Project title: Towards Quantitative Understanding of Lightning Disruptive Effects for Protection of SMART Grids

PI: Dr. Caitano L. da Silva, Sub-awarded to: New Mexico Tech (NMT)

I. Activities

The main objective of this project is to further advance the understanding of lightning physics to better devise protection mechanisms for power distribution SMART grids. The EPSCoR funds have supported the theoretical modeling research of undergraduate students Michael C. Taylor and John G. Pantuso, and the experimental research of graduate student Luis Contreras-Vidal, including the development of the Langmuir Spark Lab, pictured in Figure 1. The Langmuir Spark Lab is a new facility located on the NMT campus (in Workman Center) dedicated to the study of electrical discharges. The facility enables us to investigate fundamental process that take place in lightning discharges, but are difficult to probe in nature. The lab can also be used to test the effects of electrical discharges on SMART grid components.

II. Equipment Purchased

No major equipment has been purchased with EPSCoR funds — the grant mostly covered salaries. Specifically, we have used project funds to purchase miscellaneous supplies to support the development of the Spark Lab, and to support the experimental research done by graduate student Luis Contreras-Vidal. A desktop computer to support the student’s data analysis has also been purchased.
III. Publications

In Sections III and IV below, the PI’s name is marked in **bold**, while students supported by this grant are highlighted in **blue**. Two peer-reviewed journal publications have resulted from this grant. The research done by undergraduate student Michael C. Taylor is expected to result in a third paper to be submitted to *IEEE Trans. Electromag. Compat.* later this year.


IV. Conference Presentations

This project results in nine conference presentations. In the list below, the first author is the presenter. Please note the contributions of the students funded by this project (highlighted in **blue**) eight of the nine presentations listed below.


**Pantuso, J. G.**, and **C. L. da Silva** (2020), Geant4 monoenergetic electron beam simulations of runaway electrons in streamer discharges, Student online poster presentation at the 9th New Mexico Tech Student Research Symposium, Poster SRS2020-198, Socorro, NM.

**Taylor, M. C.**, and **C. L. da Silva** (2020), Data-constrained simulations of the temperature inside a lightning channel, Student online poster presentation at the 9th New Mexico Tech Student Research Symposium, Poster SRS2020-180, Socorro, NM.


V. Grant Applications

The support of the NM ESPCoR office was crucial in the development of the NSF CAREER proposal listed below. This is one of two proposals funded at NMT in over 20 years. See the press release linked here: [https://www.nmt.edu/news/2021/nsf_career_awards_2021.php](https://www.nmt.edu/news/2021/nsf_career_awards_2021.php)

Title: CAREER: Self-consistent and data-constrained simulations of the leader and return stroke processes in lightning discharges  
Submitted to: National Science Foundation PDM/GEO/NSF  
Role: Single PI  
Period: 08/01/2021 – 07/31/2026  
Amount: $523,159  
Status: Funded

Title: 2021 Sloan Fellowship – Polarity asymmetry in lightning physics  
Submitted to: Alfred P. Sloan Foundation  
Role: Single PI  
Period: 08/01/2021 – 07/31/2023  
Amount: $75,000  
Status: Rejected

Title: Lightning hazards to weapon systems in flight  
Submitted to: USAF Kirtland AFB/AFMC/AFNWC  
Role: Single PI  
Period: 06/01/2021 – 05/31/2022  
Amount: $68,000  
Status: Pending