

Dusty Plasma Analysis in a Varying Gravitational Field:

Interim Project Report



**The College of New Jersey
2000 Pennington Road
Ewing, NJ 98628**

Requested:

\$2,000.00

Spent:

\$2,000.00

Submitting Students:

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Faculty Advisor:

Dr. Romulo Ochoa

I. Abstract

We will study the dynamics of a silica dust suspended in an argon DC-glow discharge plasma. The work is a continuation of previous studies performed by students. The experiment will be conducted in a varying gravitational field on board NASA's 'Weightless Wonder' in June, 2010. Dust particle dynamics of a fully formed dust cloud in a zero gravity environment will be recorded and dust acoustic wave motion will be induced within the dust cloud for further analysis. Data obtained will lead to a better understanding of dust cloud formation and dynamics.

II. Statement of Progress

Over the course of the semester, the team was successful in both creating a ground based experiment for preliminary testing as well as building the experiment intended to fly with NASA's Reduced Gravity Flight Education Program. The preliminary experiment utilized the theory of thermophoresis in an attempt to simulate a zero gravity environment in ground based work. The experiment allowed us to perform our usual work of creating a dusty plasma in a DC-glow discharge plasma in earth's gravity, however the new experiment then enabled to use a thermoelectric cooling device to create a temperature gradient across our experimental field. This temperature gradient, acting within our vacuum chamber, created a thermal force which we utilized in an attempt to counter act the force of gravity. The goal of this preliminary work was to simulate what we may see in a weightless environment, and compare this data to that obtained in the actual zero gravity environment.

Once this experiment had been completed, the actual experiment that would fly on the 'Weightless Wonder' was created and assembled. The knowledge gained in the preliminary testing was used to modify the experiment from previous year's designs. The experiment was successfully assembled and tested in a ground based environment, and it was shipped to the Johnson Space Center in Houston on June 1. On June 16, the team members will fly to Houston in order to begin training for the zero gravity program. We will fly our experiment in the following week. Once the data is obtained, an analysis will be conducted throughout the remaining weeks of the summer and the following fall semester by a student.

III. Budget Summary

With the help of the Princeton Plasma Physics Lab resources, the biggest expense of the experiment was the travel cost. We were able to use the Undergraduate Research Award to contribute to funding our trip to the Johnson Space Center, where all of our research will be conducted.

Budget	
Car Rental	\$468.47
Hotel	\$1531.53
Total Budget Funds Requested	\$2000.00

IV. References

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- [4] Seurig, R., G. Morfill, V. Fortov and P. Hofman. Acta Astronautica, Vol. 61, 2007: 940-953.
- [5] Rosenberg, M. "Some Physical Processes in Dusty Plasmas." Astrophysics and Space Science, 2001: 125-133.
- [6] Thomas, E. Jr. and M. Watson. "First Experiments in the Dusty Plasma Experiment Device." Physics of Plasmas, October 1999: 4111-4117.
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- [8] Shukla, P.K. "A Survey of Dusty Plasma Physics." Physics of Plasmas. Vol. 8, May 2001: 1791-1803.
- [9] Annaratone, B.M. et al. "Complex-Plasma Boundaries." Physical Review E, November, 2002: 1-4.
- [10] Fortov, V.E. Et al, "Transport of Microparticles in Weakly Ionized Gas-Discharge Plasmas under Microgravity Conditions." Physical Review Letters. Vol 90, June, 2003: 1-4.