

Department of the Navy SBIR/STTR Transition Program

STATEMENT A. Approved for public release; distribution is unlimited.

ONR Approval # 43-2203-16

Topic # N13A-T018

Compact robust testbed for cold-atom clock and sensor applications

ColdQuanta

WHO

SYSCOM: ONR

Sponsoring Program: Code 31

Transition Target: Precision Navigation & Timekeeping Program

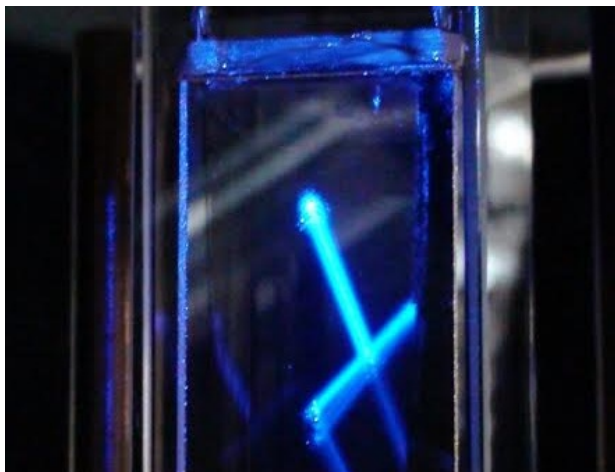
TPOC:

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Other transition opportunities:

Precision navigation, positioning, timekeeping, and communications warfighter applications

Notes: Photograph shows fluorescence induced in a hot vapor of strontium atoms by blue laser beams. The vapor was created in a prototype vacuum system developed under this contract.



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WHAT

Operational Need and Improvement: The DoD is continuously searching for new technologies to enhance navigation, positioning, geospatial measurements, and communications. To improve the performance of atomic clocks, accelerometers, gyroscopes, magnetometers, gravimeters, and gravity gradiometers, atoms cooled with lasers to microkelvin temperatures offer superior performance over existing technologies. The scientific community has made remarkable advances in cold-atom science over the past twenty-five years. The maturing state of laboratory techniques in this area suggests that it is timely to begin testing cold-atom technologies on Navy platforms to ascertain whether the great advantages they display in controlled laboratory environments can also be realized by warfighters.

Specifications Required: This topic calls for the development of a cold-atom testbed that can be deployed aboard a mobile Navy platform, to demonstrate functions relevant to navigation, timekeeping, sensing or communication. The testbed will offer turnkey generation of a laser-cooled cloud of atoms in a vacuum cell that can be sustained for a sufficient length of time to demonstrate functions of interest. It will require no resources other than footprint space and standard electrical power from the Navy platform and must meet specific platform requirements for test instrumentation.

Technology Developed: ColdQuanta is developing a hand-held vacuum system for implementing laser cooling of atomic strontium down to microkelvin temperatures. We will integrate the vacuum system into a complete physics package that includes lasers, optics, and sources of magnetic fields. To create a testbed, the physics package will be combined with electronics and power supplies in a portable rack.

Warfighter Value: ColdQuanta's cold-atom testbed will substantially reduce the SWaP of laboratory systems used to produce samples of laser-cooled strontium atoms. This will open the door for the testbed to serve as the heart of a portable, rugged, next-generation atomic clock or sensor.

WHEN

Contract Number: N00014-15-C-0124 **Ending on:** July 16, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Production of laser-cooled strontium atoms (millikelvin temperatures) in table-top system	High	Photograph	3	October 2016
Production of laser-cooled strontium atoms (microkelvin temperatures) in table-top system	Med	Photograph	3	July 2017
Production of laser-cooled strontium atoms (microkelvin temperatures) in turn-key testbed system	Low	Photograph	4	October 2018

HOW

Projected Business Model: ColdQuanta's goal is to manufacture key components developed under this contract. Our intent is to sell these components to a larger company who can integrate them into application-specific systems, such as atomic clocks or inertial measurement units. In this model, we will take advantage of the partner company's existing sales contacts and market reach.

Company Objectives: ColdQuanta designs and manufactures components, instruments, and systems for applications of cold atoms and other quantum technologies. To encourage a speed-up in applications develop in the near future, we seek to make commercially available key components developed under this project. In the longer term, we seek a partner who can help us ramp up manufacturing and improve quality of these core components.

Potential Commercial Applications:

Atomic clocks, timekeeping, and frequency synthesis for positioning and communications
Accelerometers and gyroscopes for inertial measurements and navigation
Gravimeters and gravity gradiometers for mineral and hydrocarbon exploration
Magnetometers and electromagnetic field sensors

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