

SLS 2.0 High-precision Alignment of the upgraded Storage Ring using the electron beam

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SUMMARY

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Abstract

The Swiss Light Source, SLS, is an electron accelerator and storage ring, built to use the emitted synchrotron light to conduct groundbreaking research in biomedicine, engineering and natural sciences. The storage ring has been rebuilt as SLS2.0 to improve brightness and reduce horizontal emittance from 5 nm to about 150 pm. This decrease in beam size makes the machine not only more capable, but way more sensitive to a correct alignment.

The base is a solid reference network, which consists of 727 reference points distributed around the building. Using Laser trackers, vibrating and moving wires and precise manual adjustment mechanics like wedges and differential screws, the roughly 1000 magnets along the 288-meter circumference ring were aligned with a precision of 30 um RMS Element to Element. This allowed to store an electron beam in the ring, whose initial orbit was only 0.5mm off the target of 288m.

To further improve the performance of the machine, one must go beyond the capabilities of geodetic devices like laser trackers and theodolites. Using the electron beam as measurement device, exact locations of misalignment can be determined by the feedback pattern of the corrector

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magnets. The realignment can then be conducted live, with a stored electrons flying through the machine at lightspeed, by using remotely driven, small step motors to correct for values in the Micrometer region.

Freeing up the magnetic correction of the electron beam by performing a high-precision Alignment makes the Lightsource much more capable and competitive and leads to better research results, laying the foundation to more pioneering discoveries.

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