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Insertion devices for synchrotron radiation and free-electron laser applications

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Twenty undulators and wigglers have been designed and built by STI Optronics since 1980 for synchrotron radiation and free-electron laser (FEL) applications. Design concepts for producing higher magnetic field strength with improved field quality will be reviewed. Shim tuning methods have permitted magnetic field tolerances, including pole-to-pole field uniformity, trajectory straightness, and higher order moments, to be controlled to low levels as needed for various applications. A key figure of merit is the optical phase error, which determines the coherence of the light generated in the device. Coherence is a strict requirement for maintaining spectral intensity in synchrotron radiation sources with low emittance and maximizing gain in FELs.

The measurement capability necessary to certify coherence over extended undulator lengths has been developed. Example results obtained on insertion devices delivered to the APS and DESY will be presented. Among the twenty-four devices to be delivered to the APS the most prominent are the Undulator-A. The optical phase error of these 2.4 m wedged-pole hybrid undulators is nominally controlled to 3 degrees over the undulator length. This maintains the spectral intensity of the third harmonic synchrotron radiation to better than 90% of the ideal value.