NNSA/DOE 2018 High-Energy Density Laboratory Plasmas research grant awardees

UNIVERSITY OF CALIFORNIA

Project Name: An Advanced Non-Intrusive Spectroscopic Technique to Measure Magnetic Field in Imploding Plasmas
Principal Investigator: Farhat Beg
Award Amount: $450,000
Description: The objective of this project is to study magnetic fields in a pulsed-power-driven plasma as a function of space and time. Data analysis will test and improve the computational solution techniques and enhance understanding of the physical processes in magnetized plasmas.

Project Name: Characterization of Ion-Heated Warm Dense Matter and its Ion Transport Properties
Principal Investigator: Christopher McGuffey
Award Amount: $525,000
Description: Using cutting edge computational tools, researchers will study the proton beam transport and stopping dynamics that are fundamental to heating a warm dense matter sample.

Project Name: Continuation of the Application of Parallel Kinetic Simulations to Laser and Electron Transport Through Plasmas Under Conditions Relevant to Inertial Confinement Fusion and High-Energy Density Science
Principal Investigator: Warren Mori
Award Amount: $500,000
Description: The project is a continuation of previous research on nonlinear optics and electron transport of speckled laser beams.

Project Name: Development of a Self-Modulated Laser Wakefield accelerator platform for a hyper-spectral photo source from 10KV to 1MV for High-Energy Density Science
Principal Investigator: Chan Joshi
Award Amount: $825,000
Description: The objective of this project is to create an imaging capability based on a self-modulated laser wakefield accelerator, which introduces a laser pulse into a plasma and forms an electron plasma wave.

Project Name: Energy Transport in Magnetized Laser Plasmas
Principal Investigator: Christoph Niemann
Award Amount: $350,000
Description: This project will carry out a detailed experimental and numerical investigation of the dynamics of magnetized, laser-produced high-energy density laboratory plasmas by studying the transfer of internal, flow, and kinetic energy into magnetic energy and non-thermal particles.

COLORADO STATE UNIVERSITY

Project Name: Ultra-High-Energy Density Relativistic Plasmas by Ultrafast Laser Heating of Nanostructures: Scaling to Ultra-High Irradiation Intensities
Principal Investigator: Jorge Rocca
Award Amount: $300,000
Description: The team will focus on using a table-top optical laser system to volumetrically heat plasma to a new high-energy density regime of extremely high temperature at near solid density.

CORNELL UNIVERSITY

Project Name: Theory and Modeling of the Physics of Relativistic Shocks and Fermi Acceleration, and of Their Implementation under Laboratory Conditions Using Petawatt Laser Systems
Principal Investigator: Gennady Shvets
Award Amount: $480,000
Description: Researchers will carry out an original theoretical and modeling effort on issues related to relativistic, collision-less shocks in astrophysical plasmas. Objectives include: understanding the plasma formation, energetics, and acceleration; developing novel computational tools to faithfully model long-term shocks dynamics; and investigating the most promising scenarios under which the formation of such shocks can be observed.

GENERAL ATOMICS

Project Name: Magnetic-Field Effects in Unstable High-Energy Density Plasmas
Principal Investigator: Mario Manuel
Award Amount: $240,000
Description: General Atomics will be investigating the effect that a magnetic background B-field will have on Rayleigh-Taylor instability of fluid densities in a high-energy density environment.

IDAHO STATE UNIVERSITY

Project Name: Pulsed Power Driver to Generate and Measure High-Energy Density States
Principal Investigator: Rick Spielman
Award Amount: $494,009
Description: The overall objective of this project is to develop a compact pulsed-power generator for producing and studying high-energy density states of matter. This portable system will allow the study of in situ, time-dependent properties of materials.

JOHNS HOPKINS UNIVERSITY

Project Name: Development of Talbot-Lau Phase-Contrast X-ray Diagnostics for High Energy Density Laboratory Plasmas
Principal Investigator: Dan Stutman
Award Amount: $600,000
Description: This project will upgrade a Talbot-Lau X-ray Deflectometry (TXD) plasma diagnostic component from one-dimensional density gradient measurements to two-dimensions. TXD measures refraction changes in matter. The team will also develop monochromatic TXD at the K-alpha wavelength. The experiments will be performed on OMEGA-EP at the Laboratory for Laser Energetics.

UNIVERSITY OF MICHIGAN

Project Name: High-Energy Density Science Applications of Laser Wakefield Accelerators
Principal Investigator: Alexander Thomas
Award Amount: $250,000
Description: The University of Michigan will use the femtosecond duration X-rays generated in a laser wakefield particle accelerator to probe laser-heated matter in the high-energy density and warm dense matter regimes.

UNIVERSITY OF NEBRASKA-LINCOLN

Project Name: Laboratory Study of Nonlinear Quantum Electrodynamics in Intense Laser-Matter Interactions Dynamics
Principal Investigator: Donald Umstadter

Award Amount: $499,280
Description: This grant will focus on investigating the influence of radiation at the quantum level, electron-positron pair production, and quantum electrodynamics cascades – or how light and matter interact.

