

Publications and Conference Presentations

Publications

C. H. Allen, M. Oliver, L. Divol, O. L. Landen, Y. Ping, M. Scholmerich, R. Wallace, R. Earley, W. Theobald, T. G. White, and T. Döppner, “Toward an Integrated Platform for Characterizing Laser-Driven, Isochorically Heated Plasmas with 1 mm Spatial Resolution,” *Appl. Opt.* **61**, 1987 (2022).

P. T. Campbell, C. A. Walsh, B. K. Russell, J. P. Chittenden, A. Crilly, G. Fiksel, L. Gao, I. V. Igumenshchev, P. M. Nilson, A. G. R. Thomas, K. Krushelnick, and L. Willingale, “Measuring Magnetic Flux Suppression in High-Power Laser-Plasma Interactions,” *Phys. Plasmas* **29**, 012701 (2022).

T. J. B. Collins, C. Stoeckl, R. Epstein, W. A. Bittle, C. J. Forrest, V. Yu. Glebov, V. N. Goncharov, D. R. Harding, S. X. Hu, D. W. Jacobs-Perkins, T. Z. Kosc, J. A. Marozas, C. Mileham, F. J. Marshall, S. F. B. Morse, P. B. Radha, S. P. Regan, B. Rice, T. C. Sangster, M. J. Shoup III, W. T. Shmayda, C. Sorce, W. Theobald, and M. D. Wittman, “Causes of Fuel–Ablator Mix Inferred from Modeling of Monochromatic Time-Gated Radiography of OMEGA Cryogenic Implosions,” *Phys. Plasmas* **29**, 012702 (2022).

C. Dorrer and M. Spilatro, “Spectral and Temporal Shaping of Spectrally Incoherent Pulses in the Infrared and Ultraviolet,” *Opt. Express* **30**, 4942 (2022).

M. Formanek, D. Ramsey, J. P. Palastro, and A. Di Piazza, “Radiation Reaction Enhancement in Flying Focus Pulses,” *Phys. Rev. A* **105**, L020203 (2022).

A. M. Hansen, K. L. Nguyen, D. Turnbull, B. J. Albright, R. K. Follett, R. Huff, J. Katz, D. Mastrosimone, A. L. Milder, L. Yin, J. P. Palastro, and D. H. Froula, “Cross-Beam Energy Transfer Saturation: Ion Heating and Pump Depletion,” *Plasma Phys. Control. Fusion* **64**, 034003 (2022).

G. W. Jenkins, C. Feng, and J. Bromage, “Energy Scaling Beyond the Gas Ionization Threshold with Divided-Pulse Nonlinear Compression,” *Opt. Lett.* **47**, 1450 (2022).

V. V. Karasiev, D. I. Mihaylov, and S. X. Hu, “Meta-GGA Exchange–Correlation Free Energy Density Functional to Increase the Accuracy of Warm Dense Matter Simulations,” *Phys. Rev. B* **105**, L081109 (2022).

M. F. Kasim, D. Watson-Parris, L. Deaconu, S. Oliver, P. Hatfield, D. H. Froula, G. Gregori, M. Jarvis, S. Khatiwala, J. Korenaga, J. Topp-Muggleston, E. Viezzer, and S. M. Vinko, “Building High Accuracy Emulators for Scientific Simulations with Deep Neural Architecture Search,” *Mach. Learn.: Sci. Technol.* **3**, 015013 (2022).

R. G. Kraus, R. J. Hemley, S. J. Ali, J. L. Belof, L. X. Benedict, J. Bernier, D. Braun, R. E. Cohen, G. W. Collins, F. Coppari, M. P. Desjarlais, D. Fratanduono, S. Hamel, A. Krygier, A. Lazicki, J. Mcnane, M. Millot, P. C. Myint, M. G. Newman, J. R. Rygg, D. M. Sterbentz, S. T. Stewart, L. Stixrude, D. C. Swift, C. Wehrenberg, and J. H. Eggert, “Measuring the Melting Curve of Iron at Super-Earth Core Conditions,” *Science* **375**, 202 (2022).

