

**Opportunity Title:** AFRL - Quantum Dynamics of Mitochondria Internship

**Opportunity Reference Code:** AFRL-711HPW-2021-0013R

**Organization** U.S. Department of Defense (DOD)

**Reference Code** AFRL-711HPW-2021-0013R

**How to Apply** Click on *Apply* at the bottom of the opportunity to start your application.

### Description **What will I be doing?**

As an ORISE participant, you will join a community of scientists and researchers in an effort to gain knowledge in areas related to the Air Force Research Laboratory's (AFRL) mission.

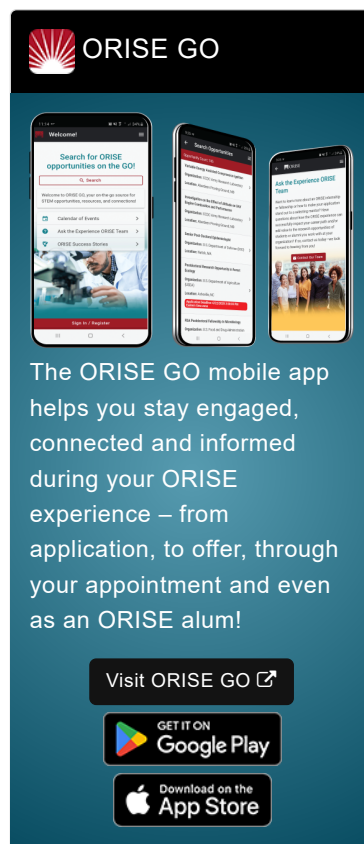
In view of the importance of mitochondria, this project addresses fundamental questions regarding the understanding of the quantum dynamics of electron transfer in mitochondria and their regulation by photoactivated Nanomaterials (NMs). Mitochondrial health is a critical indicator of medical attributes and is capable of measuring an individual's physiological condition. Human health, performance, and endurance are dependent upon the health of the cell's mitochondria. The exposure to operational stress factors is linked to critical medical attributes that impact Airmen performance. During intense exercise or physical activity, the body's consumption of ATP rises, but the electron transport chain (ETC) and ATP synthase can not keep up with the increasing demand for ATP, leading to premature fatigue.

Stress induced oxidative stress is known to decrease mitochondrial activity by depleting ATP levels, photobiomodulation (PBM) has been studied as a potential prevention, where the cell absorbs light to increase ATP production. However, the practical application of PBM is controversial and photothermal effect can be detrimental to the cell. Therefore it is important to control and understand the dynamics of electron transfer and the proton gradient to enhance ATP production. One example- NMs can be programmed to couple to the ETC through attaching a bio-molecule that binds to a protein in the ETC and regulate ATP production. By designing the NM's optical properties such that it acts as an electron donor, the NM can be excited with light and transfer an electron into the ETC. By pumping electrons into the ETC in this manner, the electron transport rate should increase, increasing the proton gradient and therefore production of ATP to delay the onset of fatigue and injury induced trauma.

### **Why should I apply?**

Under the guidance of a mentor, you will gain hands-on experience to complement your education and support your academic and professional goals. Along the way, you will engage in activities and research in several areas. These include, but are not limited to, conducting research and collecting data on the following objectives:

- Designing and programming biologically-conjugated NMs that can increase the rate of electron transfer and ATP production in mitochondria to combat stress induced premature fatigue and enhance airmen readiness.

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- Regulating the electron transfer rate by photoexciting NMs that can donate electrons into the ETC thereby modulate production of ATP in mitochondria.
- Characterizing and quantifying the intracellular source of photon emission, identify cellular biomolecules (proteins, receptors, etc.) involved in wave-mediated signaling, and characterize changes caused by biophoton signaling.

**Where will I be located?**

Wright State University in Dayton, Ohio

**What is the anticipated start date?**

Exact start dates will be determined at the time of selection and in coordination with the selected candidate. Applications are reviewed on an ongoing basis and internships will be filled as qualified candidates are identified.

