

PHILIP FRANKE

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EDUCATION

University of Rochester

PhD in Physics

Expected May 2022

Rochester, NY USA

Thesis Advisor: Professor Dustin Froula

Dissertation: *Spatiotemporal pulse shaping for laser-plasma-based applications*

University of Texas at Austin

B.Sc. in Physics

2016

Austin, TX USA

RESEARCH EXPERIENCE

University of Rochester, Laboratory for Laser Energetics

Graduate Research Assistant

2016-Present

Rochester, NY USA

- Designed, built and analyzed data from a Python-automated scanning spectral interferometer to measure the frequency response of a spatiotemporal pulse shaping system consisting of an axiparabola and radial echelon optic for use in a dephasingless laser wakefield accelerator
- Designed, and assisted in the fabrication and metrology of radial echelon optics, simulating their real world performance, and prescribing engineering tolerances and improvements to the fabrication process
- Developed computational and theoretical models to study the nonlinear propagation of light in dynamically ionizing plasmas, leading to the discovery of a novel photon acceleration regime enabling the generation of fully coherent, isolated-attosecond pulses in the extreme ultraviolet (EUV)
- Wrote, modified and utilized laser-plasma physics simulation codes, including finite-difference time-domain, pseudospectral split-step wave propagation and photon kinetics based codes
- Planned and ran large simulation parameter scans involving multi-day computations on high performance computing (HPC) resources (Bluehive cluster, LLE HPC)
- Developed, fielded and analyzed data from novel spectrally-resolved Schlieren imaging and interferometry diagnostics with chirped probe pulses to study ionization dynamics on the fs-ps time scale, enabling the first experimental demonstrations of ionization waves of arbitrary velocity (IWAVs) driven by spatiotemporally structured laser pulses
- Developed a theoretical model of ionization wave propagation for spatiotemporally shaped laser pulses with nonuniform power spectra, verified by experimental data and simulations
- Assisted in the theoretical development of several spatiotemporal pulse shaping techniques and their applications
- Developed and fielded diagnostics and analyzed data in support of experimental campaigns on the Multiterawatt laser (MTW) to study laser plasma interaction physics in underdense plasmas (filamentation, ionization refraction, stimulated Raman back-scatter, Raman amplification, ionization dynamics and inverse-bremsstrahlung)
- Gathered data and wrote a custom Levenberg-Marquardt algorithm for many-parameter, highly-nonlinear, least squares fitting of electron pulse-height distributions (photocathode response to x-rays/UV radiation), absolutely calibrating x-ray/UV streak camera (PJX3) gain for photometric applications on OMEGA-EP and MTW

University of Texas at Austin, Center for High Energy Density Science

Undergraduate Research Assistant

2013-2016

Austin, TX USA

- Assisted in ion acceleration, neutron generation and warm-dense matter experimental campaigns on the Texas Petawatt (TPW) laser, responsible for running the target area vacuum system and diagnostics including Cu stacks, Thomson parabolas, ion/electron spectrometers, neutron bubble detectors and ultrafast framing cameras

- Assisted in surface-high harmonic generation experiments on the GHOST laser, learning how to run the laser, vacuum and diagnostics systems as a qualified laser user (QLU)
- Assisted in calibrating charged particle spectrometer magnetic yokes by gathering and analyzing data using the floating wire technique to compare to simulations
- Designed, built and executed an experiment to measure momentum transfer to solid targets from ns-laser ablation, using a custom 3D printed ballistic pendulum diagnostic

University of Texas at Austin, Freshman Research Initiative

2012-2013

Undergraduate Research Assistant

Austin, TX USA

- Calibrated a CCD detector and remotely operated a telescope at the McDonald observatory to acquire astrophysical data for detector bench-marking
- Analyzed white-dwarf pulsation and planetary transit data from the Kepler space telescope using Python-Linux analysis pipelines and Mathematica
- Co-wrote a mock research proposal to study lithium-blanket tritium breeding and spent nuclear fuel transmutation in compact spherical tokamaks

PUBLICATIONS

First Author Publications

1. **Optical shock-enhanced self-photon acceleration**
P. Franke, D. Ramsey, T. T. Simpson, D. Turnbull, D. H. Froula, and J. P. Palastro, *Physical Review A* **104**, 043520 (2021)
2. **Measurement and control of large diameter ionization waves of arbitrary velocity**
P. Franke, D. Turnbull, J. Katz, J. P. Palastro, I. A. Begishev, J. Bromage, J. L. Shaw, R. Boni, and D. H. Froula, *Optics Express* **27**, 31978-31988 (2019)

