Active Project (2015 - 2017)

A Portable Source of Lattice-Trapped and Ultracold Strontium (PLUS), Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

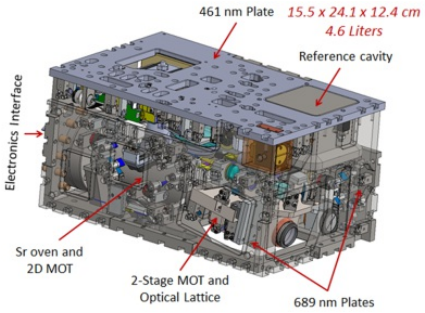
ABSTRACT

We propose to demonstrate the portable source of lattice-trapped, ultracold strontium (PLUS) designed during Phase I. The device uses simplified and robust techniques for loading the traps, and directly leverages hardware already developed by AOSense. The simplified architecture for PLUS makes it amenable to future space qualification. When paired with a sufficiently stable local oscillator, PLUS can be operated as an optical lattice clock. Alternatively, the lattice-trapped atoms could serve as a starting point for producing quantum degenerate Sr gases for use in future sensor technologies or fundamental science studies. In the latter case, possibilities span explorations of artificial gauge fields to quantum information processing. A space-qualified standard with the expected PLUS-levels of performance could revolutionize deep-space navigation by allowing spacecraft to autonomously calculate their own timing and navigation solutions rather than relying on two-way links to Earth. Similar performance levels could enable an entirely new class of sensors capable of sensitive gravitational wave detection with single baseline optical interferometers. Significant technical risk has been removed from the Phase I design by heavily leveraging hardware and strategies already developed by AOSense on other programs and conducting Phase I technology validation for the new, PLUS-specific hardware. We will continue to incorporate new developments from related AOSense programs as appropriate to further reduce technical risk or improve device performance. The primary Phase II objectives are the construction, integration, and validation of the PLUS physics package and controller and the preparation of PLUS for integration with a cavity-stabilized clock laser.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: * Gravitational wave



A Portable Source of Lattice-Trapped and Ultracold Strontium (PLUS)

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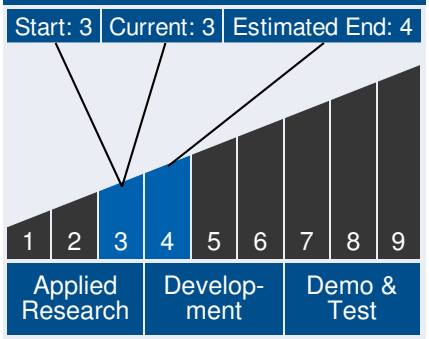
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

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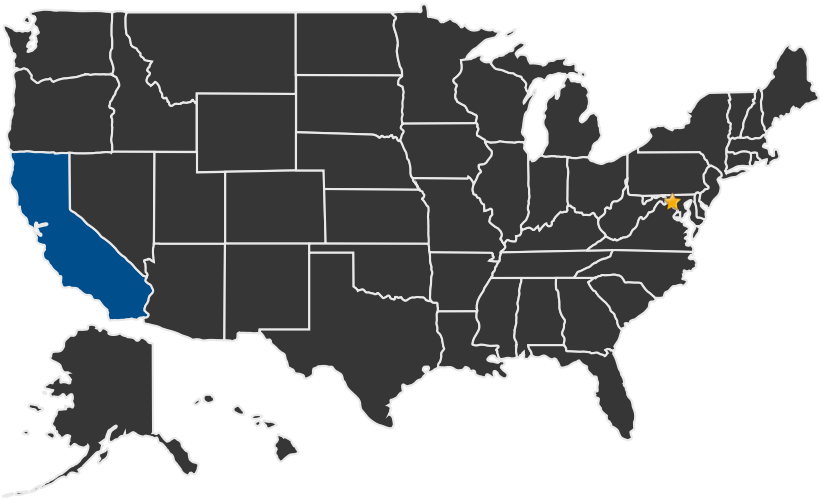
detection with single-baseline interferometers * Deep space navigation * Real-time autonomous navigation * One-way, deep-space data links

To the commercial space industry:

Potential Non-NASA Commercial Applications: * Secure data routing * Communication systems insensitive to jamming * High-resolution coherent radar * Extended mission duration in GPS-denied environments * Improved system integrity and a reduction of clock corrections and maintenance for the GPS constellation.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Goddard Space Flight Center

Other Organizations Performing Work:

- AOSense, Inc. (Sunnyvale, CA)

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

Principal Investigator:
- Tom Loftus

Technology Areas

Primary Technology Area:
Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
└ Position, Navigation, and Timing (TA 5.4)
  └ Timekeeping and Time Distribution (TA 5.4.1)
    └ Cold Atom Lattice Optical Clocks (TA 5.4.1.3)

Secondary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)
└ Remote Sensing Instruments and Sensors (TA 8.1)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/17762)

DETAILS FOR TECHNOLOGY 1

Technology Title

A Portable Source of Lattice-Trapped and Ultracold Strontium (PLUS)