# New Transport Line for 1GeV Linac (2)

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## 1. Introduction

The SPring-8 linac has been in continuous operation as an injector to the SPring-8 synchrotron since the first beam on August 8, 1996. Additionally, injection to the NewSUBARU storage ring (NS ring) started from the autumn of 1998. Accordingly, it has continued in operation even during the summer periods when construction of the new beam transport line was halted.

The west Harima district, where SPring-8 is located, had severe weather conditions of daily fierce heat during the construction period. The beam transport line requires precise alignment and should ideally be installed after the building housing is completed and the concrete has settled down. However, the installation construction had to be done while the construction work of the beam transport tunnel was in various stages of completion. Specifically, adjustment of the electromagnetic power supply had to be made before the air conditioning was fully installed, and this made construction work particularly difficult. In addition, the entire operation of SPring-8 would have been stopped without the government permission to operate the linac main body as a result of the official inspection before startup on August 25 and 26. Fortunately, construction had ended just on time and the facility passed the inspection.

## 2. The Outline of the Beam Transport Line

The new beam transport line branches on L2 of the linac. The beam is transported in two directions, which are called L3BT and L4BT (Fig.1). These beamlines are composed of five sector type bending magnets, 27 quadropole magnets and 14 sets of steering magnets. The vacuum of the beam transport line is retained in 10 sputter-ion pumps. The following have been installed as beam monitors: 14 fluorescent screen monitors, three core-style current monitors of short-pulse type, and two nondestructive beam position monitors of stripline type.

The first of three bending magnets of L3BT is installed near the linac of the L2 beam dump and is based on L2 and branches. The beam is bent 90 degree left from the linac by the three bending magnets (30 degree each) and is led toward the direction of the accelerator and beamline R&D facility. This beam transport line becomes that of the monitor and is used for beam physics research of the electron beam. This beam transport line can be assembled by either the achromatic or the isochronous system, as shown in Fig. 2.

The entrance of the L3BT tunnel is in the assembly room of the accelerator and beamline R&D facility. At present, the electron beam is not transported to the interior of the accelerator and beamline R&D facility. A hole is dug in the floor at the end of the L3BT tunnel, and the beam dump is installed in the hole. The electron beam from the linac is bent 30 degree downward by the bending magnet and it is led to the beam dump. This beam dump has been electrically insulated, and current measurement is carried out by a Faraday cup.

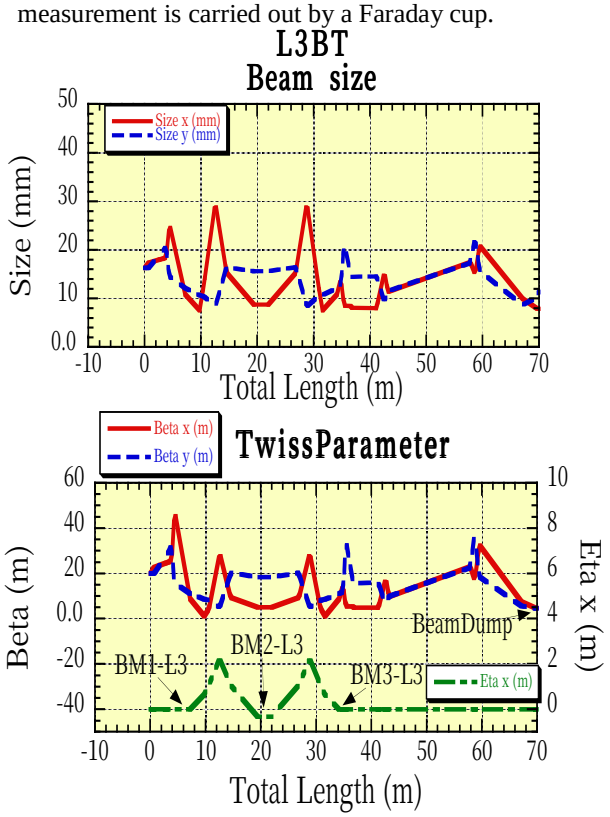


Fig.2 L3 Beam parameter

This experimental setup for sending the beam transport line to the L3BT tunnel is easy to prepare, and we can enter the L3 gate safely even during injection to the synchrotron. L3BT commissioning was started on September 18, 1998. It was confirmed that after adjustment the electron beam was transported to the beam dump in about one

