UNIVERSITY of ROCHESTER

LABORATORY FOR LASER ENERGETICS

THESIS DEFENSE

Tuesday
31 May 2022

In Person: Coliseum/Zoom Option: https://rochester.zoom.us/j/96245208377?pwd=NXZZYWQrTVVMOHYwQUxyOERqSjJSQT09

3:00 PM to to 4:00 PM
1500 to 1600 hrs

Spatiotemporal pulse shaping for laser-plasma-based applications

Philip Franke

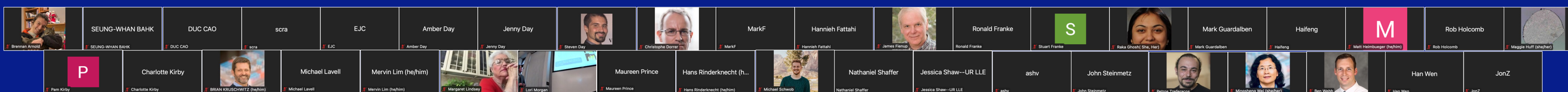
Laser produced plasma provides a basis for many emerging technologies because it can interact with photons and charged particles in powerful and unique ways. These laser-plasma-based applications frequently rely on the controlled coupling of the laser pulse to the plasma to achieve the desired effects. Spatiotemporal (ST) pulse shaping, referring to the intentional correlation of the spatial and temporal characteristics of the laser pulse, can enhance control over the laser-plasma coupling, improving the utility of laser-plasma-based applications.

We review two techniques for ST shaping recently developed at LLE, the chromatic flying focus and the ultrashort flying focus, discussing their experimental demonstration and computational investigations of their proposed applications. In two proof-of-principle experiments, chromatic flying focus pulses derived from the Multi-terawatt laser drove ionization waves of arbitrary velocity in gas targets. These ionization waves have a controllable velocity and can propagate over distances greatly exceeding the Rayleigh length. Photon acceleration based on such flying focus-driven ionization waves was shown computationally to significantly advance the state-of-the-art, generating isolated, spatially coherent, extreme ultraviolet pulses with durations of several hundred attoseconds. Preliminary results from an experiment designed to demonstrate the ultrashort flying focus, which was shown in simulations to eliminate dephasing in a laser wakefield accelerator, will be presented.

250 East River Road • Rochester, New York 14623–1299 • (585) 275-5101

UR LLE

Prof. John Palastro, Prof. Machiel Blok, Dr. Philip Franke, Prof. Petros Tzeferacos, Prof. Dustin Froula



Dr. Phil Franke received his Ph.D. in Plasma Physics from the University of Rochester's Department of Physics and Astronomy in 2022. Dr. Franke started his graduate journey in 2016 after graduating with a Bachelor of Science from The University of Texas at Austin with honors. He was awarded the Frank J. Horton Graduate Fellowship in 2017 and joined the Plasma & Ultrafast Laser Science Group at the Laboratory for Laser Energetics.

Dr. Franke joined the research team just as they were pioneering the "flying focus" concept and used his quiet confidence to help facilitate several successful studies that were published in 13 manuscripts, including four published in Physical Review Letters. His early experiments used the flying focus to drive an ionization wave of arbitrary velocity (IWAV) and extended this work through modeling and experiments to larger channels [P. Franke et al. *Optics Express 27(22) 31978 (2019)]. This led to an innovative optical shock-enhanced self-photon acceleration concept [P. Franke* et al. *Phys. Rev. A 104, 043520 (2021)]. Dr. Franke is equally capable in both modeling/theory and experiments/diagnostics.*

Diane **Boni**, Bob **Boni**, Jeremy **Pigeon**, Chrysta **Elliot**, John **Palastro**, Matthew **VanDusen-Gross**, David **Turnbull**, **Tico**, Libby **Black**, Jesula **Sanon**, Nick **Black**, Zaire **Sprowal**, Marco **Romo-Gonzalez**, Philip **Franke**, Dustin **Froula**, Collin **Stillman**, Manfred **Ambat**, Hans **Rinderknecht**, Khanh Linh **Nguyen**, Zach **Barfield**, Dillon **Ramsey**, Kyle **McMillen**, Tanner **Simpson**, Raka **Ghosh**

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Rochester, New York USA

by eugene kowaluk