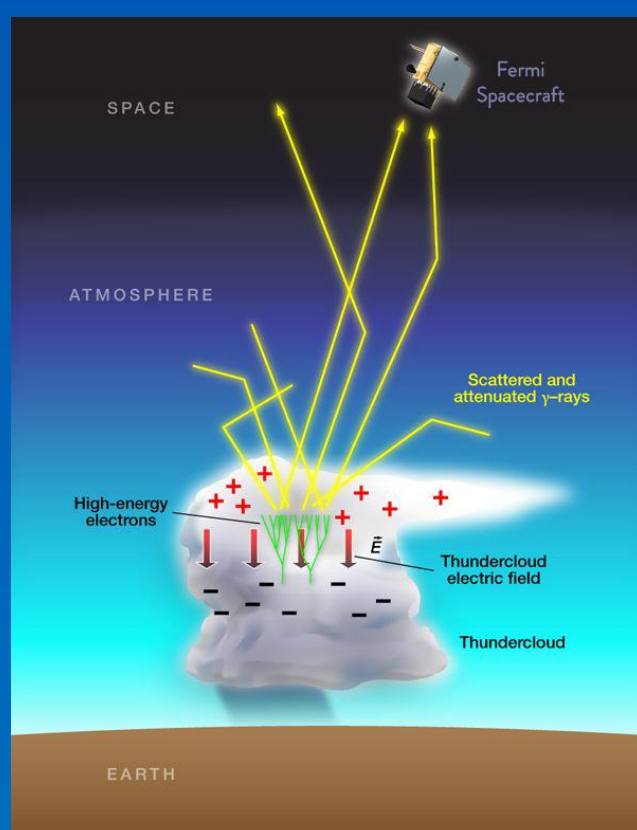
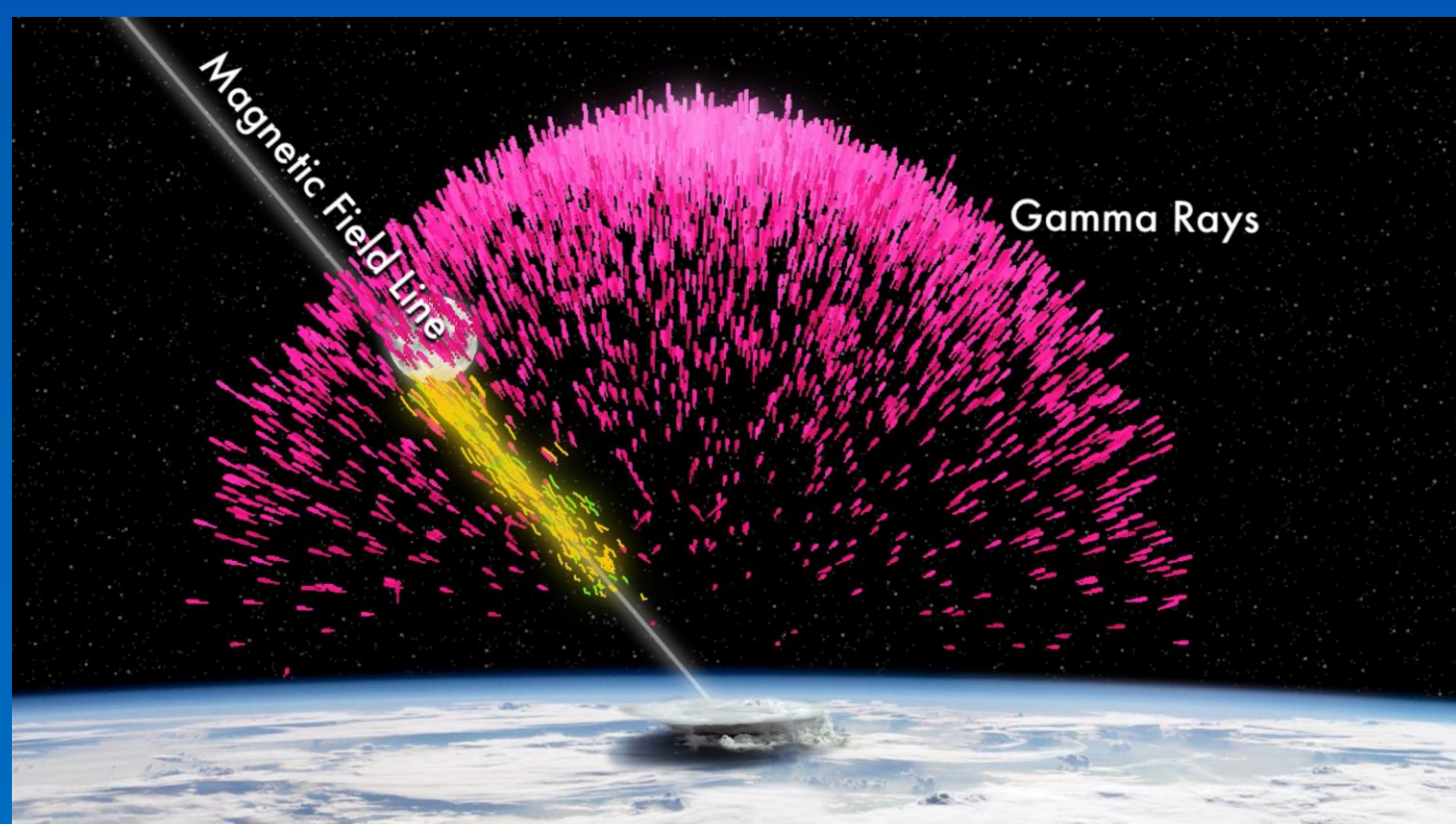


