

SPEAR3 Construction Alignment*

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Overview

An ambitious seven month shutdown of the existing SPEAR2 synchrotron radiation facility was successfully completed in March 2004 when the first synchrotron light was observed in the new SPEAR3 ring. SPEAR3 completely replaced SPEAR2 with new components aligned on a new highly-flat concrete floor. Devices such as magnets and vacuum chambers had to be fiducialized and later aligned on girder rafts that were then placed into the ring over pre-aligned support plates. Key to the success of aligning this new ring was to ensure that the new beam orbit matched the old SPEAR2 orbit so that existing experimental beamlines would not have to be reoriented. In this presentation a pictorial summary of the Alignment Engineering Group's surveying tasks for the construction of the SPEAR3 ring is provided. Details on the networking and analysis of various surveys throughout the project can be found in the accompanying paper [1].

Floor Templates

Anchor bolt locations on the new SPEAR3 concrete floor were marked using templates. Some were small and relatively light while others were long and heavy requiring some template material to be removed. Each template was positioned using three alignment points specific to the template and later checked by our laser tracker.



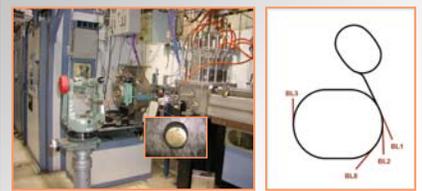
Monumentation

A network simulation was designed for the placement of new monuments to be installed in the tunnel. The points were then marked on the new concrete floor and shifted slightly if a scan revealed the presence of rebar.



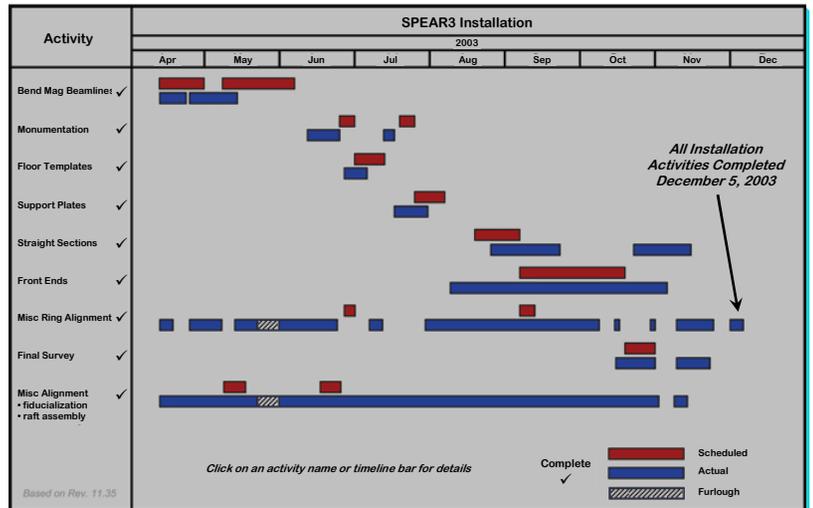
Bending Magnet Beamlines

BL1, BL2, BL3, and BL8, the four bending magnet beamlines were moved to reflect a new design. New brass plugs were set into the floor acting as beamline reference monuments.



Support Plates

The support plates were positioned horizontally and vertically to a tolerance of ±0.005 inches (±130µm) using laser trackers, total stations and levels.



Straight Sections and Front Ends

For straight section alignment, only the K2 septum located at 3S was pre-aligned in SLAC's collider hall. The other two straights with kickers were assembled in the SSRL vacuum room. Three insertion devices (IDs) were completely new (BL4, BL6 and BL7). The front ends were similarly structured for each beamline where the two stands were pre-aligned before installation.



Miscellaneous Ring Alignment

This category includes alignment of ring components that were not included in the other timeline activities. Screenshot rails were set in height for guiding the flatness of the poured concrete floor. Finished floor elevations were recorded and specialized components were aligned. These were the RF cavities, BTS (Beam-to-SPEAR) quadrupoles, and the BTS raft. Removal of some roof blocks helped considerably in the alignment of the BTS.



Miscellaneous Non-Ring Alignment

Tasks that fell outside of actual SPEAR3 ring alignment were included in this category. Some tasks began prior to actual SPEAR3 installation such as fiducialization of vacuum chambers and magnets. Beamlines, raft assembly, pin alignment and studies such as the ASTM (American Society for Testing and Materials) floor flatness investigation were also developed and reported.



Final Survey

Activities for the final survey were directed towards making a final map of every new SPEAR3 component. Due to time and access limitations in the ring, a faster survey was created to still accomplish a well aligned ring.



Reference

[1] LeCocq et. al., "The SPEAR3 Upgrade Project at SLAC"; IWAA2004 paper, CERN; October 2004.

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