M. C. Marshall, M. G. Gorman, D. N. Polsin, J. H. Eggert, M. K. Ginnane, J. R. Rygg, G. W. Collins, and L. D. Leininger, “Diamond Formation in Double-Shocked Epoxy to 150 GPa,” *J. Appl. Phys.* **131**, 085904 (2022).

J. Meinecke, P. Tzeferacos, J. S. Ross, A. F. A. Bott, S. Feister, H.-S. Park, A. R. Bell, R. Blandford, R. L. Berger, R. Bingham, A. Casner, L. E. Chen, J. Foster, D. H. Froula, C. Goyon, D. Kalantar, M. Koenig, B. Lahmann, C.-K. Li, Y. Lu, C. A. J. Palmer, R. D. Petrasso, H. Poole, B. Remington, B. Reville, A. Reyes, A. Rigby, D. Ryu, G. Swadling, A. Zylstra, F. Miniati, S. Sarkar, A. A. Schekochihin, D. Q. Lamb, and G. Gregori, “Strong Suppression of Heat Conduction in a Laboratory Replica of Galaxy-Cluster Turbulent Plasmas,” *Sci. Adv.* **8**, eabj6799 (2022).

S. F. Nwabunwanne and W. R. Donaldson, “Interdigitated Electrode Geometry Variation and External Quantum Effi-

ciency of GaN/AlGaIn-Based Metal–Semiconductor–Metal UV Photodetectors,” *Proc. SPIE* **12001**, 120010F (2022).

J. J. Pilgram, M. B. P. Adams, C. G. Constantin, P. V. Heuer, S. Ghazaryan, M. Kaloyan, R. S. Dorst, D. B. Schaeffer, P. Tzeferacos, and C. Niemann, “High Repetition Rate Exploration of the Bierman Battery Effect in Laser Produced Plasmas Over Large Spatial Regions,” *High Power Laser Sci. Eng.* **10**, e13 (2022).

N. R. Shaffer and C. E. Starrett, “Dense Plasma Opacity via the Multiple-Scattering Method,” *Phys. Rev. E* **105**, 015203 (2022).

T. T. Simpson, D. Ramsey, P. Franke, K. Weichman, M. V. Ambat, D. Turnbull, D. H. Froula, and J. P. Palastro, “Spatiotemporal Control of Laser Intensity Through Cross-Phase Modulation,” *Opt. Express* **30**, 9878 (2022).

G. F. Swadling and J. Katz, “Novel Design for a Polarizing DUV Spectrometer Using a Wollaston Prism and Its Application as a Diagnostic for Measuring Thomson Scattering Data in the Presence of Strong Self-Emission Backgrounds,” *Rev. Sci. Instrum.* **93**, 013501 (2022).

W. Theobald, D. Cao, R. C. Shah, C. A. Thomas, I. V. Igumenshchev, K. A. Bauer, R. Betti, M. J. Bonino, E. M. Campbell, A. R. Christopherson, K. Churnetski, D. H. Edgell, C. J. Forrest, J. A. Frenje, M. Gatu Johnson, V. Yu. Glebov, V. N. Goncharov, V. Gopalswamy, D. R. Harding, S. X. Hu,

S. T. Ivancic, D. W. Jacobs-Perkins, R. T. Janezic, T. Joshi, J. P. Knauer, A. Lees, R. W. Luo, O. M. Mannion, F. J. Marshall, Z. L. Mohamed, S. F. B. Morse, D. Patel, J. L. Peebles, R. D. Petrasso, P. B. Radha, H. G. Rinderknecht, M. J. Rosenberg, S. Sampat, T. C. Sangster, W. T. Shmayda, C. M. Shulldberg, A. Shvydky, C. Sorce, C. Stoeckl, M. D. Wittman, and S. P. Regan, “Enhanced Laser-Energy Coupling with Small-Spot Distributed Phase Plates (SG5-650) in OMEGA DT Cryogenic Target Implosions,” *Phys. Plasmas* **29**, 012705 (2022).

