Colton Fruhling

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Research Interest

Over the past few years, my research interests have expanded from high-intensity laser physics where I studied the effect of light scattering electrons resulting in phenomena such as nonlinear Thomson scattering, acceleration of electrons to relativistic speeds, and generation of attosecond x-ray pulse. My research now includes studying light-matter interactions in more complex materials including perovskites, transparent conducting oxides, transistion metal nitrides and MXenes. The platform has changed, however, my general interest in nonlinear and ultrafast light-matter interactions is the cornerstone of my interests.

Experience

Postdoctoral Researcher 2021-Present
Purdue University: Postdoctoral research on nanolasing and time-varying media

Graduate Research Assistant 2014-2021
Univeristy of Nebraska-Lincoln: Extreme Light Laboratory: Doctoral research on the nonlinear interaction of light and matter
Awards: Graduate Assistance in Areas of National Need fellowship

Research Assistant 2013 - 2014
Colorado State University: Designed apparatus for applying magnetic field to material with optical access and modeled spin waves with Matlab

Research Intern 2012
US Strategic Command: Part of a diverse research team providing recommendations on best practices for collaborating with sensitive material

Education

University of Nebraska Lincoln Expected: May 2021
PhD, Physics and Astronomy Lincoln, NE
Dissertation title: Fundamental Studies of Nonlinear Thomson Scattering
Advisor: Prof. Donald Umstadter - Director of the Extreme Light Laboratory

Colorado State University May 2014
BS, Physics and Astronomy Fort Collins, CO
Graduated with Honors
Advisor: Prof. Kristen Buchanan

Current Research Interests

Listed below are some of the major projects I am currently exploring

Ultrafast Optical Phenomena

- Optically induced material changes transparent conducting oxides related to switching, beam steering, and photonic time crystals

- Carrier dynamics in lead-halide perovskites and their applications towards lasing

Nano Lasing

- Random lasing in novel materials such a lead-halide perovskites
- Short pulse generation schemes via nano Q-switching, mode-locking and chaotic lasers

COLLABORATIONS

Collaboration plays an critical role in my research.

Studies of Time-Varying Media in Transparent Conduction Oxides 2022
The Technion: Mordechai Segev

Polarization-Resolved Measurements of Nonlinear Thomson Scattering 2020
Brigham Young University: Justin Peatross and Michael Ware

Laser Wakefield Betatron Enhancment with Tailored Plasma Density Profile 2019
University of Nebraska-Lincoln: Matthias Fuchs

RELEVANT CONFERENCE POSTERS AND PRESENTATIONS

Fruhling, C. et al. (2022). Demonstration of Coherent Random Lasing in Optically Thin Quasi-2D Lead-halide Perovskite *Conference on Lasers and Electro-optics*. 2022

Fruhling, C. et al. (2022). A guide to all-optical swtitching with epsilon-near-zero materials. *APS March Meeting*. 2022

Fruhling, C. et al. (2020). Measuring Attosecond Electron Pulses with Coherent Nonlinear Thomson Scattering. *Bulletin of the American Physical Society*. 2020

Fruhling C., Golovin G., Banerjee S. & Umstader D.(2019), Probing wake structure of nonlinear wakes via optical phase-space excitation, *Anomalous Absorption Conference* 2019

Fruhling C., Golovin G. . . . &Umstadter D.(2018), Experimental demonstration of optical injection of electrons into a laser wakefield, 6^{th} *High-Power Laser Workshop* 2018

Fruhling, C., Yan W., . . . & Umstadter D.(2016), Highly Nonlinear Inverse Compton Scattering, *International Committee of Ultra-High Intensity Lasers* 2016

RELEVANT PUBLICATIONS

Fruhling, C., Wang K., Chowdhury S., Xu X., Simon J., Kildishev A., Dou L., Meng X., Boltasseva A. & Shalaev V. M. (2021), Coherent Random Lasing in Subwavelength Quasi-2D Perovskites, *Laser & Photonics Reviews* 2023

Fruhling, C., Ozlu M. G., Saha S., Boltasseva A. & Shalaev V. M. (2021), Understanding all-optical switching at the epsilon-near-zero point: a tutorial review, *Applied Physics B* 2022

Fruhling, C., Junzhi Wang, Donald Umstadter, Christoph Schulzke, Mahonri Romero, Michael Ware, and Justin Peatross. (2021), Experimental observation of polarization-resolved nonlinear Thomson scattering of elliptically polarized light, *Physical Review A* 2021

Fruhling, C., Golovin, G., & Umstadter, D. (2020). Attosecond electron bunch measurement with coherent nonlinear Thomson scattering. *Physical Review Accelerators and Beams*, 23(7), 072802. 2020

Golovin, G., Horný, V., Yan, W., **Fruhling, C.**, Haden, D., Wang, J., . . . & Umstadter, D. (2020). Generation of ultrafast electron bunch trains via trapping into multiple periods of plasma wakefields. *Physics of Plasmas*, 27(3), 033105. 2020

Yan, W., **Fruhling, C.**, Golovin, G., Haden, D., Luo, J., Zhang, P., . . . & Umstadter, D. (2017). High-order multiphoton Thomson scattering. *Nature Photonics*, 11(8), 514-520. 2017