

Colloquium Notice

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*An Overview of high-energy atmospheric physics
and lightning related phenomena*

Although lightning is one of the most commonly known and destructive natural phenomena on Earth, it remains poorly understood in terms of the most basic physics. Questions such as how it is created inside thunderstorms and how it manages to travel many tens of kilometers are still being worked out today. Benjamin Franklin is considered to be the pioneer of this research field, propelled by his famous kite experiment that showed lightning to be an electrical discharge. Since that time, lightning experiments have been relatively difficult to achieve due to its seemingly random occurrence, unpredictability and short duration. However, over the last decade, the research groups at Florida Institute of Technology and the University of Florida have made detailed measurements of the lightning discharge using a rocket triggering technique at the International Center for Lightning Research and Testing (ICLRT). A consequence of this study has been the discovery that lightning emits x-rays and gamma-rays as it travels through the atmosphere and down to Earth's surface. In 1994, NASA satellite data from the Compton Gamma-Ray Observatory, originally designed to measure gamma-ray bursts from distant galaxies, discovered intense glows of radiation being emitted from the Earth. These discharges were so bright (up to 40 MeV), that they saturated all the high energy detectors onboard the spacecraft. After many similar events were observed, these phenomena, known as Terrestrial Gamma-Ray Flashes (TGFs), were shown to originate from within the thunderstorm region. Most recently, the potential radiation doses that airline passengers would experience inside the core of a TGF have been calculated. It has also been determined, with remote radio measurements and theoretical modeling, that a new type of electrical discharge, called "dark lightning", is responsible for these high energy events. However, its relationship to a normal lightning discharge still remains a mystery. Many other exotic phenomena have also been observed as a result of thunderstorms including halos, elves, sprites and blue jets. The fact that these lightning related events can affect the upper atmosphere and lower ionosphere has reshaped the scientific field to the study of high energy atmospheric physics. The research done on lightning has thus fused many areas of physics including plasma physics, atmospheric physics, and quantum electrodynamics. The rapidly expanding field has opened many opportunities for both theoretical and experimental studies. Mathematical modeling, including Monte Carlo simulations, has given us a better understanding about the nature of particle acceleration inside the high field regions of thunderstorms. Likewise, instrumentation including photomultiplier tubes, high speed video cameras, and electric field antennas, has helped us gain a better insight into the lightning discharge near the ground. In this talk, we review the history of lightning research, show many of its recent developments, and lay out the questions that are being addressed today by many physicists, meteorologists and engineers around the world. We also hope to expand the importance of lightning safety and the awareness of exciting research opportunities for many young scientists.

Monday
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Starts at 12:15 PM
Coffee at 12:00 PM
Physics Conference Room, SB B326

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