A. J. White, L. A. Collins, K. Nichols, and S. X. Hu, “Mixed Stochastic-Deterministic Time-Dependent Density Functional Theory: Application to Stopping Power of Warm Dense Carbon,” *J. Phys.: Condens. Matter* **34**, 174001 (2022).

S. Zhang, D. E. Fratanduono, M. C. Marshall, J. R. Rygg, A. E. Lazicki, A. Shvydky, D. Haberberger, V. N. Goncharov, T. R. Boehly, G. W. Collins, and S. X. Hu, “Species Separation in Polystyrene Shock Release Evidenced by Molecular-Dynamics Simulations and Laser-Drive Experiments,” *Phys. Rev. Research* **4**, 013126 (2022).

S. Zhang, M. A. Morales, R. Jeanloz, M. Millot, S. X. Hu, and E. Zurek, “Nature of the Bonded-to-Atomic Transition in Liquid Silica to TPa Pressures,” *J. Appl. Phys.* **131**, 071101 (2022).

D. Zhao, R. Betti, and H. Aluie, “Scale Interactions and Anisotropy in Rayleigh–Taylor Turbulence,” *J. Fluid Mech.* **930**, A29 (2022).

Forthcoming Publications

S.-W. Bahk, I. A. Begishev, R. Roides, C. Mileham, R. Cuffney, C. Feng, B. M. Webb, C. Jeon, M. Spilatro, S. Bucht, C. Dorrer, and J. Bromage, “Effect of the Pump Beam Profile and Wavefront on the Amplified Signal Wavefront in Optical Parametric Amplifiers,” to be published in *Optics Express*.

A. Bose, J. Peebles, C. A. Walsh, J. A. Frenje, N. V. Kabadi, P. J. Adrian, G. D. Sutcliffe, M. Gatu Johnson, C. A. Frank, J. R. Davies, R. Betti, V. Yu. Glebov, F. J. Marshall, S. P. Regan, C. Stoeckl, E. M. Campbell, H. Sio, J. Moody, A. Crilly, B. D. Appelbe, J. P. Chittenden, S. Atzeni, F. Barbato, A. Forte, C. K. Li, F. H. Séguin, and R. D. Petrasso, “Effect of Strongly Magnetized Electrons and Ions on Heat Flow and Symmetry of Inertial Fusion Implosions,” to be published in *Physical Review Letters*.

G. W. Jenkins, C. Feng, and J. Bromage, “Simultaneous Contrast Improvement and Temporal Compression Using Divided-Pulse Nonlinear Compression,” to be published in *Optics Express*.

D. Kim, R. F. Smith, I. K. Ocampo, F. Coppari, M. C. Marshall, M. K. Ginnane, J. K. Wicks, S. J. Tracy, M. Millot, A. Lazicki, J. R. Rygg, J. H. Eggert, and T. S. Duffy, “Structure and Density of Silicon Carbide to 1.5 TPa and Implications for Extrasolar Planets,” to be published in *Nature Communications*.

T. Z. Kosci, H. Huang, T. J. Kessler, and S. G. Demos, “Angular Dependence of the Transverse Raman Scattering in KDP and DKDP in Geometries Suitable for Beam Polarization Control,” to be published in *Optics Express*.

L. S. Leal, A. V. Maximov, E. C. Hansen, J. R. Davies, D. H. Barnak, J. L. Peebles, K. M. Woo, P. V. Heuer, A. B. Sefkow, and R. Betti, “The Effect of Laser Preheat in Magnetized Liner Inertial Fusion at OMEGA,” to be published in *Physics of Plasmas*.

