call this axis shifted axis.

The schematic drawing of the alignment error measurement system is shown in Fig.3.

Measurement was performed using the He-Ne laser, Zygo MODEL7701, which is the same laser for the linac alignment in 1995. The laser was mounted at the gun side on the shifted axis. The laser beam was expanded to ϕ12 mm parallel beam just after the laser head, and was transported 140 m to a reference point in the LSBT (Linac-Synchrotron Transport line). The laser path was covered with ϕ200 mm paper pipe to avoid scattering with air.

We used two types of laser detector. One is MELLES GRIOT, MODEL 13 PSQ 001, a quarter divided position sensitive detector (PSD) which is made of silicon, set on the reference point of the LSBT side, to make sure of the laser beam pointing stability during measurement. Beam positions were monitored using a position analysis system worked on a DOS/V PC.

The other is MELLES GRIOT, MODEL 13 SKP 003 "Super Beam Alyzer^{TM}", which also consists of a detector and a beam position analysis system on a DOS/V PC. This detector was mounted on each device as the target to measure an alignment error. The laser beam was focused to ϕ2.4 mm on the detector surface by a focusing lens located in front of the detector. The position sensitivity of the Super Beam Alyzer is less than $\pm$15 μm, so it is enough for the measurement.

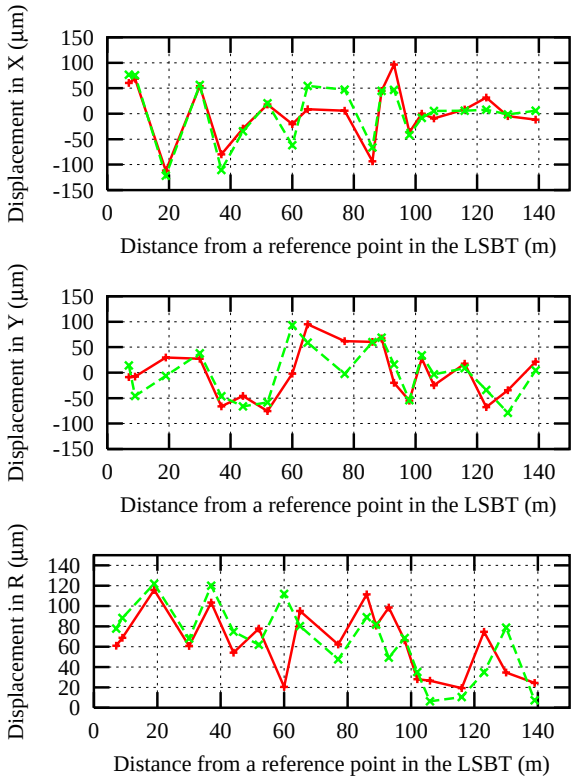

Fig. 1: Alignment error measured in 1995, just after installation of the magnets are finished. Measurements were performed along the on axis. These three data were measured in series. X is horizontal, Y is vertical, and R is radial direction.

Since air disturbance in the accelerator room gives much influences on accuracy of measurement, we took care that nobody entered in area between laser head and the detector of Super Beam Alyzer during measurement. Thus we started the measurements from the LSBT side which was the opposite side of the laser head.

3. Measured Data

Figure 1 shows alignment error measured in 1995, also we show newly data in Fig.2, measured in 1998.

The data in Fig.1 was measured along the beam line (on axis), since no vacuum chamber was installed at that time. But the latter data in Fig.2 was measured along the shifted axis mentioned before. At first in 1995, we were planning to mea-

