Measuring Microscopic Disorder with Precision

Brian
DeMarco
Professor, Physics

CURRENT RESEARCH

Using ultracold quantum gases to investigate strongly interacting quantum matter

Dr. Brian DeMarco, of the University of Illinois, Urbana-Champaign, uses ultracold quantum gases to investigate one of the frontiers of physics: strongly interacting quantum matter. The goal of his research is to use these tools to address outstanding questions, such as how disorder affects metals and superconductors and what the dynamical timescales are that control phenomena like diffusion and conductivity. The real truth of such research is the outcome of knowledge in which scientists can find answers to longstanding questions. By solving the answers to such questions, engineers and material scientists can apply Dr. DeMarco's research to revolutionize our current technologies with applications in carrying energy for heat, electricity, and information.

The process of solving such difficult questions is unique and innovative. Dr. DeMarco and his team carry out an experiment similar to a computer simulation where they are able to tweak every material parameter once every 90-second experimental cycle. Dr. DeMarco is able to test and constrain the most advanced theoretical techniques and predictions while being able to precisely tune and measure the equivalent of all material parameters. He is able to use these ultracold gases to create analogues of electronic solids. Dr. DeMarco's specific work with understanding the impact of disorder on strongly interacting quantum materials is based upon the concept that disorder cannot be completely controlled or eliminated and knowledge of the microscopic disorder is impossible to obtain. Therefore, in contrast to measurements on solids, Dr. DeMarco starts with a perfect crystalline material and adds disorder using a speckle, or a disordered, laser beam. He can then turn...

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AFFILIATION

University of Illinois Urbana-Champaign

EDUCATION

- Ph.D., in Physics, 2001 , University of Colorado at Boulder
- B.A., in Physics, 1996 , State University of New York at Geneseo

AWARDS

- University of Illinois Willett Faculty Scholar Award, 2013
- Vestal High School Hall of Fame Inductee, 2012
- State University of New York at Geneseo Outstanding Young Alumnus Award, 2006
- Sloan Foundation Research Fellowship, 2006
- National Science Foundation CAREER Award, 2005

RESEARCH AREAS

Technology, Space, Materials Science / Physics

FUNDING REQUEST

Your contributions will support the research of Dr. Brian DeMarco as he uses ultracold quantum gases to investigate strongly interacting quantum matter. Your support will fund the necessary $500K per year required to support personnel, materials, and equipment. Your donation will be an important part of advancing fundamental scientific knowledge revolutionizing our current technologies with applications in carrying energy for heat, electricity, and information.