

## **Cold Atom Gradiometer for Geodesy**

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## **Objective**

- Design, construct and test a sensitive, low-drift gravity gradiometer instrument aimed at improving satellite geodesy measurements
- Develop instrument based on light-pulse atom interferometry using ultracold atomic samples as ideal proof masses
  - Resolution goal when extrapolated to microgravity environment is 10<sup>-5</sup> Eotvos per measurement at 0.03 Hz repetition rate
  - Sensitivity better than previous development with acceleration sensitivity at 1.5 x  $10^{\text{-9}}$  m/s²/Hz  $^{1/2}$



## **Accomplishments**

- · Completed the build of the sensor head, laser system, and control electronics for the lower arm of the interferometer
- Demonstrated magnetic lensing, reaching an inferred temperature of ~50nK with an atom flux of 10<sup>8</sup> atoms/s
- Shuttled the atoms with a 2D/3D lattice from the cooling chamber to the launch tube and dropped them
- Demonstrated atom interference fringes with dropped atoms with interrogation time of 100 ms and 500 ms
- Demonstrated inferred measurement of gravity, g = 9.86  $\pm$  0.02 m/s^2
- · Completed an analysis to determine the optimal gradiometer configuration and parameter for space use

**Co-Is/Partners:** Scott Luthcke, David Rowland, GSFC; Adam Black, AOSense, Inc,

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TRL_{in} = 3 TRL_{out} = 4
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