1. **Research Title:** A Systems Biology Approach to the Impacts of DE on Human Performance
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Bioengineering, Biomedical Engineering, Chemical Engineering (M.S. or Ph.D. level)

4. **Objectives:**
    a. Establish a means for reproducible in vitro directed energy (DE) exposure of multiple classes in a controlled manner.
    b. Mechanistically characterize the effects of DE exposure on multiple, relevant cellular models of interest to Airman human performance.
    c. Integrate predictive modeling capabilities to assess and predict exposure risks to the Warfighter.

5. **Description:** In recent years, the utilization of DE sources has dramatically increased, including the implementation of novel energy- and frequency-based military systems and devices. As the modern battlefield expands its electronic footprint, DE is becoming a leading player. In addition to the intended outcome of DE-based applications, it has been identified that these targeted energy sources can introduce severe cellular and health bio-effects. While it is known that DE can modify human biological behaviors and introduce health consequences, little has been done in order to characterize the time- or dose-dependency of these effects or to elucidate mechanistic patterns. Modern technologies and relevant human cellular systems are needed to evaluate the impact of DE exposure via a systems biology approach (i.e. on the genomic, proteomic, cellular, tissue, and organ levels), in order to assess and predict exposure risks. A systematic approach is needed to accurately characterize biological outcomes, targeted or unintentional, following DE exposure of various sources. Initial efforts will focus on organ systems of interest, including lung, skin, and brain and incorporate a multi-tiered analysis, evaluating responses across numerous biological levels. In time, this work will integrate collected data into a predictive model for real-time risk assessment.

6. **Research Classification/Restrictions:** Unclassified/Unrestricted
7. **Eligible Research Institutions:** University of Dayton, Wright State University, Case Western Reserve University, Ohio State University