R. W. Paddock, H. Martin, R. T. Ruskov, R. H. H. Scott, W. Garbett, B. M. Haines, A. B. Zylstra, E. M. Campbell, T. J. B. Collins, R. S. Craxton, C. A. Thomas, V. N. Goncharov, R. Aboushelbaya, Q. S. Feng, M. W. von der Leyen, I. Ouatu, B. T. Spiers, R. Timmis, R. H. W. Wang, and P. A. Norreys, “Pathways Towards Break Even for Low Convergence Ratio Direct-Drive Inertial Confinement Fusion,” to be published in the *Journal of Plasma Physics*.

D. N. Polsin, A. Lazicki, X. Gong, S. J. Burns, F. Coppari, L. E. Hansen, B. J. Henderson, M. F. Huff, M. I. McMahon, M. Millot, R. Paul, R. F. Smith, J. H. Eggert, G. W. Collins, and J. R. Rygg, “Structural Complexity in Ramp-Compressed Sodium to 480 GPa,” to be published in *Nature Communications*.

G. F. Swadling, C. Bruulsema, W. Rozmus, and J. Katz, “Quantitative Assessment of Fitting Errors Associated with Streak Camera Noise in Thomson Scattering Data Analysis,” to be published in *Review of Scientific Instruments*.

Conference Presentations

E. M. Campbell, “Perspectives on Inertial Fusion Energy,” presented at LLE Research and Review, 14 January 2022.

S. F. Nwabunwanne and W. R. Donaldson, “Interdigitated Electrode Geometry Variation and External Quantum Efficiency of GaN/AlGaIn-Based Metal–Semiconductor–Metal UV Photodetectors,” presented at Photonics West 2022, San Francisco, CA, 22–27 January 2022.

P. V. Heuer, S. Feister, N. A. Murphy, and J. R. Davies, “Open Source Software and Data Formats for High-Energy-Density Physics,” presented at Laser-Plasma–Accelerator Control Systems and Machine Learning, virtual, 24–28 January 2022.

R. B. Spielman, E. M. Campbell, C. Deeney, P. Tzeferacos, and J. D. Zuegel, “Short-Pulse Lasers for Directed-Energy Hypersonic Defense, Swarms, and More,” presented at the Visit of J. Stiles, Rochester, NY, 26 January 2022.

The following presentations were made at the National Ignition Facility and Jupiter Laser Facility User Meeting, Livermore, CA, 7–9 February 2022:

A. Armstrong, A. Reyes, M. B. P. Adams, P. Farmakis, E. C. Hansen, Y. Lu, D. Michta, K. Moczulski, D. Q. Lamb, and

P. Tzeferacos, “Implementation and Verification of Braginskii Viscosity in the *FLASH* Code.”

L. Ceurvorst, L. Masse, S. F. Khan, D. Martinez, N. Izumi, V. Smalyuk, T. Goudal, V. Bouffetier, A. Casner, B. Canaud, V. N. Goncharov, and I. V. Igumenshchev, “Observing the Effects of Ablation and Perforation on the Deeply Nonlinear Rayleigh–Taylor Instability.”

G. W. Collins, “Extreme Matters: Pressure to Explore New Worlds and Revolutionary States of Matter.”

P. Farmakis, M. McMullan, A. Reyes, J. Laune, M. B. P. Adams, A. Armstrong, E. C. Hansen, Y. Lu, D. Michta, K. Moczulski, D. Q. Lamb, and P. Tzeferacos, “Expanding the Tabulated Equation-of-State Implementations in the *FLASH* Code of the *SESAME* Database.”

Y. Lu, S. Feister, J. Meinecke, F. Miniati, G. Gregori, A. Bott, A. Reyes, E. C. Hansen, J. T. Laune, B. Reville, J. S. Ross, D. Q. Lamb, and P. Tzeferacos, “Numerical Modeling of Laser-Driven Plasma Experiments Aiming to Study Turbulent Dynamo and Thermal Conduction at the National Ignition Facility.”

K. Moczulski, A. Reyes, M. B. P. Adams, A. Armstrong, P. Farmakis, E. Hansen, Y. Lu., D. Michta, D. Q. Lamb, and P. Tzeferacos, “Implementation and Verification of LC Circuit for Z-Pinch *FLASH* Simulations.”

