Together, Science Foundations Fund 'Tabletop' Physics That Could Transform Our Understanding of the Universe

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FOR IMMEDIATE RELEASE

Physics breakthroughs don't always require city-sized particle colliders or giant radio telescope arrays. The Gordon and Betty Moore Foundation, the Simons Foundation, the Alfred P. Sloan Foundation and the John Templeton Foundation have partnered to fund 11 innovative "tabletop" experiments, many of which will explore realms of physics typically probed by large-scale facilities.

The newly funded projects, selected from hundreds of proposals, include hunting for dark matter, building ultra-precise atomic clocks, and examining the intersection of general relativity and quantum mechanics. These ambitious experiments all aim at expanding the frontiers of fundamental physics while still fitting into a typical room-sized university physics research lab.

By pooling their resources and expertise, the foundations have magnified the impact of their grantmaking and are able to collectively fund more projects.

Each of the projects, described below, will receive funding for up to five years, with the four foundations together pledging more than $30 million over five years for all the undertakings.

David DeMille of the University of Chicago and his team will develop a method to form a trapped gas of ultra-cold francium-silver molecules. They aim to use this gas to detect time-asymmetric forces in the atomic nucleus with significantly higher sensitivity than current experiments.

Gurudev Dutt of the University of Pittsburgh and his colleagues will magnetically levitate diamond crystals to create and measure macroscopic quantum superpositions and explore the interface between quantum physics and gravity.

Ron Folman of Ben-Gurion University of the Negev in Israel will lead the development of a nano-diamond spatial interferometer to help resolve the disconnect between quantum physics and general relativity by performing spin-based interferometry measurements.

Giorgio Gratta of Stanford University will lead the measuring of gravity at tiny scales using nuclear spectroscopy. The work will test the assumption that gravity works in the same way from macroscopic scales all the way down to the sub-micron level.

Jason Hogan of Stanford University will lead the use of quantum sensing to measure the difference between the electric charges of protons and electrons with far higher precision than previous determinations.

Gavin Morley of the University of Warwick in England will lead research that will levitate tiny diamonds in quantum spatial superpositions to explore the quantum nature of gravity.

Lyman Page of Princeton University and his colleagues will build a new experiment to search for proposed ultralight particles called axions that could be part of the mysterious dark matter that makes up roughly 85 percent of the universe's mass.

Michael Tarbutt of Imperial College London and his team will measure a possible fundamental property of the electron known as the electric dipole moment with 40 times as much precision as current methods. The researchers will accomplish such precision using ultracold molecules trapped in an optical lattice.

Karl van Bibber of the University of California, Berkeley and his team will use a powerful superconducting magnet to search for proposed ultralight particles called axions that could be a component of the universe's dark matter.

Amar Vutha of the University of Toronto and his colleagues will implement a powerful new approach to finding instances in which nuclear interactions don't follow the same behavior when time is reversed as when time flows normally. The team will hunt for these nuclear time reversal symmetry violations using a combination of octupole-deformed nuclei, polarized atoms and highly coherent solid-state systems.

Jun Ye of the University of Colorado Boulder will lead the development of ultra-precise atomic clocks to perform the first experiments where quantum mechanics and general relativity both have measurable effects. The project will also perform novel laboratory-scale tests of foundational general relativity principles.

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The **ALFRED P. SLOAN FOUNDATION** is a not-for-profit, mission-driven grantmaking institution dedicated to improving the welfare of all through the advancement of scientific knowledge. Established in 1934 by Alfred Pritchard Sloan Jr., then-President and Chief Executive Officer of the General Motors Corporation, the Foundation makes grants in four broad areas: direct support of research in science, technology, engineering, mathematics, and economics; initiatives to increase the quality, equity, and diversity of scientific institutions and the science workforce; projects to develop or leverage technology to empower research; and efforts to enhance and deepen public engagement with science and scientists.

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