Lightning-based Search for TGFs in the Fermi Gamma-ray Burst Monitor

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Overview

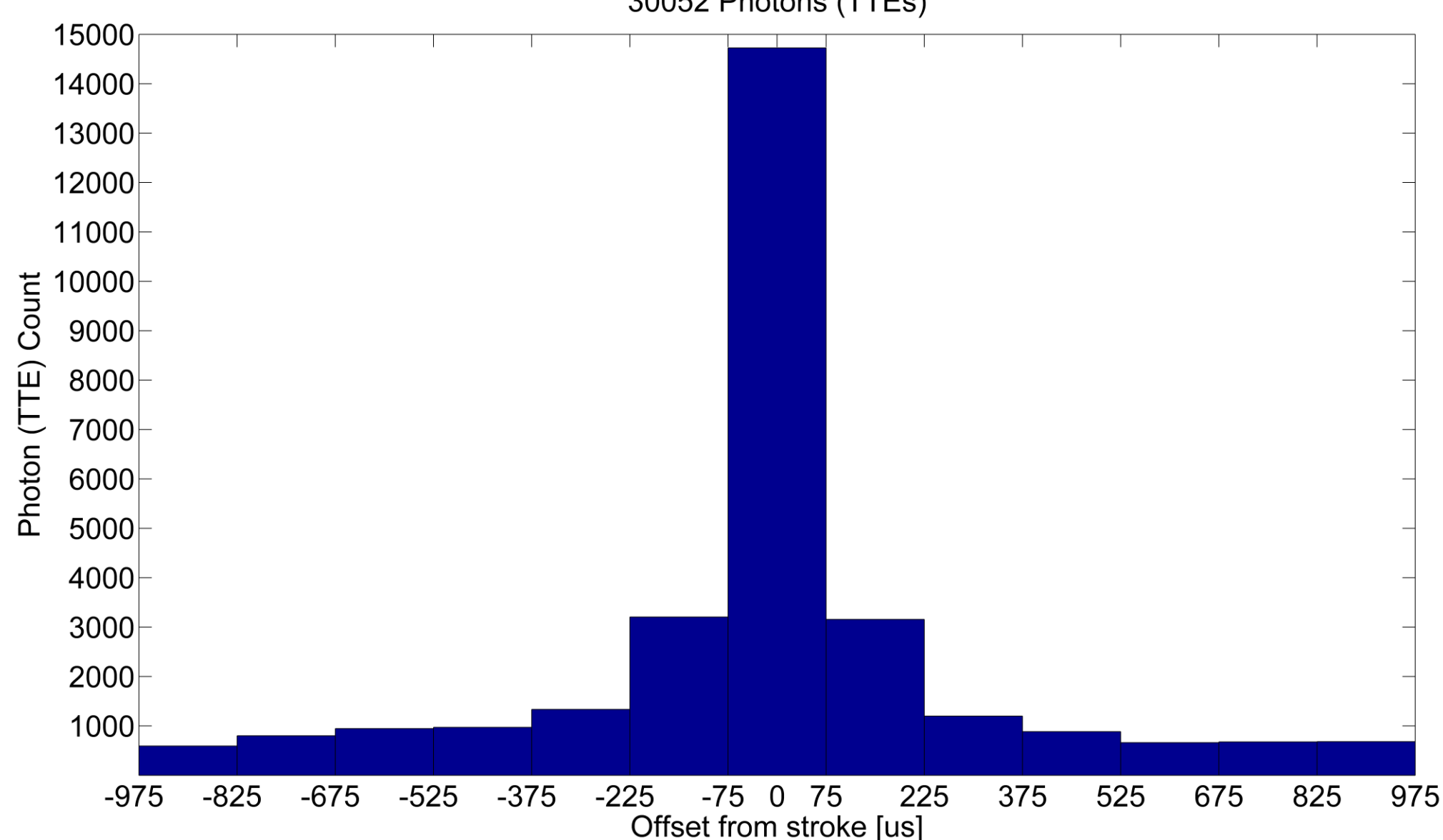
- **TGFs** are bursts of gamma-rays generated by certain lightning strokes
- Can be **detected** but not **localized** by **Gamma-ray Burst Monitor (GBM)** on the Fermi Space Telescope
- Previous research has helped localize them by correlating **timestamps** with ground-based radio **lightning** detections...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