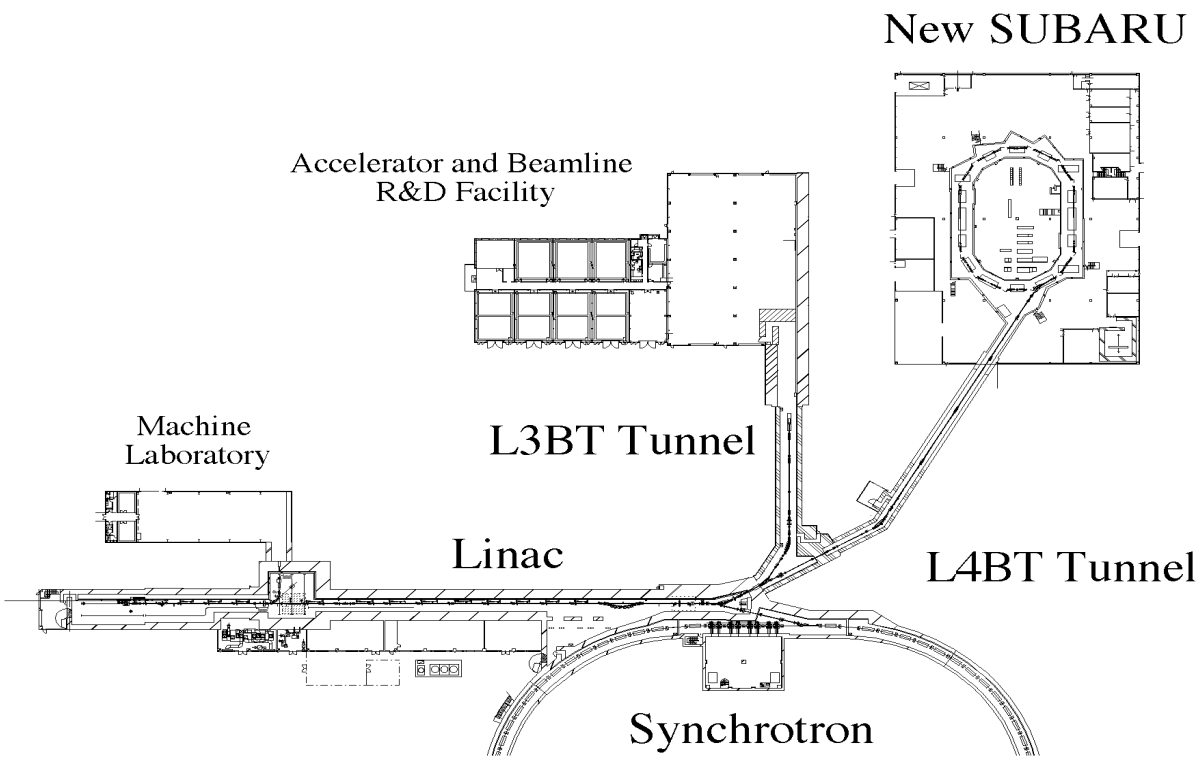


Fig.1 New beam transport line design

hour. Furthermore, it was not necessary to also excite the steering magnet because the magnetic alignment was carried out at an accuracy of ± 0.2 mm or less. Because beam loss in the transport line is also less, there is no problem from the viewpoint of radiation safety.