D. N. Polsin, G. W. Collins, J. R. Rygg, X. Gong, M. Huff, M. K. Ginnane, M. McMahon, E. Zurek, A. Lazicki, S. Bonev, M. Gorman, R. Briggs, J. H. Eggert, and J. Wark,

“Transforming Simple Metals to Topological Insulators: Sodium to 18 Mbar.”

V. Gopalaswamy, R. Betti, J. P. Knauer, D. Patel, A. Lees, A. R. Christopherson, K. M. Woo, C. A. Thomas, D. Cao, O. M. Mannion, R. C. Shah, C. J. Forrest, Z. L. Mohamed, C. Stoeckl, V. Yu. Glebov, S. P. Regan, D. H. Edgell, M. J. Rosenberg, I. V. Igumenshchev, P. B. Radha, K. S. Anderson, J. R. Davies, T. J. B. Collins, V. N. Goncharov, E. M. Campbell, R. Janezic, D. R. Harding, M. J. Bonino, S. Sampat, S. F. B. Morse, M. Gatu Johnson, R. D. Petrasso, C. K. Li, and J. A. Frenje, “Fusion Energy via Laser-Driven Inertial Confinement,” presented at Reed College Physics Seminar, virtual, 9 February 2022.

E. M. Campbell, “Perspectives on Inertial Fusion Energy,” presented at the Rochester Institute of Technology Spring Seminar, Rochester, NY, 10 February 2022.

W. Theobald, “LLE is Leading Innovative ICF/IFR Diagnostic Development, which is Amplified Through Participation in the National Diagnostics Working Group,” presented at the Workshop on New Inertial Fusion Energy/High-Energy-Density Physics Laser Facility, virtual, 10 February 2022.

V. V. Karasiev, D. I. Mihaylov, S. X. Hu, S. B. Trickey, and J. W. Dufty, “Meta-GGA Exchange-Correlation Free-Energy Density Functional: Achieving Unprecedented Accuracy for Warm-Dense-Matter Simulations,” presented at the 61st Sanibel Symposium, St. Simons Island GA, 13–18 February 2022.

J. D. Zuegel, “High-Energy Lasers for Driving Dynamic Materials Experiments,” presented at the NNSA Advanced Photon Sources Sector Opportunities Workshop, virtual, 15–17 February 2022.

E. M. Campbell, “Perspectives on Inertial Fusion Energy,” presented at the PB11 Science Seminar, virtual, 17 February 2022.

C. Deeney, “National Nuclear Security: 21st Century Science and Technology Perspectives,” presented at the World Affairs Council, West Palm Beach, FL, 21 February 2022.

D. H. Froula, “Thomson Scattering from a Different Perspective,” presented at the Oxford Seminar, Oxford, UK, 21 February 2022.

J. D. Zuegel, “Kilojoule Lasers for Dynamic Compression Studies,” presented at Science with High-Power Lasers, PETRA IV Workshop, virtual, 22–23 February 2022.

The following presentations were made at the Inertial Fusion Energy Science and Technology Workshop, virtual, 22–24 February 2022:

V. N. Goncharov, “Inertial Fusion Energy Target Designs with Advanced Laser Technologies.”

J. D. Zuegel, “A Broad View of Solid-State Laser Drivers for Inertial Fusion Energy.”

E. M. Campbell, “LLE Perspective,” presented at the Office of Experimental Sciences Executives Meeting, virtual, 24 February 2022.

J. P. Palastro, “Research at the Laboratory for Laser Energetics,” presented at the Physical Sciences and Astronomy Recruitment Event, Rochester, NY, 25 February 2022.

E. M. Campbell, “Perspectives on Inertial Fusion Energy,” presented at the Plasma Science and Fusion Center Seminar, virtual, 7 March 2022.

