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Present status and future prospect on the initial realignment at the KEKB injector linac

The initial realignment of the long beam line is in progress at the KEKB injector linac due to the big earthquake struck in Japan in March 2011 and also towards the Super KEK B-factory project. The injector linac is a 600-m-long linear accelerator that will directly inject electron and positron beams into the Super KEKB rings under construction. The injector linac comprises eight sectors (A–C and 1–5), which together constitute two long straight sections. One section is 125-m-long and is composed of sectors A and B (AB straight section); the other is 476-m-long and is composed of sectors C and 1–5 (C5 straight section). These two straight sections are connected to a 180-degree arc with a diameter of 15 m.

Two kinds of alignment methods have been basically applied to the initial realignment. One is a laser-based alignment which is applied to the two long straight sections. The transverse displacements of accelerator girder units can be aligned with respect to this long laser axis. A series of measurements may provide an accurate view in the high-precision alignment of the injector linac. The other is a method on the use of a conventional laser tracker which is applied to the component alignment installed on the accelerator girder unit with a length of 8.44 m. Based on these two alignment methods, the aim in the initial realignment is to attain the alignment precisions of 0.1 mm (rms) and 0.3 mm (rms) in a local region (typical sector length of ˜80 m) and the entire region of 476 m, respectively.

For the high-precision alignment in the long straight sections, a laser-based alignment system with a He-Ne laser has been newly developed in order to align the accelerator girder units at the KEKB injector linac. The laser beam was first implemented as a 500-m-long fiducial straight line for alignment measurements. We experimentally investigated the propagation and stability characteristics of the laser beam passing through laser pipes in vacuum. The pointing stability at the last fiducial point was successfully obtained with the transverse displacements of ±40 μm level in one standard deviation by applying a feedback control. This pointing stability corresponds to an angle of ±0.08 μrad.

For the component alignment, new target bases for accelerator structures have been developed for the alignment measurement based on the laser tracker and other target bases for quadrupole magnets have been also newly installed. The accelerator girders have been reinforced or replaced with stainless steels with high rigidity to increase resistant strength against big earthquakes. For the alignment of the 180-degree arc, the conventional laser tracker was applied to been smoothly connected to the two straight sections.

We have observed long-term drift of the floor level along with that due to daily range in the linac tunnel. The scale of the long-term drift may be over the acceptable alignment limits while the mechanism of this long-term drift has not been understood yet. We start to construct a remote measurement system of the floor level of the linac tunnel to investigate this unsure long-term drift. This report contains a detailed description of the present status and future prospect on the initial realignment at the KEKB injector linac.

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