

Final Performance Report on ONR Grant

N00014-12-1-0608

High atom number in micro-sized atom traps

for the period

15 May 2012 through 14 September 2015

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14. ABSTRACT Research was performed, investigating bichromatic laser forces for implementing a small-footprint, large-number atom-chip instrument. Bichromatic forces rely on absorption and stimulated emission to produce forces on the order of $(\hbar\omega)/k$ (Omega), where Omega is the laser Rabi frequency. We have observed behavior compatible with bichromatic slowing and cooling of some atoms in atomic beam. We have reconfigured the apparatus for applying bichromatic forces transverse to the atomic beam, as it will be easier to extend						
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As described in the grant proposal, research was performed, investigating bichromatic laser forces for implementing a small-footprint, large-number atom-chip instrument. Bichromatic forces rely on absorption and stimulated emission to produce forces on the order of $\hbar k\Omega$, where Ω is the laser Rabi frequency. We have observed behavior compatible with bichromatic slowing and cooling of some atoms in atomic beam. Results were presented at the 2012 conference of the Division of Atomic, Molecular, and Optical Physics (DAMOP) of the American Physical Society (APS). We have reconfigured the apparatus for applying bichromatic forces transverse to the atomic beam, as it will be easier to extend this to two dimensions. Research to develop these instruments will enable advances in time-keeping technologies for navigation; sensors for navigation and vessel detection; secure communication; and computing.

The funded work has also enhanced the educational aspects of student participation in research and strengthened the on-going relationship between St. Mary's College of Maryland (SMCM) and the Naval Air Warfare Center Aircraft Division (NAWCAD) operations at Naval Air Station Patuxent River, in which many students are exposed to work with the operational Navy. During the performance period of the grant, nine students worked on this apparatus or related ones. One graduated student continues as a post-bac researcher, working on the experiment as a contractor. The students interacted with Navy staff scientists. The work relied on instrumentation funded by ONR DURIP award N00014-09-1-0931. The grant PI and personnel were involved in discussions that led to the renewal of the Educational Partnership Agreement between SMCM and NAWCAD. A Cooperative Agreement between SMCM and NAWCAD is under preparation.