REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-21-02

INVESTIGATING PRIMARY AND SECONDARY BIOEFFECTS OF PHOTOTHERMAL AND PHOTOCHEMICAL EXPOSURE

PROJECT DESCRIPTION: The Warfighter Effectiveness Research Center is the research arm of the Department of Behavioral Sciences and Leadership at the United States Air Force Academy, facilitating faculty and cadet research that enhance warfighter effectiveness. The WERC conducts a wide range of research and design projects for operational customers including special operations forces, the Air Force Office of Scientific Research, Air Force Research Laboratory, and Army Research Laboratory. These projects are based in the behavioral sciences and connect to a wide range of disciplines and collaborators across government labs, academia, industry, and military operators in order to generate the most innovative and effective solutions.

The damaging effects of lasers on cells depends upon the wavelength and intensity of the irradiation, as well as the overall duration of exposure. Photochemical damage is correlated with severe oxidative stress (secondary effects), but little is known about which enzymes are the prime suspects for photon absorption (primary effects). Absorption by chromophores like melanin and water can lead to temperature rises (primary effects) that cause damage via thermal destruction of macromolecules (secondary effects). Our laboratory is interested in the biophysical alterations in the key biomolecules involved in thermal (secondary effects) and photochemical (primary effects) damage. At the cellular level, we study laser bioeffects using microthermography (IR imaging), Raman spectroscopy/imaging, and fluorescence-based microscopic detection of damage, metabolic perturbations, and macromolecule localization. At the molecular and atomic level, we use fluorescence, fluorescence anisotropy, Raman spectroscopy, transient absorption, and 2-D IR spectroscopy. Biophysical data can supply valuable input for computational models, providing revolutionary enhancements for predicting risk of laser damage on the modern battlefield.

ACADEMIC LEVEL: Bachelors, Masters, PhD

DISCIPLINE NEEDED:

- Life Health and Medical Sciences
  - Biochemistry
  - Biology (General)
  - Biophysics
  - Cellular and Molecular Biology
  - Physiology
- Physics
  - Applied Physics
  - Physics (General)

RESEARCH LOCATION: JBSA, Fort Sam Houston, San Antonio, TX

88ABW-2020-3192 The material was assigned a clearance of CLEARED on 16 Oct 2020

RESEARCH ADVISER: Michael L. Denton, PhD
Biochemistry, Kansas State University, 1991

Dr. Michael Denton is a Research Biochemist at the Air Force Research Laboratory's Optical Radiation Branch where he has studied laser-tissue interactions in cultured cells since 2000. His research interests include the study of cellular processes responsible for photothermal and photochemical damage, and the development of computational models describing those processes. Dr. Denton has 28 peer-reviewed publications and is an active member of the International Society for Optics and Photonics (SPIE), AAAS, ARVO, and the American Society for Photobiology.