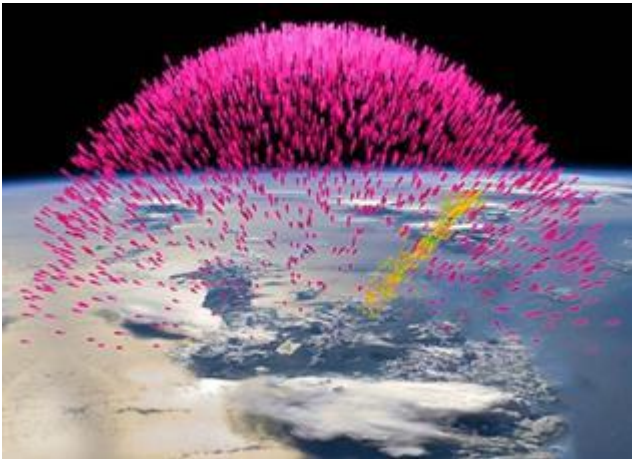


Physics and Space Science Department

## High-Energy Atmospheric Physics: Dark Lightning and Related Phenomena



**Joseph R. Dwyer**

Professor of Physics and Space Sciences Florida Institute of Technology, Melbourne, FL

**March 29, 2013 4:00p.m. OPS 140**

Until very recently, lightning was thought to be an entirely conventional discharge, involving only low-energy (few eV) electrons. This picture changed completely with the discovery of intense x-ray and gamma-ray emissions from natural cloud-to-ground lightning, rocket-triggered lightning and thunderstorms. Indeed, the gamma-rays generated by thunderstorms are so intense that they are routinely observed by spacecraft a thousand kilometers away in the form of terrestrial gamma-ray flashes (TGFs). These energetic emissions cannot be produced by conventional discharges in air, and so the presence of x-rays and gamma-rays strongly implies that relativistic runaway electrons, accelerated in air by strong electric fields, play a role in thunderstorm and lightning processes. Furthermore, it has been found that the beams of relativistic electrons produced by thunderstorms can discharge the clouds faster than normal lightning, while generating relatively little visible light. As a result, such dark lightning may compete with normal lightning as a discharge path for thunderstorms. In this talk, I will give an overview of the new field of high-energy atmospheric physics, including a discussion of the x-ray emissions from lightning, terrestrial gamma-ray flashes and dark lightning.