

Application Title: TASK Lab: Texas A&M Advanced Spectroscopy Keystone Lab

Lead contact for RDF Application:

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Key Participating Units: College of Engineering: Dogariu (Aerospace), Guzman (Aerospace), Lan (Mechanical), Miles (Aerospace), Walsh (BME), Yakovlev (BME); College of Arts and Sciences: Sheldon (Chemistry), Sokolov (Physics and Astronomy); College of Agriculture and Life Sciences: Agarwal (Biological and Agricultural Engineering), Kurouski (Biophysics and Biochemistry), Verhoef (Soil); Institute for Quantum Science and Engineering: Scully and Yi. Underlined are Assistant/Associate Professors.

Anticipated Request Amount (\$): 2,100,000.

Executive summary of this application to utilize Research Development Funds:

The National Quantum Initiative Act outlined a 10-year plan to push forward applications using quantum science and technology. Army Futures Command (AFC) is partnering with Texas A&M University to establish the nation's largest hypersonic tunnel and military medicine program. Multiple DOE National Labs and NASA are working closely with Texas A&M University. Texas A&M University has formed partnership with Houston Methodist. **All those initiatives involve optical tools and heavily rely on availability of advanced light sources and spectroscopic tools which can assist in moving those fields forward.** The major objective of this application is to establish a unique advanced optical spectroscopy facility, which can promptly place TAMU at the forefront of quantum science and precise optical measurements research by providing the most advanced equipment to perform quantum optical measurements, computations, communication, sensing and imaging and photo-bio-effects (most notably, AFOSR for anticipated MURI program (FY2023; \$1.5 M/y) on Quantum Biology and DOE for Quantum Imaging for Plant Biology (FY2022; \$0.8 M/y (**TAMU got 2!**)), Center for Photodynamic Therapy (FY2023; \$3.0 M/y), NASA STRI (FY2023; \$3 M/y)). It will also help several other ongoing initiatives, such as Army Futures Command and NASA, by allowing **new advanced spectroscopic capabilities to be explored and developed** to secure future continuous funding.

The Institute for Quantum Science and Engineering (IQSE) is well known around the world for the ground-breaking work in the field of theoretical quantum optics. While there are **more than 50 faculty members on campus involved in different aspects of optical research, no specialized facility related to spectroscopy exists.** The PI routinely gets multiple inquiries each month for availability of a light source at a desired wavelength or optical measurement tools to assist faculties all around campus with their research needs involving lasers and optical spectroscopy. Microscopy and material characterization facilities are unable to customize the existing systems to users' needs. Facilities at RELLIS campus, on the other hand, are not able to provide support for ground-breaking fundamental research, which is in the heart of all future developments (such as advanced hypersonic diagnostics).

This proposal requests funding to establish a state-of-the-art spectroscopic measurements facility. Initially, three university units (College of Engineering, College of Arts and Sciences and College of Agriculture and Life Sciences) will be involved; however, with anticipated development of methods of precise spectroscopic measurements, broader participation of other colleges, Medicine (applications of *photodynamic treatment of antibiotic resistant bacteria and viruses, spectroscopic imaging*), and Veterinary Medicine and Biomedical Sciences (applications of *photodynamic treatment and optical imaging and sensing*), is expected. Also, there will be strong synergy with the Quantum Sensing initiative engaging various Engineering disciplines, particularly AeroSpace Eng.

Such a facility, which doesn't have any other equivalent sets of equipment in the US or anywhere around the world will serve several purposes. (1) It will provide TAMU researchers with a competitive advantage for performing optical and quantum measurements related to their work. (2) It will serve a catalyzer of interdisciplinary activities. (3) It will attract other researchers from NASA, NIST, DOE, DOD, government laboratories and other academic institutions to College Station to increase visibility of Texas A&M University and to provide with strong partners for Center-level grants in the areas of quantum science and engineering. (4) It will provide a central lab for education and training of a new generation of scientists and engineers, as it is described in the National Quantum Initiative Act.