

## Study on the Method for Successful Achievement of Vacuum Closed-Loop in the HEPS Storage Ring

The High Energy Photon Source (HEPS) is China's first independently designed and constructed fourth-generation synchrotron radiation source, and also one of the brightest light sources in the world. It is of vital importance to basic scientific research and industrial innovation. The storage ring is a key component of HEPS, with a beam orbit circumference of 1,360.4 meters. To achieve a vacuum closed loop for such a large-scale ring and ultimately reach the designed vacuum level, severe challenges need to be addressed, including limited installation space, extremely high positioning accuracy requirements, and an extremely low fault tolerance rate. To enable fast, efficient, and error-free connection of each vacuum component at the installation site, we have developed a simple yet detailed streamlined installation process, which has been continuously improved and optimized in practical work. Through the optimization of the vacuum system installation process, scientific quality control methods, and solutions to key problems, HEPS successfully achieved the vacuum closed loop of the storage ring on July 1, 2024, completing the task 3 months ahead of the original schedule, and all the vacuum degrees of the storage ring met the standards. Practice has shown that this set of methods has effectively reduced quality risks during the installation process, significantly improved installation efficiency, and laid a solid vacuum foundation for the engineering construction of the HEPS storage ring. Furthermore, the effective vacuum system installation process and specifications formed in this research can provide valuable reference for the vacuum system installation of subsequent similar large-scale scientific facilities at home and abroad.

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