2023F_01_MUSSER

Research Development Fund – Fall 2023 Application Template
Submission Deadline: ***12:00PM CDT Monday – October 23, 2023,*** **to rdf@tamu.edu**

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Application Title: Acquisition of a MINFLUX 3D Super-Resolution Fluorescence Microscope

Lead contact for RDF Application:

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Key Participating Units:

Departments: Cell Biology & Genetics (instrument home), Biomedical Engineering, Chemical Engineering, Biology, Nutrition, Biochemistry & Biophysics, Veterinary Pathobiology

Schools/Colleges: School of Medicine, College of Engineering, College of Arts & Sciences, College of Agriculture & Life Sciences, School of Veterinary Medicine & Biomedical Sciences

RDF Amount Requested ($): $1,694,322

Executive Summary

This application seeks funds to purchase a MINFLUX 3D Microscope. This instrument will initially support ten research groups in six departments and five colleges/schools within the Texas A&M University (TAMU) community and a group of four NIH-funded investigators at UT Southwestern Medical Center. The MINFLUX microscope will be the second instrument in a recently established shared user facility, the Joint Microscopy Laboratory (JML), which is focused on single molecule fluorescence applications. The JML includes significant wet-lab and tissue culture space to encourage use by more distant laboratories both on campus and external to the university. Of five such MINFLUX instruments within the United States, the closest is ~900 miles away; thus, this instrument would be the first of its type within the Southern Region of the US and it is therefore expected to lead to new collaborative and multi-PI projects with both internal and external users. MINFLUX is a relatively new state-of-the-art pointillistic imaging and particle tracking strategy that is extremely thrifty with the use of photons, requiring ~10-fold less photons than other super-resolution approaches. Consequently, MINFLUX can achieve localization precision levels of a few nanometers on a sub-millisecond timescale within functionally active cellular systems, and long single molecule trajectories in three-dimensions (3D) can be obtained using single fluorophore tags. The requested three-color MINFLUX 3D system will enable numerous multi-color strategies combining both static imaging and molecular tracking approaches. Users will examine well-controlled in vitro systems as well as stabilized and complex cellular systems (fixed and permeabilized cells) with an eye towards live cell investigations. The Major Users will examine fundamental and diverse cell biological and mechanistic biochemistry questions focused on phosphoinositide binding proteins, nucleocytoplasmic transport, nuclear mechanical stress and bacterial shape. The Minor User's projects include structure, function and biophysical studies of biomolecular condensates, membrane dynamics, RNA processing, chemotaxis, pilus assembly, and extracellular vesicles. The colleges/schools and departments represented in the Major User group will contribute to instrumentation costs, emphasizing the fundamental importance of the new microscope capabilities to advance the capabilities and growth of current research programs. The instrument will be housed within the School of Medicine by the Department of Cell Biology and Genetics, which has donated substantial equipment and space for the microscope facility. Altogether, the identified users have planned new research directions that will require ~90% of the total accessible user time, indicating the substantial demand for both existing and new projects. In total, the requested MINFLUX 3D microscope will provide substantial and fundamental infrastructural support for a wide range of projects important for understanding fundamental basic bioscience questions and for improving human health.

Note: This proposal has also been submitted to the NIH High-End Instrumentation Program (PAR-22-079) and will be reviewed October 30-31, 2023. The more detailed NIH proposal and reviewer comments will be available for the RDF review, if requested. The dual submission for the requested instrument was pre-approved by RDF staff.