Contribution ID: **2720** Contribution code: **THPM136** Type: **Poster Presentation**

Phase-space reconstruction based on severe undersampling for ultrafast electron beam

Thursday, 11 May 2023 16:30 (2 hours)

In an Ultrafast Electron Diffraction (UED), high-brightness ultrafast electron beams are indispensable to capture critical ultrafast events on an atomic/molecular scale. For space-charge effects (SCE) dominated electron beams, the beam emittance increases significantly during propagation. Understanding the beam emittance evolution during its passage is critical for further improving the UED performance. To diagnose the in situ emittance of the beam at several certain positions, we use a multi-slit device with a low sampling rate to eliminate the SCE influence. Due to the fabrication technology limitation, only a few slits can be made, leading to a severe undersampling rate, creating challenges in reconstructing the original beam information. This paper introduces a method to reproduce beam from severely under-sampled data.

Funding Agency

Footnotes

State Grid Corporation of China Technology Project 5400-202199556A-0-5-ZN.
National Nature Science Foundation of China(NSFC) 12235005;
National key research and development program of China 2022YFA1602202;

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Session Classification: Thursday Poster Session

Track Classification: MC6: Beam Instrumentation, Controls, Feedback and Operational Aspects: MC6.T03: Beam Diagnostics and Instrumentation