**What is the appointment length?**

An ORISE appointment period can be a short-term (less than 2 weeks), summer (10-12 weeks), or yearlong appointment. Appointments may be extended depending on funding availability, project assignment, program rules, and availability of the participant.

**What are the benefits?**

You will receive a stipend to be determined by AFRL. Stipends are typically based on a participant's academic standing, discipline, experience, and research facility location. Other benefits may include the following:

- Health Insurance Supplement (*Participants are eligible to purchase health insurance through ORISE*)
- Relocation Allowance
- Training and Travel Allowance

**About AFRL**

AFRL leads the discovery, development and integration of affordable warfighting technologies for America's air, space and cyberspace forces. AFRL is a full-spectrum laboratory, responsible for planning and executing the Air Force's science and technology program. AFRL leads a worldwide government, industry and academic partnership in the discovery, development and delivery of a wide range of revolutionary technologies. The laboratory provides leading edge warfighting capabilities keeping our air, space and cyberspace forces the world's best. The 711 Human Performance Wing advances human performance in air, space and cyberspace through research, education and consultation, accomplished through the synergies created by the wing's two distinct but complementary entities: Airman Systems Directorate and U.S. Air Force School of Aerospace Medicine. For more information about AFRL, visit <https://www.wpafb.af.mil/afrl/>.

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### About ORISE

This program, administered by Oak Ridge Associated Universities (ORAU) through its contract with the U.S. Department of Energy (DOE) to manage the Oak Ridge Institute for Science and Education (ORISE), was established through an interagency agreement between DOE and DoD. Participants do not enter into an employee/employer relationship with ORISE, ORAU, DoD or any other office or agency. Instead, you will be affiliated with ORISE for the administration of the appointment through the ORISE appointment letter and Terms of Appointment. Proof of health insurance is required for participation in this program. Health insurance can be obtained through ORISE. For more information, visit the [ORISE Research Participation Program at the U.S. Department of Defense](#).

### Key Words

Biophysics, Cellular and Molecular Biology, Nanotechnology, Analytical Chemistry, Bio-inorganic Chemistry, Bio-organic Chemistry, Biophysical Chemistry, Chemistry (General), Physical Chemistry

**Qualifications** The qualified candidate should currently be pursuing or recently have received a bachelor's or master's degree. Degree must have been received within five years of the appointment start date.

### Application Requirements

A complete application consists of:

- Zintellect Profile
- Educational and Employment History
- Essay Questions (goals, experiences, and skills relevant to the opportunity)
- Resume (PDF)
- Transcripts/Academic Records - For this opportunity, an unofficial transcript or copy of the student academic records printed by the applicant or by academic advisors from internal institution systems may be submitted. [Click here for detailed information about acceptable transcripts](#).
- One Recommendation








If you have questions, send an email to [AIRFORCE@orise.orau.gov](mailto:AIRFORCE@orise.orau.gov). Please list the reference code of this opportunity [AFRL-711HPW-2021-0013R] in the subject line of the email.

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- Eligibility Requirements**
- **Citizenship:** U.S. Citizen Only
  - **Degree:** Bachelor's Degree or Master's Degree received within the last 60 months or currently pursuing.
  - **Discipline(s):**
    - **Chemistry and Materials Sciences** ([12](#))
    - **Communications and Graphics Design** ([2](#))
    - **Computer, Information, and Data Sciences** ([17](#))
    - **Earth and Geosciences** ([21](#))

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- **Engineering** ([27](#) )
- **Environmental and Marine Sciences** ([14](#) )
- **Life Health and Medical Sciences** ([46](#) )
- **Mathematics and Statistics** ([10](#) )
- **Physics** ([16](#) )
- **Science & Engineering-related** ([1](#) )
- **Social and Behavioral Sciences** ([28](#) )