NATIONAL RESEARCH COUNCIL
Division on Engineering and Physical Sciences
Board on Physics and Astronomy

Final Technical Report
for the period
July 1, 2014 to June 30, 2015
to the
U.S. Department of Energy
on the

COMMITTEE ON ATOMIC, MOLECULAR AND OPTICAL SCIENCES

DE-SC0012349

The Committee on Atomic, Molecular, and Optical Sciences (CAMOS) is a standing activity of the National Research Council (NRC) that operates under the auspices of the Board on Physics and Astronomy. CAMOS is one of five standing committees of the BPA that are charged with assisting it in achieving its goals—monitoring the health of physics and astronomy, identifying important new developments at the scientific forefronts, fostering interactions with other fields, strengthening connections to technology, facilitating effective service to the nation, and enhancing education in physics. CAMOS provides these capabilities for the atomic, molecular and optical (AMO) sciences.

In particular, over the time period of this grant, CAMOS had the following objectives:

- To provide active stewardship of the agenda laid out in *Controlling the Quantum World*, the NRC decadal survey for AMO sciences;
- To provide a means for dialog with federal agencies on AMO sciences and related fields;
- To initiate case studies on important timely topics in AMO sciences and/or its multidisciplinary connections with other fields of science and technology.
- To provide a venue for discussion among AMO scientists and thereby provide a unifying force in this diverse and varied field.

Several mechanisms have been developed to achieve these objectives. CAMOS periodically proposes and oversees special technical studies, science surveys, workshops, and other meetings. It provides oversight for study panels that are formed to prepare reports on specific scientific or policy issues. From time to time it holds symposia to focus attention on facilities, programs, or other matters of concern to the AMO science community. From its position within the NRC's Board on Physics and Astronomy, CAMOS also generally monitors advances in the physical sciences, technology, and engineering in order to identify important synergies with traditional AMO activities.

The NRC has appointed the following members to CAMOS, as of the end of the funding cycle -

Christopher Monroe, *Chair,* University of Maryland
Louis F. DiMauro, *Vice-chair,* Ohio State University
Gordon Baym, University of Illinois at Urbana-Champaign
Paul Corkum, University of Ottawa
Kristan L. Corwin, Kansas State University
Brian L. DeMarco, University of Illinois
Ivan Deutsch, University of New Mexico
Todd Ditmire, University of Texas
Roger Falcone, Lawrence Berkeley National Laboratory
Mette Gaarde, Louisiana State University
Anthony Johnson, University of Maryland, Baltimore County
Robert Jones, University of Virginia
Cindy Regal, University of Colorado at Boulder
David Reitze, California Institute of Technology
Marianna Safronova, University of Delaware
David R. Schultz, University of North Texas
Jun Ye, JILA

Highlights of Meetings During the Grant Cycle

CAMOS held one meeting during the reporting period.

+ Spring Meeting – April 15-16, 2015.

CAMOS held its spring 2015 meeting at the Keck Center in Washington, D.C. on April 15-16, 2015.
The first part of the meeting consisted of presentations from representatives of agencies that support AMO physics. John Gillaspy and Ann Orel began by discussing AMO physics at NSF. Among the topics covered were selected major investments in the Mathematical and Physical Sciences Directorate such as mid-scale research infrastructure, the optics and photonics initiative, and DMREF (Designing Materials to Engineer and Revolutionize Our Future). They then presented several questions for the community that they are grappling with, as well as changes being implemented in the proposal submission process. DOE's Jeff Krause discussed the AMO portfolio in DOE's Basic Energy Science program. He noted that the FY2015 President's Request for BES called for increased funding for additional Energy Frontier Research Centers and computational materials research, as well as new funding for mid-scale instrumentation for ultrafast electron scattering. David Moehring and Brad Blakestad discussed some of the efforts underway at IARPA, with their comments focusing on several of their programs including multi-qubit coherent operations, and then completed their comments by discussing quantum computing and AMO physics at the Laboratory for Physical Sciences at College Park. Riq Parra then discussed the AMO programs at the Air Force Office of Scientific Research, with a focus on his portfolio that covers ultrashort pulse laser-matter interactions. Paul Baker discussed the program vision and research thrusts in the AMO investments made by ARO. New investment areas

include interacting photons, QM Foundations, Quantum Metrology, and new platforms for computation. Prem Kumar completed the morning's session by discussing AMO programs at DARPA. His comments focused on two areas—their investments in ultrafast/high-field physics and in quantum information.

The afternoon session consisted on preparation for the next decadal survey in the AMO sciences. Participating in that session were Ian Walmsley (Oxford University), Carl Williams (NIST/JQI), Stephen Leone (University of California at Berkeley), and Gérard Mourou (École Polytechnique), and Joe Dehmer.

Outreach Activities. As part of its efforts to reach the larger AMO community, CAMOS maintains a website at which it makes available to the public the presentations made at its meetings. That material is available for download at - http://sites.nationalacademies.org/BPA/BPA_048649.

Study Proposals. In carrying out its responsibilities to initiate case studies on important timely topics in the AMO sciences, during current grant cycle CAMOS spend much of its efforts in developing the proposal for the next decadal survey for AMO sciences, which is expected to be underway in the spring of 2016..

Summary

This report is the final technical report for the first year of DOE support for the Committee on Atomic, Molecular, and Optical Sciences. Highlights of the committee's activities over this period include its annual meeting, which took place on April 15-16, 2015 at which it obtained community and agency input needed to develop the scope of the next decadal survey for the atomic, molecular, and optical sciences.

DOE support for CAMOS has been of central importance to the committee's ability to continue to fulfill its mandate to the Board on Physics and Astronomy and to the wider atomic, molecular, and optical sciences research community.