Re-Visiting SPEAR After 25 Years

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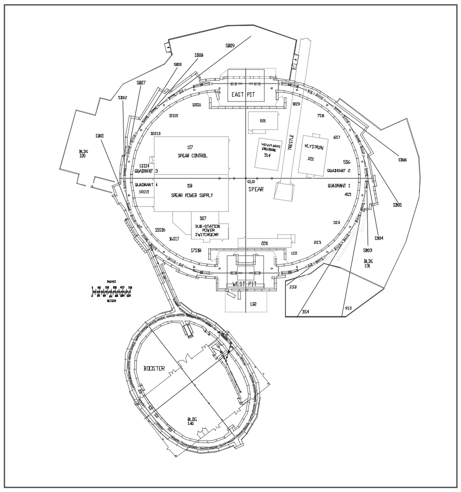
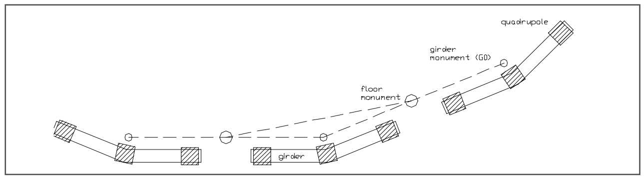
Abstract:

The SPEAR machine was completed in 1972. It consists of a single ring about 80 meters in diameter and started its very productive life as a positron-electron collider circulating beams up to 4 GeV. Synchrotron radiation research began almost immediately parasitically, then as half the program in the 1980s, and then became the whole program in 1991. The original network surveys used optical theodolites and invar tapes to place ring monuments in their ideal positions at constant offsets from the lines of ring quadrupoles. Optical tooling techniques were used to reference the monuments and survey offset targets on fixtures attached to the magnets. For more than 20 years neither the monuments nor magnets were restored to their ideal positions; the obvious discrepancies were simply "feathered." In 1992 SLC technology was used for the first time to re-measure the network and map the magnets. The discovery of many multiple-millimeter problems spurred planning for a 1995 global re-alignment. In 1995, all storage ring magnets and beamlines were mapped and moved. The band of displacements from ideal was reduced from about +/- 5mm to +/-0.5mm. Upon start-up, beam stored without correctors.



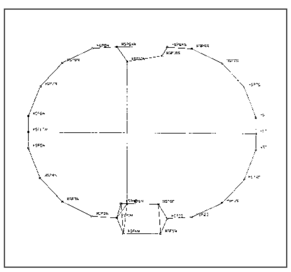
SSRL facility schematic showing SPEAR ring, booster, and beamlines.



The old alignment plan required monuments located in ideal locations. Both the floor and girder monuments were designed to be adjustable in the horizontal plane. The monument positions were measured and moved repeatedly until deemed "perfect." In these perfect positions, the quads would all lie at a constant distance from a monument line.

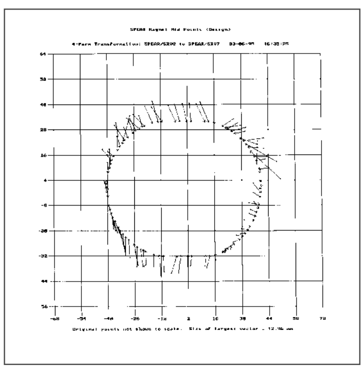
The ring enclosure was made from shielding blocks placed on an asphalt parking lot. To isolate from the asphalt, the floor monuments and girder feet reside on top of deep pillars. Monuments accept "candlesticks" which hold 3.5" sphere targets.

Table-style fixtures were made to stand on the quad split-planes and carry 1.5" sphere targets. Also visible is a CERN socket girder monument.

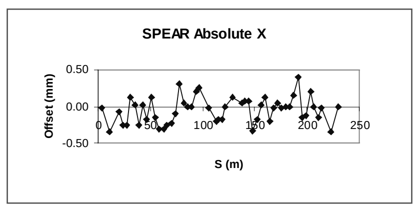


Distances measured using ME5000 and SLC forced centering system.

TC2002s were used to map magnet positions and control moves.



Moves required to bring magnets back to their ideal positions. Largest move was 12.96mm, for a dipole. Typical quad moves were several millimeters.



Final global X-offsets. The standard deviation of absolute x-residuals was 170µm.