UNIVERSITY OF NEW MEXICO

Project Name: Seeding and Evolution of Magnetohydrodynamic Instabilities of a Metal Surface Driven by Intense Current*
Principal Investigator: Mark Gilmore
Award Amount: $479,998
Description: The project will investigate the development of instabilities on the surface of a thick conductor as it is driven from the solid state to the plasma state.
(*Three grants awarded for this consortium)

NEVADA SYSTEM OF HIGHER EDUCATION - UNIVERSITY OF NEVADA

Project Name: Atomic Kinetics of Laboratory Photoionized Plasmas Relevant to Astrophysics
Principal Investigator: Roberto Mancini
Award Amount: $900,000
Description: The focus of this proposal is to study the fundamental atomic and radiation physics of plasmas driven by a broadband intense flux of X-rays.

Project Name: Hard and Soft X-ray Line Emission from High-Z Multiply Ionized Ions Influenced by Dielectronic Recombination and Polarization from High-Energy Density Laboratory Plasmas
Principal Investigator: Alla Safronova
Award Amount: $900,000
Description: The goal of this grant is to compare dielectronic recombination (DR) and X-ray line polarization of the same charged particles. DR is a two-step process that greatly increases the efficiency for electrons and ions to recombine in a plasma.

Project Name: Investigation into the Transport Properties of Planetary Interiors Through Inelastic X-ray Scattering Experiments and Quantum Molecular Dynamics
Principal Investigator: Thomas White
Award Amount: $150,000

Description: The goal of this grant is to provide computational support for ongoing experiments through data analysis and state-of-the-art atomistic simulations of dense plasmas.

Project Name: Seeding and Evolution of Magnetohydrodynamic Instabilities of a Metal Surface Driven by Intense Current*
Principal Investigator: Bruno Bauer
Award Amount: $375,000
Description: The project will investigate the development of instabilities on the surface of a thick conductor as it is driven from the solid state to the plasma state.
*(*Three grants awarded for this consortium)*

OHIO STATE UNIVERSITY

Project Name: A Novel Study of Warm Dense Matter Using Hybrid Particle-In-Cell/Molecular Dynamics Simulation Approaches Combined with Hybrid Ultrafast Digital-to-Analog Converter Based Experiments
Principal Investigator: Douglass Schumacher
Award Amount: $599,999
Description: The objective of this grant is to use a new computational technique to predict equation of state and transport characteristics, and compare them to published values from existing approaches. The team will subsequently capture shock and explosion dynamics in targets using various imaging methods and specialized materials.

POLYMATH RESEARCH INC.

Project Name: Resonant Excitation and Multi-Stage Re-Amplification of Nonlinear Plasma Waves with Ultrafast High Energy Density Applications
Principal Investigator: Bedros Afeyan
Award Amount: $1,050,000
Description: Researchers will explore electron plasma waves near their critical density as they relate to X-ray optics and extreme ultraviolet lithography – a process for creating next-generation integrated circuits.

PRINCETON UNIVERSITY

Project Name: Fundamental Issues in the Interaction of Intense Lasers with Plasma
Principal Investigator: Nathaniel Fisch

Award Amount: $974,998
Description: The project objective is to uncover new and unusual effects in the nonlinear optics of plasma, to develop the mathematical language to describe these effects, and to address the practical applications that may be derived.

UNIVERSITY OF ROCHESTER

Project Name: The Ablative Magnetohydrodynamic Rayleigh-Taylor Instability
Principal Investigator: Hussein Aluie
Award Amount: $299,999
Description: The team will develop a fundamental understanding of the evolution and role of magnetic fields in the ablative Rayleigh-Taylor instability (RTI), which occurs at the interface between two fluids of different densities when the lighter fluid is pushing the heavier fluid. Ablative RTI includes the additional physics of mass evaporation of the lighter fluid due to a heat source.

Project Name: Converging Towards Atomic and Nuclear Pressures
Principal Investigator: Gilbert Collins
Award Amount: $699,816
Description: The project will develop and use a new generation of convergent shock-wave techniques to create and accurately characterize dense plasmas. The team will also explore cylindrical geometries as a means of reducing uncertainties and gradients.

Project Name: Probing High-Energy Density Turbulence with Lasers and Coherent Light Sources **Principal Investigator:** Jessica Shang
Award Amount: $614,913
Description: The team will probe features of high-energy density plasma turbulence by adapting flow configurations. Experiments will be conducted on OMEGA-EP at the Laboratory for Laser Energetics and the Linac Coherent Light Source at SLAC Accelerator Laboratory.

UNIVERSITY OF TEXAS AT AUSTIN

Project Name: Studies of Particle Transport in High-Energy Density Plasma in the Presence of a Megagauss Magnetic Field
Principal Investigator: Hernan Quevedo
Award Amount: $500,000
Description: The goal of this grant is to measure and examine the transport of particles in previously unexplored regimes of laser-generated, high-energy density

plasma embedded in a strong magnetic field (up to 60 teslas), both computationally and theoretically.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Project Name: Seeding and Evolution of Magnetohydrodynamic Instabilities of a Metal Surface Driven by Intense Current*
Principal Investigator: Bhuvana Srinivasan
Award Amount: $300,000
Description: The project will investigate the development of instabilities on the surface of a thick conductor as it is driven from the solid state to the plasma state.
(*Three grants awarded for this consortium)

WEST VIRGINIA UNIVERSITY RESEARCH CORPORATION

Project Name: Spectroscopic Methods for Obtaining Plasma Parameters Applied to Soft X-ray Absorption Spectra from Radiatively Heated Z-Pinch Plasmas
Principal Investigator: Mark Koepke
Award Amount: $450,000
Description: The principal goal of this project is to systematically study the consistency of techniques for obtaining electron temperature and density from a soft X-ray absorption spectrum.