Abstract Submitted
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Simulation of ultrashort photoelectron pulses as a guide for developing reliable ultrafast electron diffraction systems[1] JENNI PORTMAN, HE ZHANG, ZHENSHENG TAO, CHONG-YU RUAN, MARTIN BERZ, PHILLIP DUXBURY, Michigan State University — The development of a reliable experimental ultrafast electron diffraction and imaging system requires a theoretical understanding of the underlying physical phenomena and an accurate modeling of the optical elements present in the beam column. To achieve this goal, we have developed two types of computer simulations: a mean-field Gaussian approximation, in which the linear effects of realistic optical elements are incorporated. Due to the limitations inherent in the theory, it fails to capture the intricate behavior of a real system but it is computationally very inexpensive and offers valuable information on the relevant parameter ranges. The second type of simulation considered is an explicit N particle model which uses a O(N) method for calculating the space charge effects, enabling simulations of over one million electrons in a pulse. While being computationally very expensive, it offers the advantage of incorporating realistic descriptions for the electromagnetic fields of the optical elements, along with their linear and non-linear contributions. The results of this work show the limits of the validity of the mean-field approach and offer a detailed and highly accurate physical description of the beam dynamics under different operational regimes.

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Jenni Portman
Michigan State University

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