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Temporal diagnostics on electron bunches from laser wakefield acceleration via single-shot electro-optic spatial decoding

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We established electro-optic (EO) sampling techniques adequate for the diagnostics of electron temporal information in laser wakefield acceleration (LWFA). For the investigation of electron timing jitter and injection process, EO spatial decoding on the electron Coulomb field was performed. The spherical wavefront of the Coulomb field and plasma-density-dependent electron emission timing were discovered. For the determination of electron bunch durations, EO spatial decoding on the coherent transition radiation (CTR) produced when electrons passing through a metal foil was conducted. Electron beam timing fluctuation of 7 fs and bunch durations of few tens of femtoseconds had been demonstrated.
This research not only showed the capability of EO sampling serving as a real-time electron temporal diagnostic for laser-driven sources but also demonstrated the ultra-fast nature of laser-driven electron sources for various applications.

Speaker's Name

Kai Huang

Speaker's Title

Dr.

Speaker's Gender

Man

Speaker's Pronouns

He/Him

Speaker's Preferred name (if any)

Primary author(s) : Dr HUANG, Kai (National Institutes for Quantum Science and Technology, Japan); Dr KOTAKI, Hideki (Dr); MORI, Michiaki (National Institutes for Quantum Science and Technology); Dr ESIRKEPOV, Timur (National Institutes for Quantum Science and Technology); Dr KOGA, James (National Institutes for Quantum Science and Technology); Dr HAYASHI, Yukio (National Institutes for Quantum Science and Technology); Dr

NAKANII, Nobuhiko (National Institutes for Quantum Science and Technology); Dr KANDO, Masaki (National Institutes for Quantum Science and Technology); Prof. JIN, Zhan (Osaka University); Prof. HOSOKAI, Tomonao (Osaka University)

Presenter(s) : Dr HUANG, Kai (National Institutes for Quantum Science and Technology, Japan)

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