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Bunch-by-bunch beam current and lifetime measurement with interleaved sampling at Hefei Light Source

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To achieve high-precision bunch-by-bunch current and lifetime measurements at the Hefei Light Source (HLS), we developed a beam diagnostics system based on interleaved sampling technology, achieving an equivalent sampling rate of 6.5 GHz. In single-bunch mode, amplitude extraction via cross-correlation with a single response function achieves a turn-by-turn current relative resolution of 0.12%. By averaging over 200 turns, the resolution is improved to 0.04% with a 23 kHz data refresh rate, enabling fast and accurate lifetime calculations. However, in multi-bunch high-current mode, large longitudinal oscillations degrade the accuracy of amplitude extraction when using a fixed-response function. We propose a data-processing algorithm to jointly extract bunch length, phase, and current, thereby mitigating the impact of longitudinal oscillations on amplitude extraction. The method and experimental results provide a practical solution for machines exhibiting large longitudinal oscillations, such as HLS.

Footnotes

Funding Agency

I have read and accept the Conference Policies

Yes

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