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Advancements in beam arrival time measurement for SHINE*

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The jitter of the beam arrival time can significantly impact the synchronization between the seed laser and the electron beam, which will constrain the brightness and stability of the FEL. It is one of the important parameters for beam diagnostics. To align with the SHINE's (Shanghai HIgh repetition rate XFEL aNd Extreme light facility) requirements of a 1MHz repetition rate and a dynamic range from 10pC to 300pC, we developed a beam arrival time measurement system utilizing a cavity probe. This system is capable of achieving a specification of 20fs at a charge of 100pC. Our approach included designing measurement schemes based on intermediate and radio frequencies and establishing a comparative test platform at the SXFEL (Shanghai Soft X-ray Free-Electron Laser Facility). This article will detail the construction of two systems and compare their test results across various charges. It has also been confirmed that the system can accurately measure beam arrival times for charges less than 1pC. A major challenge identified was temperature drift, which significantly affects measurement accuracy and limits the system's application in beam feedback. To counter this, we implemented and evaluated constant temperature controls for the RF cables, demonstrating their effectiveness in enhancing measurement reliability.

Footnotes

Funding Agency

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Yes

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