The following presentations were made at the Ecosystem for Collaborative Leadership and Inclusive Innovation in Plasma Science and Engineering, Alexandria, VA, 9–11 March 2022:

G. W. Collins, “Extreme Matters: Pressures to Explore New Worlds and Revolutionary States of Matter.”

P. Tzeferacos, “Laser-Driven Experiments Shed New Light on Magnetized Turbulence and Fluctuation Dynamo in Astrophysical Plasmas.”

J. D. Zuegel, “Multi-Petawatt Physics Prioritization (MP3) Workshop.”

The following presentations were made at Matter in Extreme Conditions from Material Science to Planetary Physics, Montgenevre, France, 12–19 March 2022:

D. A. Chin, P. M. Nilson, D. T. Bishel, R. Paul, E. Smith, X. Gong, M. K. Ginnane, B. J. Henderson, D. N. Polsin, S. X. Hu, J. R. Rygg, G. W. Collins, D. Trail, A. Amouretti, M. Harmand, O. Mathon, R. Torchio, J. J. Ruby, F. Coppari, A. Coleman, and Y. Ping, “X-Ray Absorption Spectroscopy Temperature Measurements at High-Energy-Density Conditions.”

D. H. Froula, “Thomson Scattering from a Different Perspective.”

S. X. Hu, V. V. Karasiev, P. M. Nilson, D. T. Bishel, D. A. Chin, K. Nichols, R. Paul, R. Goshadze, M. Ghosh, J. Hinz, S. Zhang, D. I. Mihaylov, G. W. Collins, N. Shaffer, L. A. Collins, A. J. White, V. Recoules, N. Brouwer, M. Torrent, I. E. Golovkin, M. Gu, T. Walton, and S. B. Hansen, “Understanding Matter in Extreme Conditions with *ab initio* Calculations.”

Z. K. Sprowal, L. E. Hansen, M. F. Huff, D. N. Polsin, D. G. Hicks, T. R. Boehly, J. R. Rygg, and G. W. Collins, “Accessing High Density States in D₂ Using Double Shock.”

The following presentations were made at the APS March Meeting, Chicago, IL, 14–18 March 2022:

M. Ghosh, S. Zhang, and S. X. Hu, “*Ab Initio* Investigation of the Cooperative Diffusion in Body-Centered-Cubic Iron Under Inner-Core Conditions of Earth and Super-Earth Exoplanets.”

R. M. N. Goshadze, V. V. Karasiev, D. I. Mihaylov, and S. X. Hu, “Equation of State of Metallization of CH Along the Principal Hugoniot.”

B. J. Henderson, M. C. Marshall, J. R. Rygg, D. N. Polsin, L. E. Hansen, M. K. Ginnane, and G. W. Collins, “Silica Aerogel as a Bright Optical Source for High-Energy-Density Experiments.”

M. Huff, J. R. Rygg, G. W. Collins, T. R. Boehly, D. N. Polsin, M. Nakajima, B. J. Henderson, M. C. Marshall, T. A. Suer, D. E. Fratanduono, M. Millot, R. F. Smith, C. A. McCoy, and L. E. Hansen, “Measurements of Sound Speed in Iron Shock Compressed to ~3000 GPa.”

R. Paul, S. Zhang, V. V. Karasiev, and S. X. Hu, “Thermal-Induced Evolution of Magnetic Properties of FeO₂ Under High Pressures.”

S. Zhang, M. A. Morales, R. Jeanloz, M. Millot, S. X. Hu, and E. Zurek, “Nature of the Bonded-to-Atomic Transition in Liquid Silica at Extreme Conditions.”

M. Ghosh, S. Zhang, and S. X. Hu, “An Exotic Phase of Iron in Earth’s Inner Core: A First-Principles–Based Study on the Mechanism of Cooperative Diffusion in Body-Centered-Cubic Iron,” presented at the University of Rochester Graduate Education and Postdoctoral Affairs Research Symposium, Rochester, NY, 23 March 2022.

C. Deeney, “The Laboratory for Laser Energetics: Progress in Science and Technology,” presented at the Plasma Science and Fusion Center Seminar, virtual, 28 March 2022.