

Analysis of absolute position alignment and absolute position deviation of the high energy photon source storage ring tunnel

Abstract: The design emittance of the High Energy Photon Source (HEPS) is $\leq 60 \text{ pm} \cdot \text{rad}$, and its brightness reaches $1 \times 10^{22} \text{ phs} \cdot \text{s}^{-1} \cdot \text{mm}^{-2} \cdot \text{mrad}^{-2} \cdot (0.1\% \text{bw})^{-1}$. This places higher demands on the absolute position accuracy of the storage ring equipment. To achieve the technical indicators of the HEPS and ensure smooth light emission, the accelerator alignment team precisely aligned the equipment of the 1360.4m circumference storage ring to its theoretical design position. The precise alignment of the storage ring ensures the position accuracy of the synchrotron radiation light emission equipment and provides a relatively smooth track under absolute position accuracy control for the efficient operation of the electron beam. In view of the narrow and long space inside the tunnel and the inability to have a wide field of view, to improve the absolute position measurement accuracy, a control network layout scheme based on precise measurement with a laser tracker and a dual-instrument synchronous measurement method were adopted. To reduce the systematic error of the instrument, the laser tracker used the double-sided measurement method for observation. Through displacement adjustment, the final alignment accuracy achieved a maximum deviation of 0.305mm and a standard deviation of 0.136mm for the absolute position of the storage ring unit magnets, both of which are better than the design indicators.

Key words: High Energy Photon Source; control network; laser tracker; alignment; precision analysis

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