MAGNETIC LEVITATION FOR SPHERICAL DRAG-FREE SENSOR TESTING

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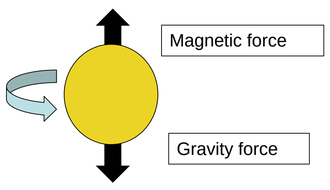
Introduction



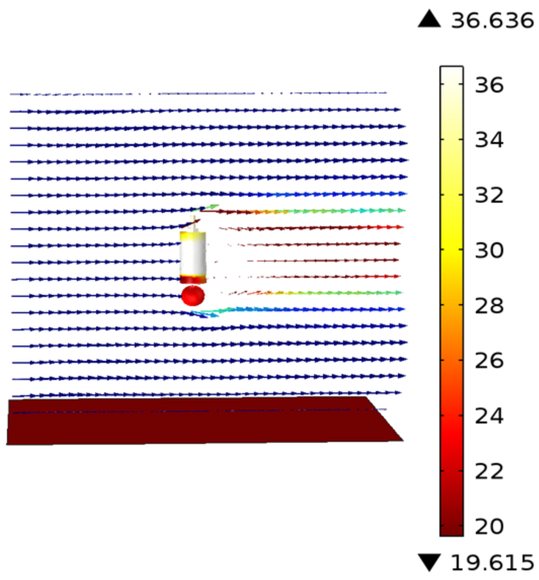
.F=qv X B

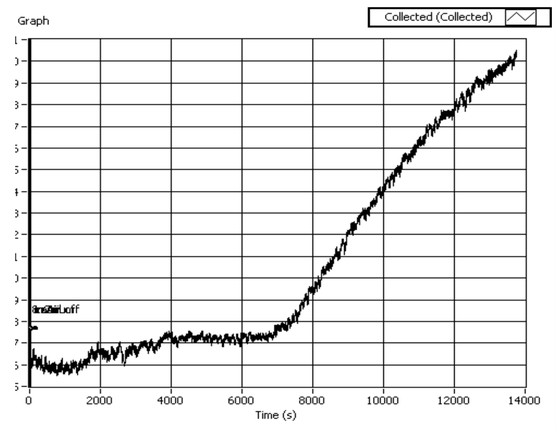
- Design and build a system that can levitate and hold a hollow sphere in vacuum, “simulating zero-g operation”
- Spin the TM by using 4 coils to produce a rotating magnetic field around the equator of the sphere.

Thermal

Coil Power Dissipation

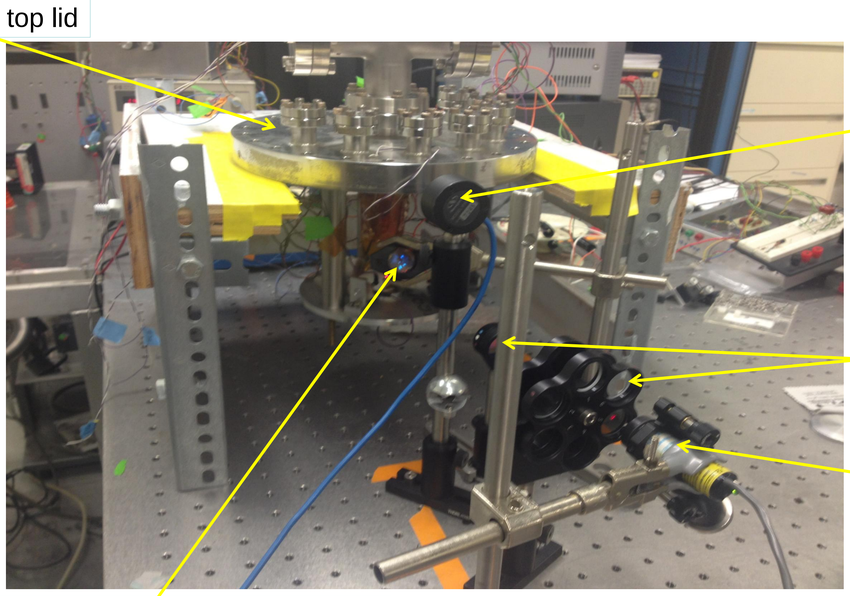
- Used COMSOL to simulate thermal simulation in air and vacuum.
- Install 2 temperature sensor in the coil
- Run the coil in vacuum for about 3 hours.





Coil In vacuum with current 0.26A ~2 hours

Experiment Levitation



Experiment running in air before it is moved to vacuum.

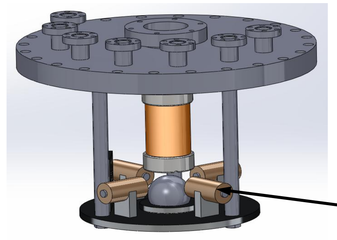
Future Work

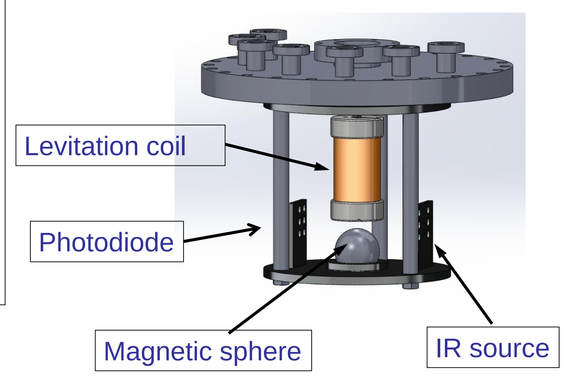
- The system will be used to test the three-axis optical sensor system, DOSS, that is being developed separately, by rapidly switching to the DOSS sensor while the ball is levitated.
- Small magnetic pulses will be used to simulate thruster perturbations in the plane orthogonal to the support axis