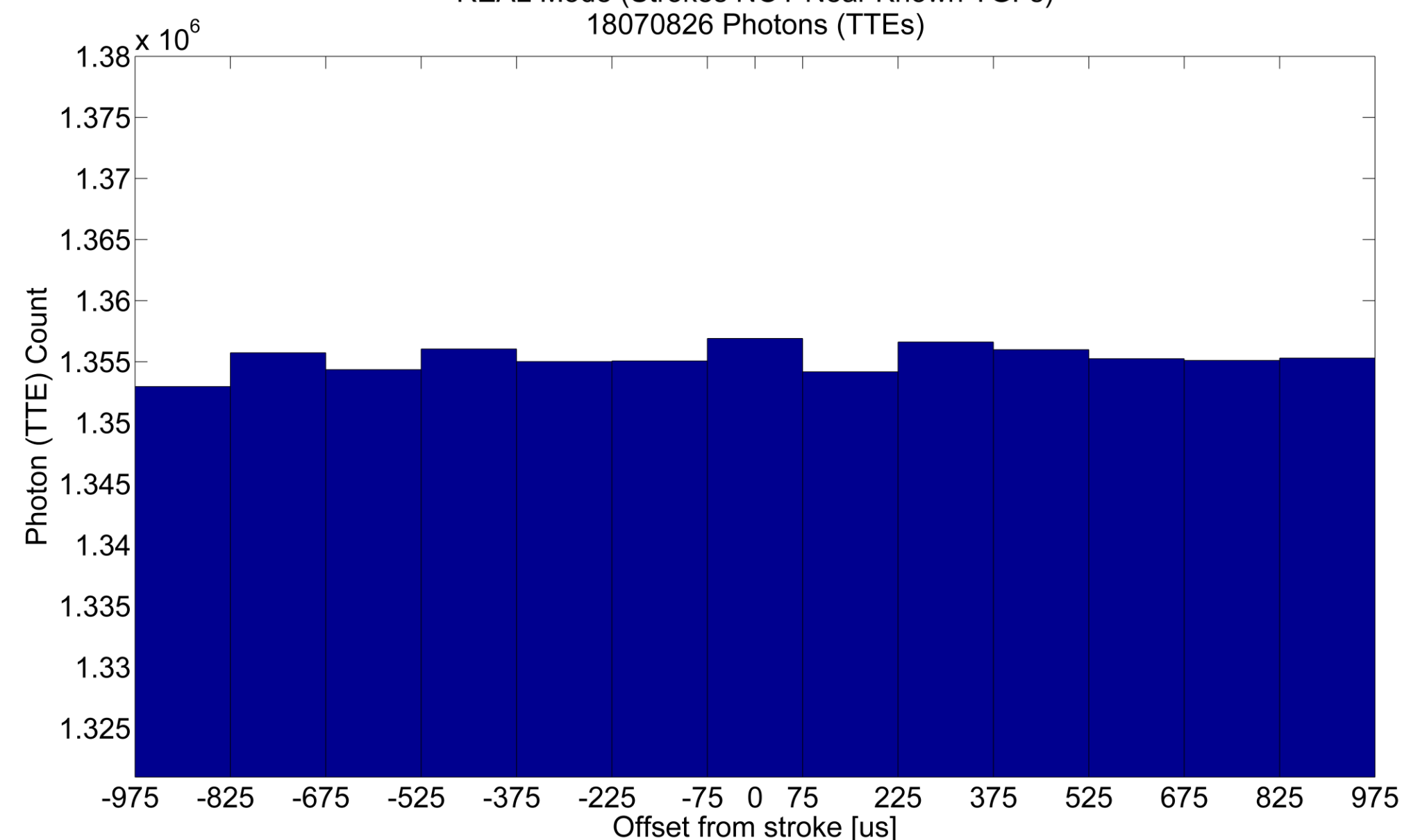
Analysis

- **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/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:** REAL mode – **discard** known TGFs to see if a residual signal remains, indicating previously **unidentified** TGFs

TEST Mode (Strokes Near Known TGFs)
30052 Photons (TTEs)



REAL Mode (Strokes NOT Near Known TGFs)
18070826 Photons (TTEs)



- TEST mode reveals a huge signal at zero time offset from strokes, corresponding to photons from TGFs reaching Fermi from lightning, as expected! Software and travel-time correction are **working**.
- REAL mode reveals no statistically significant signal, even zoomed in. Thus, the Fermi GBM team appears to be **successfully identifying** the vast majority of incoming TGFs.

Acknowledgements

I wish to thank Dr. 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 RCEU program. Funds for this research were provided by NASA, CSPAR, and the UAH Research Creative Experience for Undergraduates (RCEU) program.