

3-D x-ray mirror metrology with a vertical scanning long trace profiler

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The Long Trace Profiler (LTP) was originally developed at the Brookhaven National Laboratory for the specific purpose of measuring the surface figure of large cylindrical mirrors used at grazing incidence in synchrotron radiation (SR) beamlines. In its original configuration, it could measure only along one line down the center of the cylinder. A single linear profile is often sufficient to gauge the quality of the optical surface on these kinds of mirrors. For some applications it is necessary to measure the topography of the entire surface, not just along one line, but over a grid that covers the entire surface area. We have modified a standard LTP to enable measurement of the complete surface of Wolter telescope optics in a vertical configuration. The vertical scanning LTP (VSLTP) can produce a complete 3-D map of the surface topography errors relative to the ideal desired surface on complete segments of paraboloids and hyperboloids. The instrument uses a penta prism assembly to scan the probe beam in the longitudinal direction parallel to the mirror symmetry axis, and uses a precision rotary stage to provide scans in the azimuthal direction. A Risley prism pair and a dove prism are used to orient the probe beam for the azimuthal scans. The repeatability of the prototype instrument is better than 20 nm over trace lengths of 35 mm with a slope measurement accuracy of about 1 microradian.

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