NASA SBIR 2011 Phase I Solicitation

S1.10 Atomic Interferometry

Lead Center: GSFC

Participating Center(s): JPL

"Atom/BEC (Bose Einstein Condensate) Interferometry for space applications"

Sensors based on Atom/BEC Interferometry are attractive because:

Atoms have internal and external degrees of freedom that are used to optimize detection of desired signal. These states are easily manipulated by external magnetic and electric fields. Different Atoms posses a wide range of different properties that offer the experimentalists an opportunity to address a wide range of problems. Laser Cooling and Atom trapping enable experimentalists long measurement times that translates to high precision Interferometry measurements. Generally these measurements are done in the inertial frame of the atoms, which is mostly isolated from the environment.

The Atom/BEC Interferometry based sensors of interest to NASA are:

- Accelerometers.
- Gyros.
- Inertial Measurement Units for navigation.
- Gravity Gradient sensors (Gravimeters and gradiometers).
- Optical metrology instrumentation.
- Large area matter wave interferometers.
- Precise clocks for space applications.

- Higher sensitivity space magnetometers.

These are subset of the possible sensors based on this technology that has direct applications to GRACE II, Gravity Wave Science Mission, and small explorer missions. In general, Atom/BEC Interferometry enables much higher precision of the phase than optical Interferometers.

This subtopic seeks concepts and prototypes of devices below:

- Compact Low Noise accelerometers are Vital to gravity mapping, gravity wave detections, and navigation. Noise of 5E-10 (m/s^2 Hz-1/2) over frequency range of 1E-05 Hz to 1E+00 Hz are required.
- Compact Low Noise gyroscopes based on Atom/BEC Interferometry with better than 0.01deg/hour accuracy and better than 0.001deg/sqrt(Hz) low drift.

The criteria for evaluations also include:

- Lowest temperature achieved.
- Number of Atoms in the gas.

Robustness of the design /prototype to Space environments.