Co-Author Publications

3. **Nonlinear Thomson scattering with ponderomotive control**
D. Ramsey, B. Malaca, A. Di Piazza, M. Formanek, **P. Franke**, D. H. Froula, M. Pardal, T. T. Simpson, J. Vieira, K. Weichman, and J. P. Palastro, *in review* (2022)
4. **Spatiotemporal control of laser intensity through cross-phase modulation**
T. T. Simpson, D. Ramsey, **P. Franke**, D. H. Froula, and J. P. Palastro, *Optics Express* (Accepted - 2022)
5. **Laser-plasma acceleration beyond wave breaking**
J. P. Palastro, B. Malaca, J. Vieira, D. Ramsey, T. T. Simpson, **P. Franke**, J. L. Shaw, and D. H. Froula, *Physics of Plasmas* **28**, 013109 (2021)
6. **Nonlinear spatiotemporal control of laser intensity**
T. T. Simpson, D. Ramsey, **P. Franke**, N. Vafaei-Najafabadi, D. Turnbull, D. H. Froula, and J. P. Palastro, *Optics Express* **28**, 38516-38526 (2020)
7. **Vacuum acceleration of electrons in a dynamic laser pulse**
D. Ramsey, **P. Franke**, T. T. Simpson, D. H. Froula, and J. P. Palastro, *Physical Review E* **102**, 043207 (2020)
8. **Dephasingless laser wakefield acceleration**
J. P. Palastro, J. L. Shaw, **P. Franke**, D. Ramsey, T. T. Simpson and D. H. Froula, *Physical Review Letters* **124**, 134802 (2020)
9. **Evolution of the electron distribution function in the presence of inverse bremsstrahlung heating and collisional ionization**
A. L. Milder, H. P. Le, M. Sherlock, **P. Franke**, J. Katz, S. T. Ivancic, J. L. Shaw, J. P. Palastro, A. M. Hansen, I. A. Begishev, W. Rozmus, and D. H. Froula, *Physical Review Letters* **124**, 025001 (2020)
10. **Photon acceleration in a flying focus**
A. J. Howard, D. Turnbull, A. S. Davies, **P. Franke**, D. H. Froula, and J. P. Palastro *Physical Review Letters* **123**(12), 124801 (2019)

11. **Flying focus: Spatial and temporal control of intensity for laser-based applications**
D. H. Froula, J. P. Palastro, D. Turnbull, A. Davies, L. Nguyen, A. Howard, D. Ramsey, **P. Franke**, S.-W. Bahk, I. A. Begishev, R. Boni, J. Bromage, S. Bucht, R. K. Follett, D. Haberberger, G. W. Jenkins, J. Katz, T. J. Kessler, J. L. Shaw, and J. Vieira *Physics of Plasmas* **26**, 032109 (2019)
12. **Flying focus and its application to plasma-based laser amplifiers**
D. Turnbull, S.-W. Bahk, I. A. Begishev, R. Boni, J. Bromage, S. Bucht, A. Davies, **P. Franke**, D. Haberberger, J. Katz, T. J. Kessler, A. L. Milder, J. P. Palastro, J. L. Shaw, and D. H. Froula, *Plasma Physics and Controlled Fusion* **61(1)**, 014022 (2019)
13. **Ionization waves of arbitrary velocity**
D. Turnbull, **P. Franke**, J. Katz, J. P. Palastro, I. A. Begishev, R. Boni, J. Bromage, A. L. Milder, J. L. Shaw, and D. H. Froula, *Physical Review Letters* **120(22)**, 225001 (2018)

White Papers

14. **An Ultrafast X-Ray Streak Camera for Time-Resolved High-Energy-Density Applications**
S. T. Ivancic, **P. Franke**, C. Mileham, R. Boni, J. Katz, C. R. Stillman, P. M. Nilson, and D. H. Froula, *Diagnostic White Paper/LLE Review 153* (2017)

SELECTED PRESENTATIONS

Invited Talks

- **Spatiotemporal control of laser pulses for broadband extreme ultraviolet generation** - 47th Annual Conference of the European Physical Society (EPS) on Plasma Physics (2021)
- **Dephasingless laser wakefield acceleration** - 2020 Advanced Accelerator Seminar Series, Working Group 1 Meeting (2020)
- **Measurement and control of ionization waves of arbitrary velocity** - 49th Annual Anomalous Absorption Conference (2019)

Contributed Talks and Posters

- **Optical shock-enhanced self-photon acceleration** - 63rd Annual Meeting of the American Physical Society (APS) Division of Plasma Physics (2021)
- **Dynamically guided extreme ultraviolet photon acceleration using a structured flying focus** - 62nd Annual Meeting of the American Physical Society (APS) Division of Plasma Physics (2020)
- **Frequency conversion of laser pulses reflected from ionization waves of arbitrary velocity** - 61st Annual Meeting of the American Physical Society (APS) Division of Plasma Physics (2019)
- **Ionization waves of arbitrary velocity (Poster)** - 60th Annual Meeting of the American Physical Society (APS) Division of Plasma Physics (2018)

FELLOWSHIPS AND AWARDS

- Laboratory for Laser Energetics Horton Fellowship, 2017-Present
- University of Texas, Graduated with Physics Departmental Honors, 2016
- Eagle Scout, Boy Scout Troop 49, 2011
- Order of the Arrow, Brotherhood Member, 2010