L4BT is an electron beam transport line to the NS ring based on L3BT and branches. When there is no fault that excites the L3BT second deflection electromagnets, the distribution of L3BT and L4BT is carried out. Achromatic transport has been formed in order to place eight L4BT quadropole magnets between bending magnets, and the transport parameter is shown in Fig. 3. In the linac control, the electron beam is transported to the position called the P point. After the P point, the electron beam is controlled by the NS control system. Only a 1 ns beam width has been permitted for L4BT. The P point is near in order to confirm the quality of the beam to the NS ring, and this confirmation is carried out by two monitor screens By keeping to the center of the two monitors, leaving about 8 m, the axis of the beam transport line is held. L4BT commissioning was started on September 21, 1998. The beam transport to the P point can end in a few hours and handle the electron beam in the NS ring. In this stage, the transport cannot perfectly be achromatic. In the measurement, a dispersion of about 30 cm remained. By re-adjustment at a later date, it was possible to eliminate this. The control of these beam transport lines is equivalent to that of the linac by the composition of WS-VME.

## 3. The Injection to NewSUBARU

Though L4BT can be transported in the 1.2 GeV electron beam, the NS ring is injected at 1.0 GeV, which is equivalent to the synchrotron [1]. The NS ring is injected at the current stability of about 30 % $\Delta E/E = \pm 0.1$ %. The mode change time from NS to the synchrotron takes a few minutes, and this time is necessary for changing the mode in order to do the magnetic initializing, which takes about 20 minutes. The timing system is equivalent to the synchrotron for NS, and the switching of that timing system could be carried out in the VME control. The jitter of the timing system is held at 15 ps or less. The change in the beam parameter is nearly reproduced by only loading the file.

At present, the NS ring is being commissioned, and a current of about 10 mA accumulates in the ring by radiation survey of physical aperture, adjustment of the tune, and compensation of COD. The life of the beam is still only a few minutes because the vacuum in the NS ring is insufficient. A vacuum bakeout operation by synchrotron radiation is being carried out during the commissioning.

## 4. Future Plan

The linac's primary mission is to operate as an injector of the synchrotron. In September 1998, commissioning of the NS storage ring was started and the injection to the NS ring became necessary.

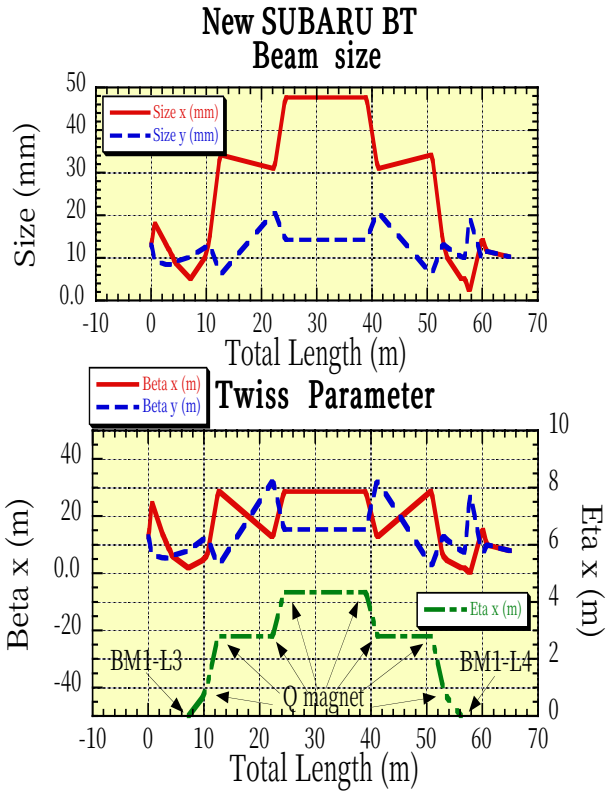


Fig.3 L4 Beam parameter

Then the more stabilized and troubleless operation was required. Energy compression system is a solution for the energy and current stabilization. On the other hand, the dualization of the electron gun and buncher section is necessary for troubleless operation .

However, the linac still requires a certain waiting time between injections. Future improvements include using L3BT, various measurement techniques of short-bunched beams, generation of reverse laser Compton light, and PXR. Outside researchers are also very interested in getting involved in future research efforts. They are particularly enthusiastic about the upgrading of linear accelerators by such means as short-bunch and low-emittance approaches .

## References

[1] A. Ando et al., Proc. Particl Accl. Conf. (1997) to be publish.