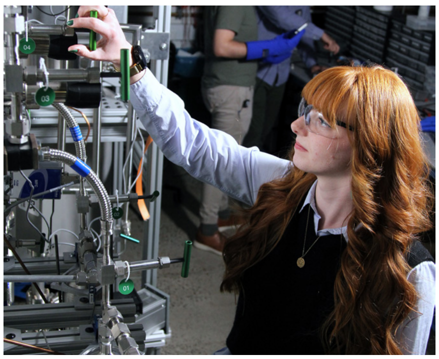
Probing the nature of neutrinos, dark matter, & gravity

David Moore
Associate Professor

David Moore develops new technologies and techniques aimed at answering some of the major outstanding questions in nuclear and particle physics about neutrinos, dark matter, the preference for matter over antimatter in the Universe, and the nature of gravitational interactions among quantum systems.

Moore received the Alfred P. Sloan Research Fellowship in Physics, the National Science Foundation (NSF) Early Career Award, the Lee Grodzins Postdoctoral Award at MIT, and the Mitsuyoshi Tanaka Dissertation Award in Experimental Particle Physics from the American Physical Society (APS).

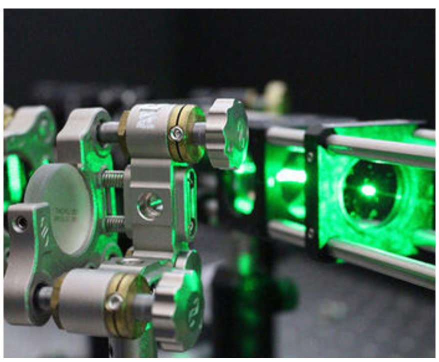
Moore is subsystem scientist for the nEXO photon detector, a member of the nEXO Executive Council, and an EXO-200/nEXO Collaboration Board member.



nEXO

The Moore group has been among the leaders of the development of large-scale liquid xenon detectors—such as the planned nEXO (next Enriched Xenon Observatory) experiment at SNOLAB in Ontario, Canada—to search for neutrinoless double beta decay. If this process is observed, it may answer why we live in a Universe made of matter, not antimatter.

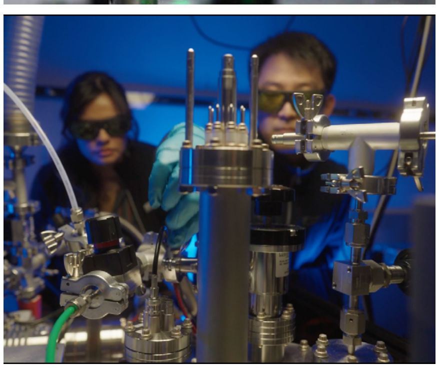
The Moore group is leading efforts to build photon detectors for nEXO and studying ways to capture xenon directly from the atmosphere to enable even larger, more sensitive detectors.



MAST-QG

Moore is collaborating on the MAST-QG (MAcroscopic Superpositions Towards witnessing the Quantum nature of Gravity) experiment to test whether gravity has a quantum nature by levitating tiny diamonds in a vacuum to see if they become entangled through their gravitational interaction.

The Moore group is using their expertise in precisely trapping nanoparticles in a vacuum to study the electromagnetic interactions between nanodiamonds.

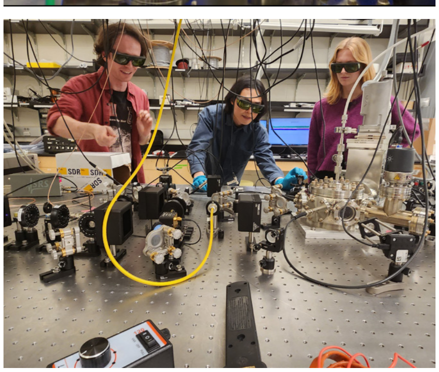


SIMPLE

SIMPLE (Search for new Interactions in a Microsphere Precision Levitation Experiment) is a small-scale tabletop experiment that fits in a laboratory at Wright Lab, yet is used to study interactions involving neutrinos; to test gravity; and to search for dark matter, quantum phenomenon, and new forces.

SIMPLE uses a technique called optical tweezers, in which a laser optically levitates, controls, and measures micron-sized spheres (microspheres). By measuring the motion of the microsphere, the group can precisely detect extremely tiny impulses, which are smaller than one-quadrillionth of the momentum transferred by a feather landing on your shoulder.

The Moore group has developed the world's most sensitive micron-sized force sensors, using them to search for dark matter interactions with the microspheres.



QuIPS

QuIPS extends the techniques used by SIMPLE to even smaller nanoparticles and will measure the momentum kick from a single nucleus decaying within a particle. QuIPS is located at Wright Lab and will enable new searches for otherwise invisible particles emitted in nuclear decays, such as sterile neutrinos.