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Widely tunable laser pulses enable the generation of femtosecond electron beams with controllable lengths

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The length of the ultrafast electron bunch is crucial for ultrafast electron diffraction, serving as the timescale for observing ultrafast dynamic changes. Achieving continuous control over the length of these bunches within a certain range is crucial. This control ensures the accuracy of diffraction images, precise measurement of electron bunch length, and efficient terahertz radiation generation. Current devices often employ radio frequency (RF) cavity compression for electron bunch length compression. Still, this approach introduces time jitter and faces limitations in continuously adjusting the bunch length due to structural constraints. This paper focuses on compressing femtosecond laser pulses to obtain laser pulses with continuously adjustable pulse widths. It further analyzes the distribution of photocathode bunches and combines it with the bunch compression process to enhance the time resolution of ultrafast electron diffraction devices. Simultaneously, the use of continuously adjustable laser pulses can improve the precision of terahertz pulse generation.

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