Design

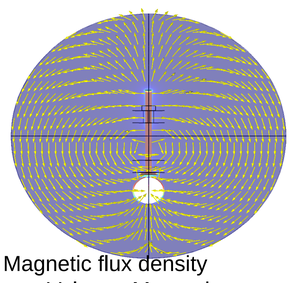
System features:

- Coil designed to run in vacuum for at least 2 hours without any damage.
- The ball position sensor is optical and is made up of an infrared emitter and a pair of phototransistors.
- The system is designed to restore the ball to the levitated position if it drops out of lock, as it might be needed while it is running in vacuum.

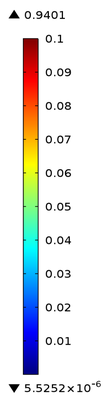




Simulation



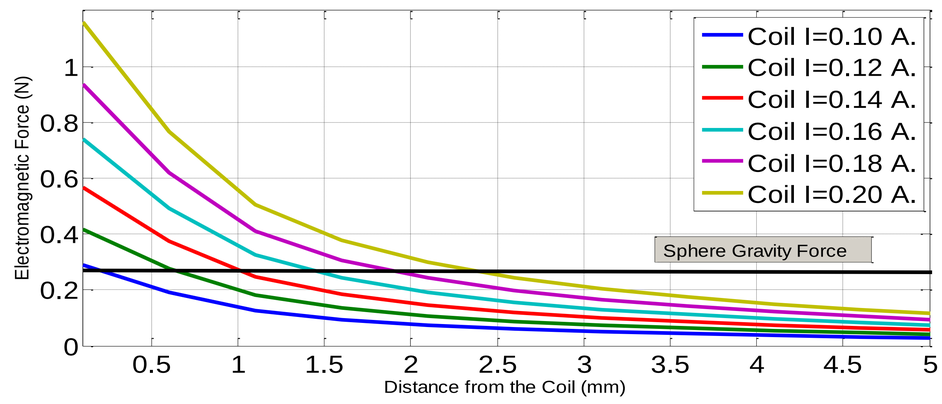
Multislice: Magnetic flux density norm (T) Arrow Volume: Magnetic field



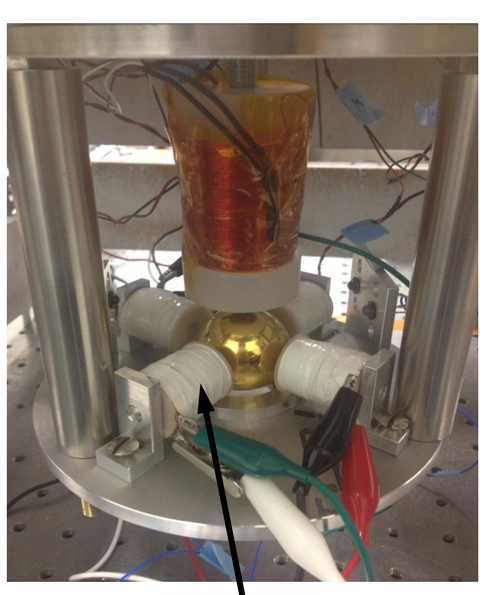
Magnetic analysis:

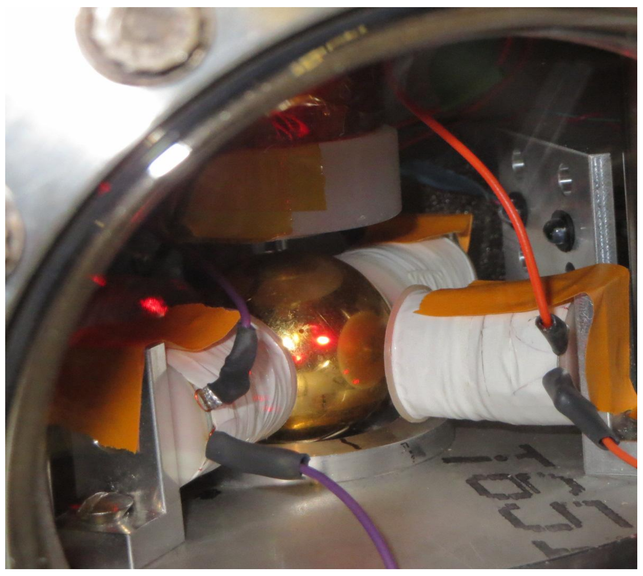
- Used COMSOL to analyze the coil and simulate the magnetic field which is produce by coil.
- Calculate the magnetic force on the sphere for different situation
- The figure below shows the electromagnetic force versus the distance between the coil and the sphere for different currents.

Electromagnetic force VS. Distance



Experiment Spinning





Sphere is spinning in vacuum

Was able to spin the sphere up to 11Hz in vacuum.

Acknowledgements

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