



Department of Physics and Astronomy  
SPRING 2022 Colloquium Series

# “High-Energy Radiation from Thunderstorms”

**Dr. David Smith**  
*University of California, Santa Cruz*

C. T. R. Wilson, who won the Nobel Prize in Physics in 1927 for inventing the cloud chamber, was primarily interested in atmospheric physics, and in the 1920s predicted that thunderstorm electric fields would accelerate electrons to relativistic energies. It took over half a century for his predictions to be convincingly confirmed, and now we find ourselves confronted by a surprising range of related phenomena: gamma-ray "glows" produced over periods of minutes or longer in thunderstorm cells, which may be a sign of a gradual discharge mechanism that competes with lightning; short burst of x-rays emitted with each "step" that a lightning leader takes toward the ground; and, most remarkably, the powerful terrestrial gamma-ray flashes (TGFs). TGFs, sub-millisecond bursts of radiation associated with a small fraction of lightning flashes, are bright enough to paralyze detectors in orbit 600km above, to pose a serious health hazard to anyone in a plane near their point of origin inside the storm, and to leave a cloud of radioactive air in their wake. I will review glows and stepped leader x-rays briefly but will focus on our main questions about TGFs: Why are they so bright? Why do they occur only in a small fraction of lightning flashes, but in a wide variety of flash types and storm configurations? Do they indeed ever pose a radiation hazard to aircraft passengers and crew? I will describe the instrumentation and techniques that our group at the University of California, Santa Cruz and our collaborators are using to observe TGFs from the ground, aircraft, balloons, and space, and review some recent insights.

**Thursday, April 14, 2022**  
**4:00 - 5:20PM**  
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