THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

8th Wernher von Braun Memorial Symposium
October 27 – 29, 2015

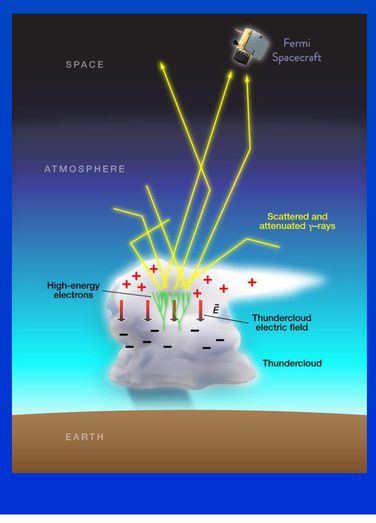
1954 2015 American Astronautical Society

Searching for Terrestrial Gamma-Ray Flashes via Lightning and the Fermi Space Telescope

Kareem Omar
Center for Space Plasma and Aeronomic Research

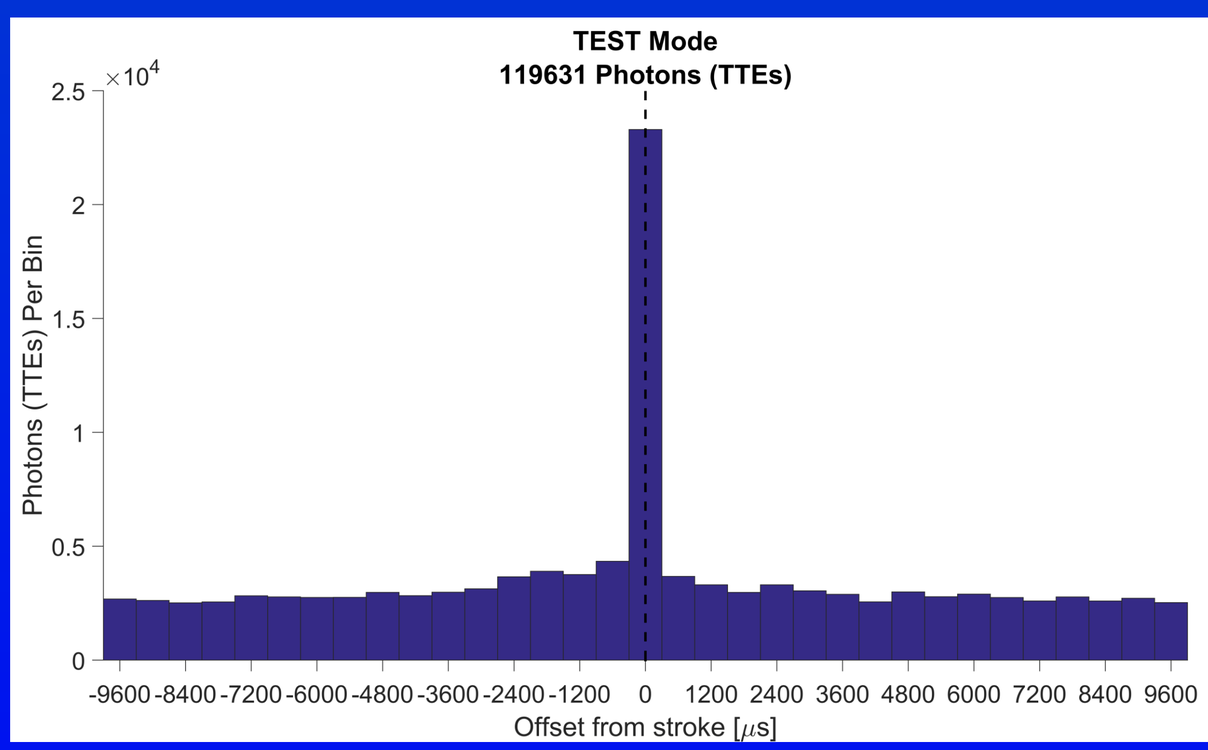
Overview

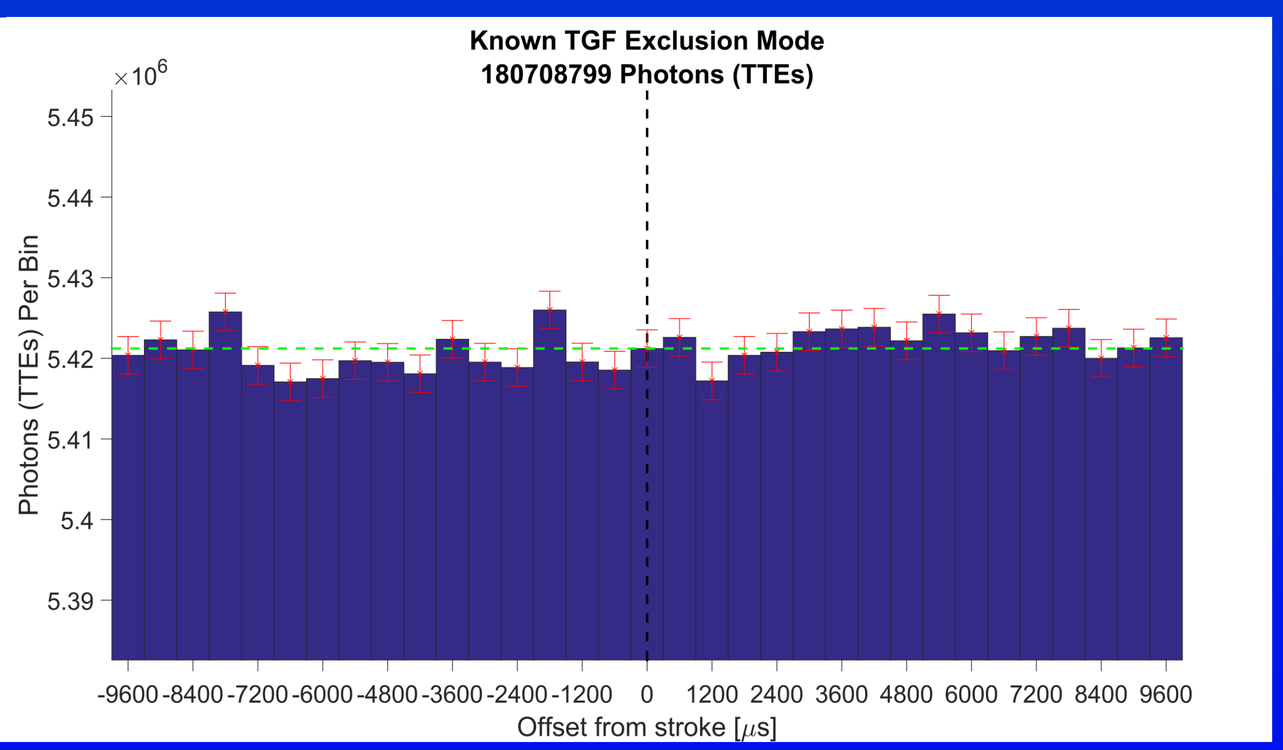
- **TGFs** are bursts of **gamma-rays** generated by certain lightning strokes
- Can be detected but not localized by the **Gamma-ray Burst Monitor** (GBM) on the Fermi Space Telescope
- My previous research involved localizing them by correlating Fermi TGF detection **timestamps** with ground-based radio lightning detections…
- …but have we failed to correctly identify some of the TGFs that have reached Fermi in the past?



Analysis

- **IDEA**: cumulatively analyzing raw gamma-ray **photons** reaching Fermi around the times of lightning strokes after **removing** strokes near **known** TGFs would reveal a residual TGF signal if we've missed some TGFs
- **DATA**: approx. 3 million lightning strokes and 300 million gamma photons per day to correlate and correct for storm→Fermi travel-time for **every day** from **Jan 1, 2013** to **Jun 24, 2015**
- **EXECUTE**: >2000 lines of code, >4 day runtime
- **VALIDATE**: test mode – Intentionally plot **only** gamma photons near **known** TGFs (which should produce a large signal) to verify method and software
- **EXPERIMENT**: exclusion mode – **discard** known TGFs to see if a residual signal remains, indicating previously **unidentified** TGFs





- Test mode reveals a huge signal at zero time offset from strokes, corresponding to gamma photons from TGFs reaching Fermi, as expected! Software, including frame transformations and second-order TGF travel-time correction, are **working**.
- Exclusion mode reveals no statistically significant signal, even zoomed in on the vertical axis. Thus, the Fermi GBM team appears to be **successfully identifying** the vast majority of incoming TGFs.

Acknowledgements

I wish to thank Drs. Briggs and Connaughton of CSPAR for their guidance, as well as Stan Heckman and the Earth Networks team for providing ENTLN radio data. I also wish to thank Drs. Vogler and Cook of the UAH RCEU program. Funds for this research were provided by NASA and the UAH Research Creative Experience for Undergraduates (RCEU) program.

NASA

CSPAR Center for Space Plasma and Aeronomic Research

HONORS COLLEGE THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Fermi Gamma-ray Space Telescope