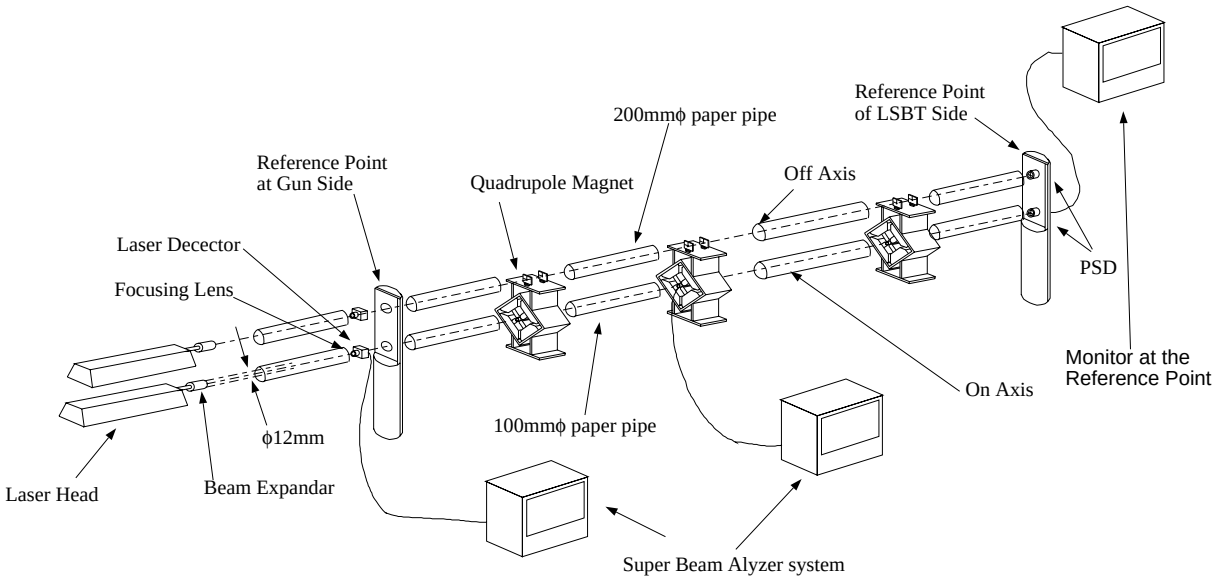

Fig. 3 The alignment error measurement system.

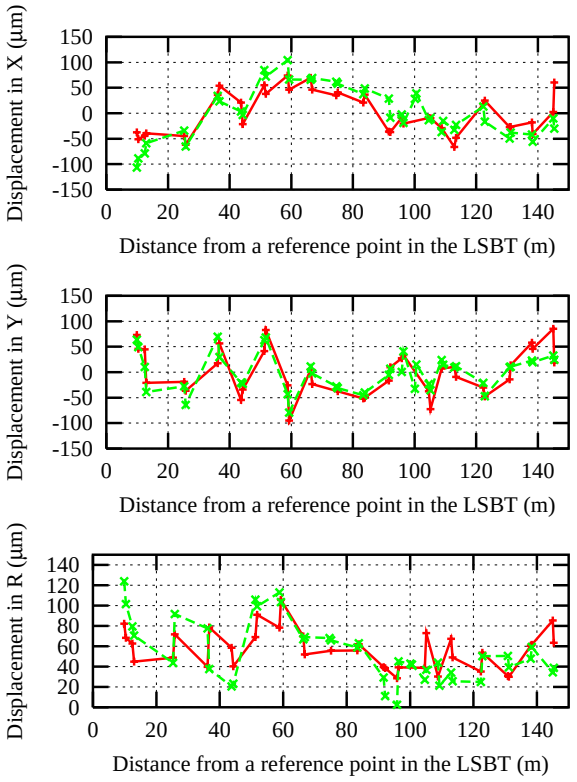

Fig. 2: Alignment error measured in 1998 summer. Measurements were performed along the shifted axis. Definition of X, Y and R is the same as Fig.1

sure along these two axes simultaneously in order to check differences of errors between them. But actually, we could not check the difference because the difference was much larger than our expectation. It is not clear that these two series of data were not agree at that time. Anyway, we did not have measured data for the differences between on and shifted axis.

The measurements are performed twice, a solid line and a dashed line. The two lines shows good coincidence in each graph, thus we can make sure of measurement accuracy.

It is natural that Fig.2 does not agree with Fig.1. Though in the both figures, the error was less than ± 150 μm. Maximum transverse position difference between the target and mechanical bore center in each quadrupole magnet, which causes from manufactural process, is estimated about 0.3 mm. Thus, maximum error of 150 μm shows that the alignment situation did not widely changed.

We are planing to measure the alignment error once a year for the future.

Reference

[1] A.Mizuno et al, SPring-8 Annual Report 1996, 96(1996).