

- **Project Title:** Generation and Analysis of Stable Free-Space Atmospheric-Pressure Microwave-Induced Plasmoids

Investigator: Karl Stehpan

Department: Technology

Project Summary:

The goal of this project was to produce and analyze stable free-space atmospheric-pressure microwave-induced plasmoids. We also investigated other aspects of ball lightning. In order to perform experiments at Texas State, we decided to develop a microwave generator unit as well as a microwave cavity (original plans would have required the use of a generator at UT Austin).

By December, the microwave generator was substantially complete, and considerable progress had been made on the simplified microwave cavity. The cavity consists of two three-foot parabolic dishes enclosed in a metal box for safety reasons. We have tested the enclosure for leakage under power and it meets safety regulations. We are currently investigating how to position microwave absorber material so as to eliminate undesired cavity modes.

In addition to the microwave cavity project, we have completed two related investigations using REG funds. The first involved using the motion of soap bubbles in electrostatic fields to model the motion of ball lightning. This investigation resulted in a publication in *Physica Scripta*. The second involved using an arc welder to produce ball-lightning-like objects per Paiva et al. (*Phys. Rev. Ltrs.* 98, 048501 (2007)). The paper describing this work was rejected, revised, and is now being reviewed by the *Jour. of Atmospheric and Space-Terrestrial Physics*.

We used initial work from this REG in a \$25,000 proposal to investigate ball lightning submitted to the Julian Schwinger Foundation. This proposal was accepted, and should allow us to complete work on the microwave cavity and perform related investigations.

Publications:

1.) Accepted: 1. "Electrostatic charge bounds for ball lightning models," by K. D. Stehpan, *Physica Scripta*, vol. 77, 035504 (5 pages), Feb. 12, 2007.

2.) Under review: "Burning Molten Metallic Spheres: One Class of Ball Lightning?" by K. D. Stephan and Nathan Massey, submitted to Jour. of Atmospheric and Space-Terrestrial Physics

Presentations:

1.) Microwave-Assisted Investigation of Luminous Atmospheric-Pressure Plasmoids, by K. D. Stephan, pp. 98-101, International Microwave Power Institute 41st Annual International Microwave Symposium Proceedings, Vancouver, BC, Canada, Aug. 1-3, 2007.

External Grants Applied:

1.) Julian Schwinger Foundation, "Experimental Investigation of Ball Lightning Formation Mechanisms", \$25,000.

2.) National Science Foundation, "Experimental Investigation of Ball Lightning Formation Mechanisms", \$170,000 (under review).

External Grants Awarded:

1. Julian Schwinger Foundation, "Experimental Investigation of Ball Lightning Formation Mechanisms", \$25,000 awarded Dec. 2007.

Student Number: 2