

REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-26-04

PetaWatt Directed Energy Bioeffects Pathfinder

PROJECT DESCRIPTION: The increasing accessibility of PetaWatt (PW) class lasers is enabling novel light-matter interactions capable of generating secondary particle beams. However, the bioeffects of these several-stage interactions are complex, and current safety standards are not equipped to address these power levels or the complex particle showers they can produce. Experimental approaches are limited by the complexity and hazards of these systems. This project will serve as a pathfinder to bridge this knowledge gap by reviewing the PW technical field and using simulation to analyze novel particle production scenarios. This project will investigate various laser-target interactions, identify applicable models for the regime of interest, and quantify the resulting particle beams to identify meaningful bioeffect data gaps and inform future safety guidelines.

LEARNING OBJECTIVES: Participants will gain a deep understanding of the fundamental physics of high-intensity laser-matter interactions and will develop hands-on skills with advanced Monte Carlo simulation toolkits to model secondary particle generation. Through this work, they will learn to critically analyze complex simulation data to identify knowledge gaps and will practice communicating their findings to a multidisciplinary research team.

ACADEMIC LEVEL: Undergraduate; Masters

DISCIPLINES NEEDED: Physics, Engineering

RESEARCH LOCATION: JBSA Fort Sam Houston, Texas

RESEARCH MENTOR: Clint Lanham
Master's of Science in Physics, Virginia Tech, 2023



Clint Lanham is a research physicist in the Air Force Research Laboratory's Optical Radiation Branch (711 HPW/RHDO). In his current role, he works on the Bioeffects Division's modeling and simulation team, applying his computation and theory background as a subject matter expert, scoping new research initiatives and leading technical discussions to develop physics-based projects and implement component library integration towards directed energy risk assessments. Prior to his work with the Air Force, Clint was a Health Physicist at UCLA, where he managed comprehensive radiation safety programs for university facilities. His research background is rooted in nuclear, particle, and condensed matter physics, with a focus on data analysis, physics-based modeling, and Monte Carlo simulations. His current research pursuit areas include modeling high-energy laser-particle interactions,

condensed matter theory for advanced protective equipment, reflectance modeling for vision effects, and digital engineering.

Photo courtesy of Air Force Research Laboratory